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| Study of monohybrid and di-hybrid ratio providing hypothetical data and solving problems based on Mendelian laws (E) |

## Monohybrid Cross vs Dihybrid Cross Differences

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| --- | --- | --- |
| Characteristics | Monohybrid Cross | Dihybrid Cross |
| Definition | A Monohybrid cross is a type of genetic cross between two individuals with homozygous genotypes of a single character or trait, often resulting in an opposite phenotype. | A Dihybrid cross is a type of genetic cross between two individuals with either homozygous or heterozygous genotypes of two characters or traits. |
| Occurs between | Monohybrid crosses takes place between homozygous individuals with different alleles for a single trait. | Dihybrid crosses takes place between homozygous or heterozygous individuals with different alleles for two distinct traits. |
| Phenotypic ratio | The phenotypic ratio of the offsprings in the F2 generation in the case of a monohybrid cross is 3:1. | The phenotypic ratio of the offsprings in the F2 generation in the case of dihybrid cross is 9:3:3:1. |
| Genotypic ratio | The genotypic ratio of the offsprings in the F2 generation in the case of a monohybrid cross is 1:2:1. | The genotypic ratio of the offsprings in the F2 generation in the case of dihybrid cross is 1:2:2:4:1:2:1:2:1. |
| Test cross ratio | The test cross-ratio of a monohybrid cross is 1:1:1:1. | The test cross-ratio of a dihybrid cross is 1:1. |
| Significance | Monohybrid crosses are performed to determine the dominant allele of a character. | Dihybrid crosses are performed to study offspring assortment. |

Examples of Monohybrid Cross

1. The seed texture for round shape is RR and for the wrinkled is rr. Find out the cross between the plants having seed texture (round vs wrinkled) and comment on its phenotypic and genotypic ratio.

For F1generation

Parents : male X female

Phenotype : round X wrinkled

Gamete genotype : RR X rr

Punnet square method

|  |  |  |
| --- | --- | --- |
| P gametes (round parent)  P gametes (wrinkled parent) | R | R |
| r | Rr | Rr |
| r | Rr | Rr |

All the peas produced in the second or hybrid generation were round.

All the peas of this F1 generation have an Rr genotype. The R allele is dominant to the r allele, the phenotype of all the seeds was round. The phenotypic ratio in this case of Monohybrid cross is 1.

For F2 generation on selfing.

Parents : male X female

Phenotype : Round X Round

Gamete genotype : Rr X Rr

|  |  |  |
| --- | --- | --- |
| F1 gametes  F1 gametes | R | r |
| R | RR | Rr |
| r | Rr | rr |

[Mendel](https://en.wikipedia.org/wiki/Gregor_Mendel) then allowed his hybrid peas to self-pollinate. The wrinkled trait—which did not appear in his hybrid generation—reappeared in 25% of the new crop of peas.

Random union of equal numbers of R and r gametes produced an F2 generation with 25% RR and 50% Rr—both with the round phenotype—and 25% rr with the wrinkled phenotype.(1:2:1)

**2. In humans brown eyes are dominant over blue eyes. What type of offspring would you expect if you crossed a homozygous brown (BB) eyed father to a heterozygous brown eyed mother?**

**Solve as per the above example**

|  |  |  |  |
| --- | --- | --- | --- |
|  |  | Father | |
| Gametes | B | B |
| Mother | B | BB | BB |
| b | Bb | Bb |

Result:

**3. Homozygous (HH) or heterozygous (Hh) will develop Huntington’s disease.** The mother carries one copy of the Huntington’s allele and has the disease. The father does not carry the Huntington’s allele, so he does not have the disease. **Find the percentage of the possibility in the cross between the parents?**

**Huntington’s disease is a condition resulting from a genetic disorder. The disease is caused by the Huntington gene. It was discovered that the dominant allele was responsible for the disease and that all the children of such individuals would have the disease.**

**For F1 progeny**

|  |  |  |  |
| --- | --- | --- | --- |
|  |  | Father | |
| Gametes | h | h |
| Mother | H | Hh | Hh |
| h | Hh | hh |

The chance of them producing a child with Huntington’s disease is 2 in 4, or 50%.

4. In a certain animal, black fur (BB) is dominant to white fur (bb). Determine the possible offspring from crosses between:

a. Homozygous black (BB) x white(bb)

b. Heterozygous black (Bb) x heterozygous black (Bb)

Examples of Dihybrid Cross

1. Find the F1 for the cross between the drosophila which are true breeding wild-type body and wild- type wings when crossed with a ebony body colour and vestigial wing also the F1 and F1 cross. Find the genotypes and phenotypes of the F2 generation.

Parent phenotype : wild-type body and wild- type wings X ebony body colour , vestigial wing

Genotype : e+e+ vg+vg+ X ee vg vg

Gametes : e+ vg+ e vg

F1 generation : e+ e vg+vg (wild-type)

if the offspring from the F1 generation are crossed the phenotype ratio is 9:3:3:1

Selfing of F1 : wild-type body and wild- type wings X wild-type body and wild- type wings

Genotype : e+ e vg+vg X e+ e vg+vg

Gametes :

F2 Generation :

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Male  Female | e+ vg+ | e+ vg | e vg+ | e vg |
| e+ vg+ | e+e+vg+ vg+ | e+ e+vg+  vg | e+e vg+ vg+ | e+e vg+vg |
| e+ vg | e+e+ vg+vg | e+e+vgvg | e+e vg+ vg | e+e vg vg |
| e vg+ | e+e vg+ vg+ | e+e vg+vg | e vg+  e vg+ | e e vg+ vg |
| e vg | e+ e vg+ vg | e+e vg vg | e vg e vg+ | e e vg vg |

Result :

Phenotypic ratio :

wild-type body and wild- type wings - 9

wild-type body and vestigial wing - 3

ebony body colour and wild-type wigs - 3

ebony body colour and vestigial wing - 1

1. In guinea pigs, rough coat (R) is dominant to smooth coat (r); and short hair (S) is dominant over long hair (s). Cross a guinea pig homozygous for a rough and short coat with a guinea pig with a smooth long hair. After doing the cross, write the expected phenotypic and genotypic ratios of the offspring.
2. In horses, black is dependent upon a dominant gene, B, and chestnut upon its recessive allele, b. The trotting gait is due to a dominant gene, T, the pacing gait to its recessive allele, t. If a homozygous black pacer is mated to a homozygous chestnut trotter, what will be the appearance of the F1 generation?
3. Dihybrid Cross Worksheet In rabbits, gray hair is dominant to white hair. Also in rabbits, black

eyes are dominant to red eyes. These letters represent the genotypes of the rabbits:

1. What are the phenotypes (descriptions) of rabbits that have the following genotypes?

Ggbb \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ ggBB \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

ggbb \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ GgBb \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

1. A male rabbit with the genotype GGbb is crossed with a female rabbit with the genotype ggBb the square is set up below. Fill it out and determine the phenotypes and proportions in the offspring.

How many out of 16 have gray fur and black eyes? \_\_\_\_\_\_\_\_

How many out of 16 have gray fur and red eyes? \_\_\_\_\_\_\_\_

How many out of 16 have white fur and black eyes? \_\_\_\_\_\_\_\_

How many out of 16 have white fur and red eyes\_\_\_\_\_\_\_\_

1. A male rabbit with the genotype GgBb is crossed with a female rabbit with the genotype GgBb The square is set up below. Fill it out and determine the phenotypes and proportions of offspring

How many out of 16 have gray fur and black eyes? \_\_\_\_\_\_\_\_

How many out of 16 have gray fur and red eyes? \_\_\_\_\_\_\_\_

How many out of 16 have white fur and black eyes? \_\_\_\_\_\_\_\_

How many out of 16 have white fur and red eyes?\_\_\_\_\_\_\_\_