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CLASS X CASE STUDY BASED QUESTIONS

Case Study Questions

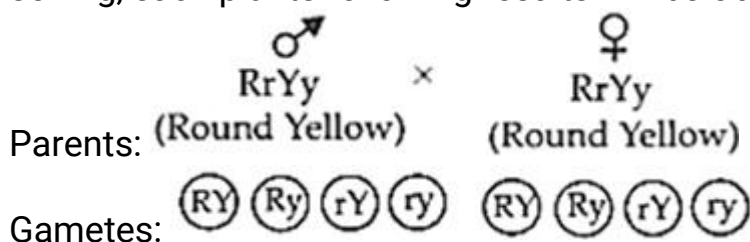
Heredity and Evolution - 01

The cross that includes the inheritance of two pairs of contrasting characters simultaneously is referred to as a dihybrid cross. Mendel chose pure breeding plants for yellow and green seeds and round and wrinkled shape of seeds. He cross-pollinated the plant having yellow round seeds with the plant having green wrinkled seeds. All the plants produced in F₁ generation were having yellow round seeds. The plants raised from these seeds were self-pollinated, which resulted in the production of plants having four phenotypically different types of seeds.

- What will be the percentage of yr gamete produced by YyRr parent?
- How many types of gametes can be produced by YYrr?
- In the Mendelian dihybrid cross, when a heterozygous tall plant with green seeds is self-crossed then what will be the progenies?
- When round yellow seeded heterozygous pea plants are self-fertilised, then what will be the frequency of occurrence of RrYY genotype among the offsprings?

Answer Key:

- Gametes produced by YyRr parent would be 25% YR, 25% yR, 25% Yr and 25% yr.
- 1 gamete can be produced by YYrr.
All sexually reproducing organisms have sex cells called gametes.
- Tt_{yy}, TT_{yy}, tt_{yy}
- Round yellow heterozygous pea plant may be represented by genotype RrYy. On selfing, such plants following results will be obtained.

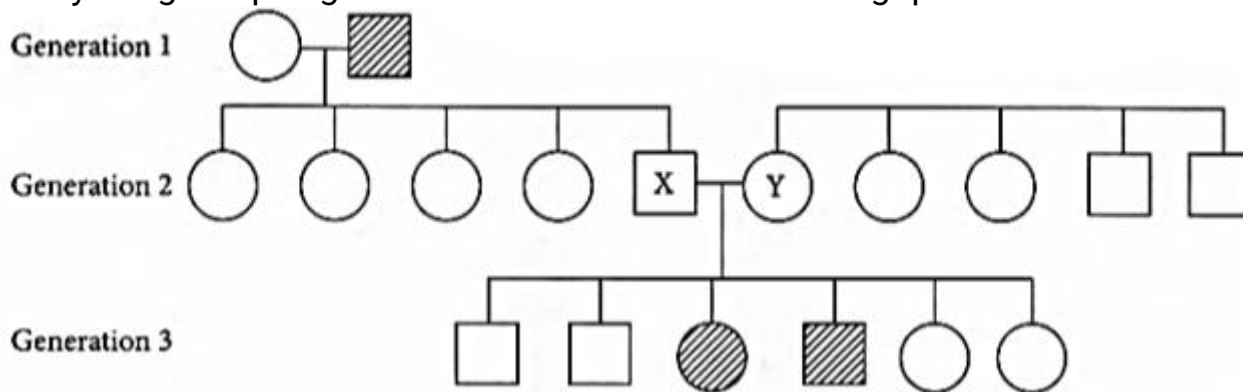


♂ \ ♀	RY	Ry	rY	ry
RY	RRYY	RRYy	RrYY	RrYy
Ry	RRYy	RRyy	RrYy	Rryy
rY	RrYY	RrYy	rrYY	rrYy
ry	RrYy	Rryy	rrYy	rryy

Case Study Questions

Heredity and Evolution - 02

Refer to the schematic representation of albinism which is an inherited condition caused by a recessive allele (a). 'A' is the dominant allele for the normal condition. The inheritance of certain genetic traits for two or more generations is represented in a pedigree or family tree. Study the given pedigree chart and answer the following questions.



- i. What could be the genotypes of X and Y?
- ii. What could be the genotype of generation - 1 male and female?
- iii. If X married an albino female, then what is the probability that their children would be albino?
- iv. If Y married a normal homozygous male, then what is the probability that their children would be albino?

Answer Key:

- i. X - Aa, Y - Aa
X and Y parents must have 'a allele (recessive) that is respective for albinism, the genotype of both X and Y individuals would be Aa and Aa as they are normal and 3rd generation, normal and albino male and female is formed in 3 : 1 ratio
- ii. Male - aa, Female - AA
Albinism is caused by the recessive allele. The children of generation-1, male and female all are normal (Aa). So, in generation-1, the genotype of female must be AA as she is normal and genotype of male is aa as he is albino male.
- iii. Albinism is caused by the recessive allele and father of X is albino male so, the genotype of X is Aa and genotype of albino female is aa. So, the probability that their children would be albino is 50% or 0.5.
- iv. If Y married a normal homozygous male, then the probability is zero that their children would be albino.
Individuals carrying two identical alleles (RR or rr) are known as homozygous.

Case Study Questions

Heredity and Evolution - 03

Mendel crossed tall and dwarf pea plants to study the inheritance of one gene. He collected the seeds produced as a result of this cross and grew them to generate plants of the first hybrid generation which is called the first filial progeny or F_1 . Mendel then self-pollinated the tall F_1 plants and he obtained F_2 generation.

- i. In garden peas, the round shape of the seeds is dominant over the wrinkled shape. A pea plant heterozygous for the round shape of seed is selfed and 1600 seeds produced during the cross are subsequently germinated. How many seedlings would have a non-parental phenotype?
- ii. If 'A' represents the dominant gene and 'a' represents its recessive allele, which of the following would be the most likely result in the first generation offspring when Aa is crossed with aa?
- iii. What result Mendel would have got if he self-pollinated a homozygous tall F_2 plant?
- iv. In plants, the tall phenotype is dominant over the dwarf phenotype, and the alleles are designated as T and t, respectively. Upon crossing one tall and one dwarf plant, a total of 250 plants were obtained, out of which 124 displayed tall phenotype and rest were dwarf. Then, What would be the genotype of the parent plants?

Answer Key:

- i. 400
Since this pea plant is heterozygous for the round shape, its genotype would be Rr.

Parents : Rr × Rr

↓ (selfing)

Progeny : RR Rr Rr rr

Phenotypically, the ratio will be 3 : 1, i.e., only rr seedlings will show wrinkled seed phenotype, rest will show round seed shape.

1200 → Round shape (RR, Rr) 400 → Wrinkled (rr)

- ii. Dominant and recessive phenotypes will be 50% each.

A represents the dominant gene and 'a' represents its recessive allele. The most likely result in the first generation offspring when Aa is crossed with aa is :

Parents: Aa × aa



Gametes:

F_1 : Aa Aa aa aa

Hence, A a: aa

1 : 1

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- iii. Self-pollination of homozygous tall F_2 plant (TT) will give rise to all individuals of genotype TT.
Individuals carrying two identical alleles (RR or rr) are known as homozygous.
- iv. $Tt \times tt$

Case Study Questions

Heredity and Evolution - 04

In humans, the allele for brown eyes (B) is dominant over that for blue eyes (b). A brown-eyed woman marries a blue-eyed man, and they have six children. Four of the children are brown-eyed and two of them are blue-eyed.

- i. What is the genotype of blue-eyed offspring?
- ii. What is the woman's genotype?
- iii. What is the gene carried by the mother's ovum regarding eye color?
- iv. What is the gene carried by the man's sperm regarding eye color?

Answer Key:

- i. bb
The genotype is a set of genes in DNA responsible for unique traits or characteristics while the phenotype is the physical appearance or characteristic of an organism.
- ii. Bb
According to the given passage, some children show recessive traits, i.e., homozygous. So, the woman must be heterozygous.
- iii. B or b
Human ova are haploid, hence they only contain one copy of each gene. Since the woman has a Bb genotype her ova would contain either B or b allele.
- iv. Human sperm is haploid, hence they only contain one copy of each gene. Since the man has a bb genotype, his sperm would contain allele b only.

Case Study Questions

Heredity and Evolution - 05

A purebred pea plant with smooth seeds (dominated characteristic) was crossed with a purebred pea plant with wrinkled seeds (recessive characteristic). The F_1 generation was self-pollinated to give rise to the F_2 generation.

- i. What will be the genotypic ratio of the given F_2 generation?
- ii. What is the expected observation of the F_2 generation of plants?
- iii. If a genotype consists of different types of alleles, what is it called?
- iv. What is the alternative form of the gene?

Answer Key:

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- i. In given case, genotypic ratio of F_2 progeny will be 1 : 2 : 1 where one is homozygous dominant, two are heterozygous dominant and one is homozygous recessive.
- ii. 1/4 of them have wrinkled seeds and 3/4 of them have smooth seeds.
- iii. Factors representing the alternate or same form of a character are called alleles. In heterozygous individuals or hybrids, a character is represented by two contrasting alleles. Out of the two contrasting alleles, only one is able to express its effect in the individual. It is called the dominant allele. The other allele which does not show its effect in the heterozygous individual is called the recessive allele, e.g., in the case of hybrid tall pea plants (Tt). 'T' is a dominant allele whereas 't' is a recessive allele.
- iv. The alternative form of the gene is called Allele. Alleles are a pair of genes that occupy a specific location on a particular chromosome and control the same trait.