

# Biology- Genetics: Who Dares Wins

## Probability and Heredity Lab Report

**QUESTION/PROBLEM:** How can you predict the possible results of genetic crosses?

### **BACKGROUND INFO**

The purpose of this Lab report is to find out whether one can predict the possible results of genetic crosses. To do so, this lab requires a sort of trial, where one must repeat a step over some time and record it in a table. Think about probability and statistics in Mathematics.

### **KEY WORDS:**

Alleles: The different forms of a gene.

Dominant Allele: An allele whose trait always shows up in the organism when the allele is present.

Recessive Allele: An allele that “disappears” when a dominant allele is present.

Phenotype: An organism’s physical appearance, or visible traits.

Genotype: An organism’s genetic makeup, or allele combinations.

Homozygous: Having two identical alleles for a trait.

Heterozygous: Having two different alleles for a trait.

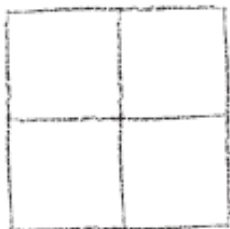
Punnett Square: A chart that shows all the possible combinations of alleles that can result from a genetic cross.

### **HYPOTHESIS**

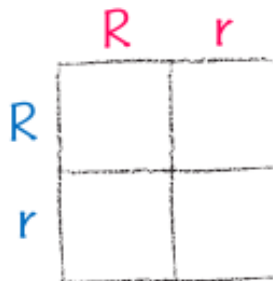
(State your answer to the above question -What evidence/research do you have to support your hypothesis?)

If one can predict the possible results of genetic crosses, it must be because one must have used a punnett square. By using a punnett square and listing all possible genotypes to be crossed, an individual can see the possible genotype outcomes of the offspring’s. An individual can also see how likely it is for an offspring to be dominant or recessive out of 100% or 4/4 in the punnett square. (view example/ image below)

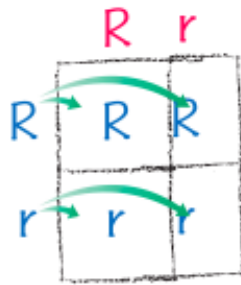
**1** Start by drawing a box and dividing it into four squares.



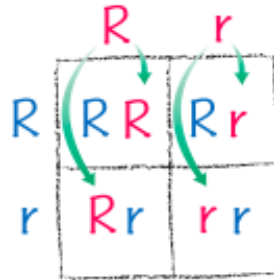
**2** Write the male parent's alleles along the top of the square and the female parent's alleles along the left side.



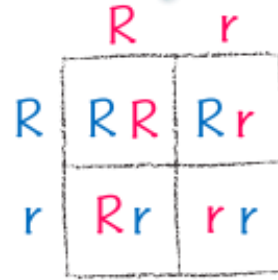
3 Copy the female parent's alleles into the boxes to their right.



4 Copy the male parent's alleles into the boxes beneath them.



5 The completed Punnett square shows all the possible allele combinations in the offspring.



\*By looking at the complete punnet square one can calculate the probability of the possible genotypes of an offspring in this case in the example there will be 25% chance of an offspring to be homozygous dominant (RR), 50% chance of an offspring to be heterozygous (Rr), and 25% chance for an offspring to be homozygous recessive (rr).

### VARIABLES

Independent: Genotype of the parents, therefore the alleles

Dependent: Offspring combinations

Constants: Blue and white marbles (allele versions)

### MATERIALS

- \* 2 small paper bags
- \* Marking pen
- \* 3 blue marbles
- \* 3 white marbles

### PROCEDURE

1. Take one paper bag and label it "Bag 1, Female Parent".
2. Take the second paper bag and label it "Bag 2, Male Parent".
3. Then, read over part 1, part 2, and part 3 of this lab.

### PROCEDURE- PART 1: CROSSING 2 HOMOZYGOUS PARENTS

4. Place two blue marbles in bag 1, "Female Parent", use the letter **B** to represent the dominant blue allele of the female alleles.
5. Then, place two white marbles in bag 2, "Male Parent", use the letter **b** to represent the recessive white allele of the male alleles.
6. Now, to start the experiment...
7. Copy the data table given in the text.
8. For trial 1, remove one marble from the bag, without looking.
9. Then, record the result (ex: whether its blue, **B**) into the data table in the corresponding place.
10. Return the marble into the bag 1, "Female Parent".
11. Again, without looking remove one marble from bag 2, "Male Parent".

12. Then, Record the result (ex: whether its white, **b**) into the data table in the corresponding place.
13. Return the marble into the bag 2, “Male Parent”.
14. Finally, in the column labeled offspring’s alleles on the data table, write **BB** if both the removed marbles were blue. Write **bb** if both the removed marbles were white. Write **Bb** if the marbles removed was one blue marble and one white marble.
15. Repeat steps 8-14 until the data table reaches 10 trials.

### **PROCEDURE- PART 2: CROSSING HOMOZYGOUS & HETEROZYGOUS PARENTS**

16. Place two blue marbles in bag 1, “Female Parent”.
17. Place one white marble and one blue marble in bag 2, “Male Parent”.
18. Make a new data table, exactly the same as the text.
19. Repeat steps 8-14 until the data table reaches 10 trials.
20. Record data in data table for part 2.

### **PROCEDURE- PART 3: CROSSING 2 HETEROZYGOUS PARENTS**

21. Place one blue marble and one white marble into bag 1, “Female Parent”.
22. Place one blue marble and one white marble into bag 2, “Male Parent”.
23. Make a new data table, exactly the same as the text.
24. Repeat steps 8-14 until the data table reaches 10 trials.
25. Record data in data table for part 3.

### **FINAL PROCEDURE**

26. Then, create punnett squares for each of the crosses modeled in Part 1, Part 2, and Part 3.
27. Finally, analyze and conclude.

## DATA

Describe your observations.

### PART 1: Crossing two Homozygous Parents

Trial	Allele from bag 1 (Female parent)	Allele from bag 2 (Male parent)	Offspring's alleles
1	b	B	Bb
2	b	B	Bb
3	b	B	Bb
4	b	B	Bb
5	b	B	Bb
6	b	B	Bb
7	b	B	Bb
8	b	B	Bb
9	b	B	Bb
10	b	B	Bb

\*This data table shows the results of the experiment for part 1. By crossing two homozygous parents, and pulling random marbles representing the alleles of either female or male parents. The crossing of the female and male alleles made all the offspring's to come out as heterozygous dominant (Bb).

According to your results in Part 1, how many different kinds of offspring are possible when the homozygous parents (*BB* and *bb*) are crossed? Do the results you obtained using the marble model agree with the results shown by a Punnett square?

		<b>B</b>	<b>BB</b>	<b>B</b>
<b>b</b>		<b>Bb</b>		<b>Bb</b>
<b>bb</b>				
<b>b</b>		<b>Bb</b>		<b>Bb</b>

\*By crossing two homozygous parents (*BB* and *bb*) all the offspring's will be 100% heterozygous dominant. This punnett square obtains the same results as the marble model and agrees with the results shown. In the data table all the offspring's were heterozygous dominant and is then reinforced in this punnett square above.

## Crossing two Homozygous Parents (BB and bb)



This pie chart shows the percentage of the offspring's outcomes seen in the data table and from the punnett square.

● Heterozygous Offspring's Bb

### PART 2: Crossing Homozygous and Heterozygous Parents

Trial	Allele from bag 1 (Female parent)	Allele from bag 2 (Male parent)	Offspring's alleles
1	b	B	Bb
2	b	B	Bb
3	b	B	Bb
4	B	B	BB
5	B	B	BB
6	B	B	BB
7	B	B	BB
8	b	B	Bb
9	B	B	BB
10	b	B	Bb

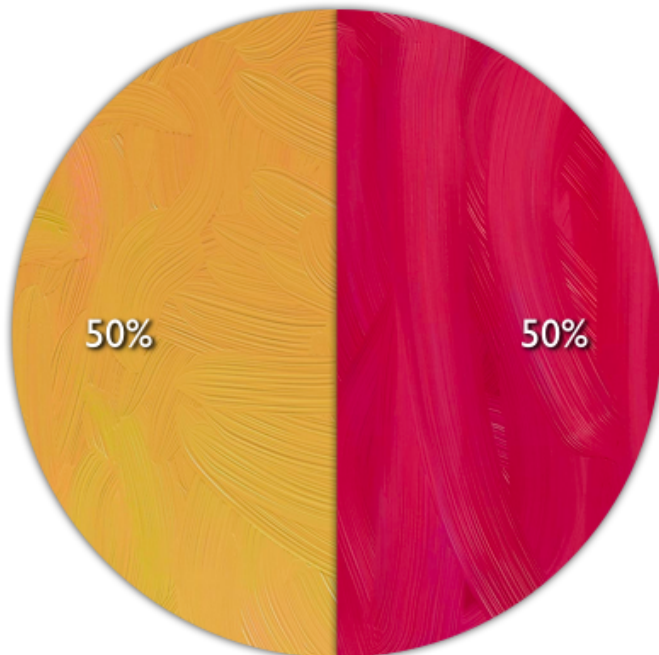
\*This data table shows the results of the experiment for part 2. By crossing homozygous and heterozygous parents, and pulling random marbles representing the alleles of either female or male parents. The crosses of those female and male alleles, then made the offspring's half heterozygous dominant and half homozygous dominant (Bb and BB).

According to your results in Part 2, what percentage of offspring are likely to be homozygous when a homozygous parent ( $BB$ ) and a heterozygous parent ( $Bb$ ) are crossed? What percentage of offspring are likely to be heterozygous ( $Bb$ )? Does the model agree with the results shown by a Punnett square?

	<b>B</b>	<b>BB</b>	<b>B</b>
<b>B</b>	<b>BB</b>	<b>BB</b>	
<b>Bb</b>	<b>Bb</b>	<b>Bb</b>	
<b>b</b>	<b>Bb</b>	<b>Bb</b>	

\*By crossing homozygous dominant and heterozygous parents ( $BB$  and  $Bb$ ), the offspring's then came out half or 50% as homozygous dominant and half or 50% as heterozygous. By comparing the data table results and the punnett square, the punnett square obtains the same results as the marble model and agrees with the results shown. In the table, half the offspring's were homozygous dominant and half the offspring's were heterozygous and is once more, reinforced in the punnett square seen above.

### Crossing Homozygous Dominant and Heterozygous Parents ( $BB$ and $Bb$ )



This pie chart shows the percentage of the offspring's outcomes seen in the data table and from the punnett square.

- Heterozygous Offspring's  $Bb$
- Homozygous Dominant offspring's  $BB$

### PART 3: Crossing two Heterozygous Parents

Trial	Allele from bag 1 (Female parent)	Allele from bag 2 (Male parent)	Offspring's alleles
1	B	b	Bb
2	b	b	bb
3	B	B	BB
4	b	b	bb
5	b	b	bb
6	B	b	Bb
7	B	b	Bb
8	B	B	BB
9	B	b	Bb
10	b	b	bb

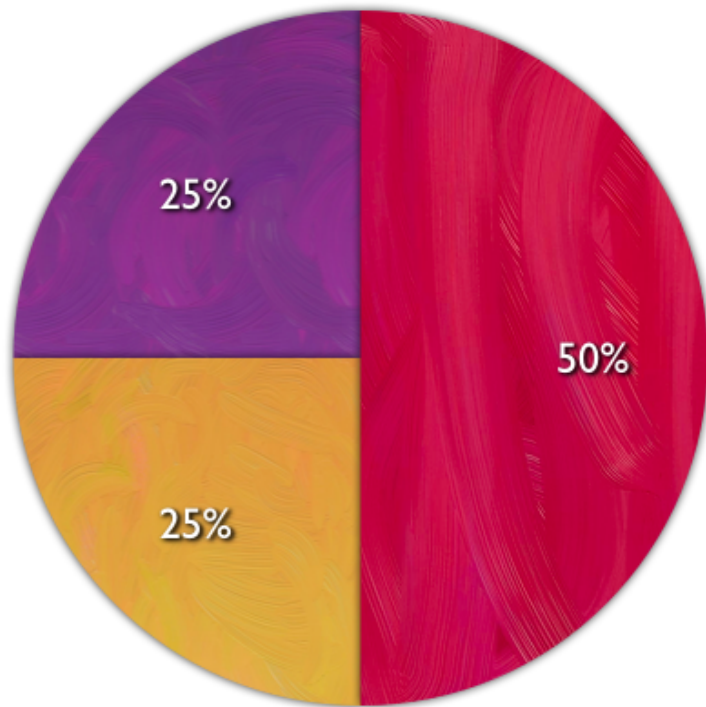
\*This data table shows the results of the experiment for part 3. By crossing two heterozygous parents, and pulling random marbles representing the alleles of either female or male parents. The crosses of those female and male alleles then made the 4/10 offspring's heterozygous, 4/10 offspring's homozygous recessive, and 2/10 offspring's homozygous dominant (Bb, BB, and bb).

According to your results in Part 3, what different kinds of offspring are possible when two heterozygous parents ( $Bb \times Bb$ ) are crossed? What percentages of each type of offspring are likely to be produced? Does the model agree with the results of a Punnett square?

		<b>B</b>	<b>Bb</b>	<b>b</b>
<b>B</b>		<b>BB</b>	<b>Bb</b>	
<b>Bb</b>		<b>Bb</b>	<b>bb</b>	
<b>b</b>		<b>Bb</b>	<b>bb</b>	

\*By crossing two heterozygous parents ( $Bb$  and  $Bb$ ), the offspring's then came out 25% homozygous dominant, 50% heterozygous, and 25% homozygous recessive. Therefore, it is more likely for an offspring to be heterozygous. By comparing the data table results and the punnett square, the punnett square obtains the same results as the marble model and agrees with the results shown. In the table, there was 4/10 offspring's as heterozygous, 4/10 offspring's as homozygous recessive, and 2/10 offspring's as homozygous dominant (Bb, BB, and bb). Once more, this is reinforced in the punnett square seen above.

## Crossing two Heterozygous Parents (Bb)



This pie chart shows the percentage of the offspring's outcomes seen in the data table and from the punnett square.

- Heterozygous Offspring's Bb
- Homozygous Dominant offspring's BB
- Homozygous Recessive Offspring's bb

### ANALYSIS

Explain your data. Make sure you use all relevant vocabulary in your description. In a paragraph, explain how the marble model compares with a Punnett square. How are the two methods alike? How are they different?

### TO RECAP...

In Part 1: Crossing two homozygous parents (BB and bb) made all the offspring's to be 100% heterozygous dominant. Both the punnett square and the data table of the marble model obtained the same results and agreed that the offspring's were all heterozygous (Bb).

In Part 2: Crossing homozygous dominant and heterozygous parents (BB and Bb), the offspring's then came out half or 50% as homozygous dominant and half or 50% as heterozygous. Both the punnett square and the data table of the marble model obtained the same results and agreed that the offspring's were half homozygous dominant and half heterozygous (BB and Bb).

In Part 3: Crossing two heterozygous parents (Bb and Bb), the offspring's then came out as 25% homozygous dominant (BB), 50% heterozygous (Bb), and 25% homozygous



recessive. Both the punnett square and the data table of the marble model obtain the same results and agree that the offspring's were homozygous dominant (BB), heterozygous (Bb), and homozygous recessive (bb).

The data tables of the marble model compared to the punnett squares are quite similar but yet different. These two methods are both used to present and see the possible genetic crosses or genotypes of offspring's. However, punnett squares are the method commonly used to predict the possible results of genetic crosses. It is an organized method that is clear and informative and unlike a data table, the punnett squares convey much more information. From a punnet square one can find the percentage of how likely a genotype is for an offspring. While a data table is just an organizational tool used to show the results of the trials done in the experiment. Also, a data table does not directly show what the different combinations of the offspring's could be from the parent's crosses, it simply shows what the genotype is for each trial but not all the combinations. So, a data table is a longer version to see the genotypes of individual offspring's while, punnett squares are a simple way that gathers all the possible information. Punnett squares show all the possible combinations of offspring's and their probability. Never the less, it all comes down to the results and both these methods show the same end results. So, then its up to the individuals favorable working style.

### **CONCLUSION**

Has your hypothesis been proved or disproved. Why? What evidence did you observe to support this statement?

The hypothesis has been proved because all the marble model table connects perfectly with the punnett squares done. Both the tables and punnett squares obtain the same results just shown differently. So, an individual can predict the possible genetic crosses by using the very best punnett square or data table as seen above in this lab.

### **ERROR ANALYSIS/ IMPROVEMENTS**

Error analysis/ improvements: highlights any anomalies in the method which could lead to faulty data. Human or equipment error are not valid anomalies as these should not occur.

An improvement that could be done is that the task should specify how the data should be presented whether in a table, pie chart, punnett square etc... because there are many ways to present the information collected.