

Biology AP/IB Lab: Genetics – Mono & Dihybrid Crosses

Name: _____ Date: _____ Score: _____

Biologists like other scientists, construct conceptual models to explain biological processes. In this investigation you will use mathematical models of monohybrid and dihybrid crosses to predict the outcome corn breeding experiments. These models are tested using a nonbiological system (bead-bag genetics) and a biological one (kernels on natural corn cobs). Afterwards you will use the Chi Square Test to determine the probability of your outcomes.

Part One: Monohybrid Cross

1. First, you will calculate the frequencies of the expected genotypes and phenotypes of F_1 and F_2 generations. Two alleles are **R** for red and **r** for brown.

Assume the parental generation genotypes are **RR** and **rr**.

What would be the genotype of their offspring (F_1)? _____ Their phenotype? _____

Mating between members of the F_1 generation produces the F_2 generation. Show this cross

_____ X _____

The possible gametes from one parent are _____ or _____, while the gametes from the other parent are _____ or _____.

These parents can produce offspring (F_2) with three possible genotypes: _____, _____ and _____. Their proportions/ratios would be _____, _____ and _____.

Their phenotypes would be _____ and _____, while their proportions/ratios would be _____ : _____

2. You will now simulate a bead-bag cross of these F_1 offspring. Put an equal number (100 red “**R**” and 100 brown “**r**” beads in a bag. Mix up your beads.
3. Without looking pull out two beads. Record their color (allele) combination in the table below. Replace the beads back in the bag.
4. Repeat this process 99 more times. You will produce a total of 100 hundred F_2 offspring.

F₂ offspring of a monohybrid bead-bag cross

Genotype	Tally Marks	Total	Proportion (%)	
			Actual	Expected
(Homozygous Dom)	_____	_____	_____	_____
(Heterozygous)	_____	_____	_____	_____
(Homozygous Rec)	_____	_____	_____	_____

Use the Chi Square Test to determine the likelihood of your bead-bag outcome. *Complete the table.*

Genotype	Observed	Expected	$o - e$	$(o - e)^2$	$(o - e)^2/e$

Number of outcomes: _____ Degrees of Freedom: _____

Value of $\alpha^2 =$ _____ Probability value P: _____

Is the Null hypothesis accepted? _____ Do the results match the expected? _____

Part Two: Dihybrid Cross

You will now simulate a dihybrid cross. In addition the above alleles (red & brown), you will use a blue "B" and green "b" alleles. In a second bag place 100 blue beads and 100 green beads.

1. What would be the genotypes of two parents with one being homozygous for Red/Blue and the other homozygous Brown/Green?

_____ X _____

What would be the genotype of their offspring? _____ Their phenotype? _____

Now consider crossing these F₁ offspring.

_____ X _____

What gametes would each produce?

If you were to cross the offspring (F₁), what would be the genotypes and phenotypes of the F₂ generation? Complete the punnett square below.

Identify the possible phenotypes and genotypes for the above cross.

Bead Combination	Phenotype	Genotypes
R-, Bl-	_____	_____
R-, GG	_____	_____
BrBr, Bl-	_____	_____
BrBr, GG	_____	_____

(R = red, Bl = blue, G = green, Br = brown)

- Now you will simulate a dihybrid cross with above F₁ parents. Use your first bead-bag with the red and brown beads and a second bag using 100 blue beads and 100 green beads.
- Remove two beads from each bag without looking at them. Record your result in the chart below. Return the beads to their original bag.
- Repeat to produce a total of 48 offspring. Record your results in the table below.

Phenotype	Tally Marks	Total Observed	Proportion (%)	
			Expected	Observed
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____

Use the Chi Square Test to determine the likelihood of your bead-bag outcome. Complete the table.

Phenotype	Observed	Expected	$o - e$	$(o - e)^2$	$(o - e)^2/e$

Number of outcomes: _____ Degrees of Freedom: _____

Value of $\alpha^2 =$ _____ Probability value P: _____

Is the Null hypothesis accepted? _____ Do the results match the expected? _____

Part Three: Dihybrid Crosses in Corn

You will be provided with two cobs of corn that have been produce from two different dihybrid crosses (see below). By observing the results of these crosses and the Chi Square Test you determine which ear of corn was produced from which cross. Kernel color in field corn is determined by the action of two alleles, one dominant (R) for purple color and the other one recessive (r) for white color. Not only is field corn identified by their kernel color, but also by their kernel shape. These include a dominant allele (Su) for dented/plump kernels and a recessive allele (su) for sweet/wrinkled kernels. Along with kernel color these alleles for shape assortment themselves independently.

