Appendix VII

ACHIEVEMENT TEST

BY

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Four options (possible answers) are given for the following items.Tick mark (✓) which is the most possible answer in each case.

1. Genetics is the branch which deals with the causes and factors responsible for the
   (a) similarities between parents and offsprings.
   (b) dissimilarities between parents and offsprings.
   (c) similarities and dissimilarities both between parents and offsprings.
   (d) similarities between two offsprings of the same parents.

2. Heredity can be defined as the :
   (a) process of transmission of characters from parents to offsprings.
   (b) transmission of blood from one generation to another.
   (c) study of similarities (resemblances) and dissimilarities (variation) between offsprings and parents.
   (d) study of dissimilarities between two offsprings of the same parents.

3. Gamete is the :
   (a) somatic cell which is diploid in nature.
   (b) reproductive cell which is diploid in nature.
   (c) reproductive unit which is haploid in nature.
   (d) germinal cell which is diploid in nature.

4. Chromosomes can be defined as the :
   (a) tiny units which determine the characters of organism.
   (b) elongated thread like delicate coiled structures found in the nucleus.
(c) elongated thread like structures found outside of the nucleus, i.e., in the cytoplasm.
(d) round bodies found in the centre of the cell.

5. The smallest unit of heredity which determines the single character is called -
   (a) gametes
   (b) chromosomes
   (c) nucleus
   (d) genes

6. Mendelism does not include -
   (a) the principle of segregation.
   (b) the principle of independent assortment.
   (c) the blending theory.
   (d) the principle of dominance.

7. Due to variation:
   (a) no two individuals are alike.
   (b) offsprings resemble with their parents.
   (c) differences exist between a plant cell and an animal cell.
   (d) the male gamete is smaller than the female gamete.

8. Somatic variation is the variation which affects the -
   (a) tissue of the organisms.
   (b) reproductive cells of the organisms.
   (c) body cells of the organisms.
   (d) nuclei of the cells.

9. Germinal variation may be explained as a variation which affects the -
   (a) body cells.
   (b) reproductive cells.
   (c) nucleus.
   (d) tissue.
10. One of the important characteristic features of germinal variation is that it is
(a) inheritable.
(b) non-inheritable.
(c) changeable.
(d) found in plants only.

11. Gamete may be defined as the -
(a) first cell of a new organism.
(b) basic functional unit of organism.
(c) reproductive unit of organism.
(d) smallest unit which determines the character.

12. Gametes are produced in the -
(a) somatic cells through reduction division (meiosis).
(b) somatic cells through mitosis cell division.
(c) reproductive cells through meiosis.
(d) reproductive cells through mitosis.

13. The main function of a gamete is to -
(a) help in transmission of nucleus from one generation to another.
(b) carry the hereditary units from parents to offsprings.
(c) help in cell division.
(d) carry blood from parents to offsprings.

14. The types of fusion does not include -
(a) Anisogamous.
(b) Heterozygous.
(c) Oogamous.
(d) Isogamous.
15. The most important characteristic feature of a haploid cell is that it contains -
   (a) half of the nucleus than the diploid cell.
   (b) larger size of nucleus than the diploid cell.
   (c) half number of chromosomes than the diploid cell.
   (d) double number of chromosomes than the diploid cell.

16. One of the example of a haploid cell is -
   (a) nucleus.
   (b) zygote.
   (c) reproductive cell.
   (d) gamete.

17. What is the division through which 4 haploid gametes are produced from each reproductive cell?
   (a) Amitosis.
   (b) Meiosis.
   (c) Mitosis.
   (d) Somatic.

18. Gamete may be defined as a reproductive unit which is produced from a -
   (a) diploid cell through meiosis and contains half the number of chromosomes than the diploid cell.
   (b) pre-existing haploid cell through mitosis and contains same number of chromosomes of the pre-existing cell.
   (c) diploid cell through mitosis and contains same number of chromosomes of a diploid cell.
   (d) fusion of two haploid cells and contains double number of chromosomes than the haploid cell.

19. Genes may be defined as the -
   (a) hereditary units that determine the characters.
   (b) basic units of life which determine the characters.
   (c) hereditary units which help in character transmission.
   (d) structural units of gamete and determine the characters.
20. The function of genes is to
(a) determine the characters of organism.
(b) determine the height of the organism.
(c) help in reproduction.
(d) help in cell division.

21. Following are the important characteristic features of a
diploid cell. Identify the wrong statements:
(a) The diploid cell contains homologous pair
of chromosomes.
(b) The cell undergoes meiosis and mitosis cell-
division.
(c) The all somatic cells are diploid in nature.
(d) The diploid cell contains single set of
chromosome.

22. Following are few examples of diploid cell. Identify wrong
one:
(a) Somatic cell.
(b) Zygote.
(c) Gamete.
(d) Reproductive cells.

23. Zygote is the first diploid cell of a new life and it results
from
(a) fusion of two nucleii.
(b) fusion of two chromosomes.
(c) fusion of two gametes.
(d) fusion of somatic cells.

24. Hybrids may be defined as offsprings those are produced
from a cross between two
(a) genetically different parents.
(b) phenotypically different parents.
(c) genetically and phenotypically different parents.
(d) male and female parents of the same genotypes.
25. The process of hybrid formation is called:
   (a) cross.
   (b) self-breeding.
   (c) selfing.
   (d) hybridization.

26. Hybridization may be explained as:
   (a) a process through which better offsprings are produced.
   (b) a process through which hybrids are produced.
   (c) a cross between two different genotypic and phenotypic parents.
   (d) a cross between two different phenotypic parents.

27. Homozygous character is that character which is determined by:
   (a) similar pair of genes.
   (b) dissimilar pair of genes.
   (c) more than a pair of genes.
   (d) dominant genes.

28. Heterozygous character is that character which is determined by:
   (a) homozygous pair of genes.
   (b) homologous pair of chromosomes.
   (c) dissimilar pair of genes.
   (d) similar pair of genes.

29. Heterozygous character is also called:
   (a) Pure character.
   (b) Hybrid character.
   (c) Dominant character.
   (d) Recessive character.
30. Monohybrid cross is that cross which considers:
   (a) two contrasting pairs of genes.
   (b) one contrasting pair of genes.
   (c) only dominant genes.
   (d) only homozygous pair of genes.

31. A cross between a pure tall (TT) plant with a pure dwarf plant (tt), the genotype of the offspring at F₁ generation will be:
   (a) TT
   (b) Tt
   (c) tt
   (d) both i.e. TT and tt.

32. A cross between redflowered plant (RR) with a whiteflowered plant (ww). Here red colour is dominant over the white colour. So all the offsprings at F₁ generation will be -
   (a) Red and white both.
   (b) Red only.
   (c) White only.
   (d) Pink only.

33. Recessive character is that character which remains unexpressed:
   (a) at F₁ generation when there is a cross between a pure dominant plant and another pure recessive plant.
   (b) at F₂ generation of a cross between a pure dominant and a pure recessive plant.
   (c) at F₁ generation when there is a selfing between two dominant plants.
   (d) at F₂ generation when there is selfing between two recessive plants.
34. When there is a cross between two pure plants, one is dominant and other is recessive at F₁ generation:

(a) both the characters will express.
(b) one of the characters will express which is dominant.
(c) recessive character will express.
(d) a new character will express.

35. In the diagram given in item 35, the four steps have been marked. Which one is the F₂ generation?

(a) Step I
(b) Step II
(c) Step III
(d) Step IV

36. In the diagram given in item 35, the four steps have been marked. Which one is the F₂ generation?

(a) Step I
(b) Step II
(c) Step III
(d) Step IV
37. At $F_2$ generation (Reference to the cross given in the item 35) -

(a) all the offsprings are with red flowers.
(b) all are white in colour.
(c) three are red and one is with white flowers.
(d) half the offsprings are with red flowers and half with white flowers.

38. A cross between a redflowered tall plant with a white flowered dwarf plant. Here red and tall, these two are the dominant characters. So at $F_1$ generation all the offsprings will be:

(a) tall plants with white flowers.
(b) tall plants with red flowers.
(c) dwarf plants with white flowers.
(d) dwarf plants with red flowers.

39. Pure characters are determined by:

(a) homozygous pair of genes.
(b) more than a pair of genes.
(c) heterozygous pair of genes.
(d) dominant genes.

40. A cross between a yellow seeded plant and a green seeded plant. Here yellow colour is dominant over the green colour. At $F_1$ generation offsprings will be:

(a) half yellow seeded plants and half green seeded plants.
(b) yellow seeded plants only.
(c) green seeded plants only.
(d) an intermediate colour between yellow and green.
41. After selfing between two heterozygous yellow (Tg) plants of \( F_2 \) generation. Here yellow colour is dominant over green colour. What will be the different phenotypes of this selfing \((F_1 \times F_1)\) at \( F_2 \) generation?

(a) all yellow seeded plants.
(b) one yellow seeded plant and 3 green seeded plant.
(c) half yellow and half green seeded plants.
(d) three yellow seeded plant and one green seeded plant.

42. Phenotype may be defined as the -

(a) genetic constitution of an organism with regard to one or more characters.
(b) physical structure of an organism.
(c) external appearance of an organism with regard to one or more characters.
(d) total characters of an organism.

43. Genotype of an organism may be defined as -

(a) the external appearance of an organism regarding one or more characters.
(b) internal structure of an organism.
(c) genetic make-up of an organism.
(d) homozygous pair of genes which determine the characters.

44. Heterosis may be explained as -

(a) the organisms those are produced from a cross between two pure dominant organisms (plant or animals).
(b) the organisms those are with homozygous characters (pure characters).
(c) the offsprings those are better in their qualities than either of the parents.
(d) organisms those are produced from a selfing.
45. Hybridization is a process of hybrid formation which involves two different organisms (plants or animals) those are -

(a) genetically same.
(b) phenotypically same.
(c) genetically different.
(d) phenotypically different.

46. Find out the wrong statement regarding the importance of hybridization:

(a) improve the quality of crops, fruits, etc.
(b) develop a new variety of plants or animals.
(c) develop homozygous plants or animals.
(d) develop the disease-resistant power of plants or animals.

47. Find out the wrong statement regarding the important characteristics of heterosis?

(a) It is better than the parental organism.
(b) It develops new variety.
(c) It helps to develop pure characters i.e. homozygous characters.
(d) It brings together desired characters.

48. What is Mendelism?

(a) Experiments those are conducted by Mendel.
(b) The principles those are derived from Mendel's experiments.
(c) The principle of segregation which is also known as first law of Mendel.
(d) The principle of dominance and incomplete dominance.
49. Relationship between an 'unit character' and an organism is that:

(a) an organism includes a 'unit character' only.
(b) an organism has two 'unit characters'.
(c) a 'unit character' determines the nature of an organism.
(d) an organism consists of a number of unit characters.

50. Relationship between a pair of genes and an 'unit character' is that:

(a) a pair of genes determines a single unit character.
(b) a unit character determines a pair of genes.
(c) only a pair of homozygous genes determines a unit character.
(d) only a pair of heterozygous genes determines a 'unit character'.

51. Unit character is defined as:

(a) an organism is the sum total of characters; each of these characters act as a unit for the total organism.
(b) a total body of an organism itself act as a unit character.
(c) a unit character is the functional unit of an organism.
(d) a unit character is the structural unit of an organism.

52. Paired factor may be defined as:

(a) a pair of chromosomes which are similar in their size and shape.
(b) a pair of genes which unite together and form zygote.
(c) a pair of genes which determines a character.
(d) a pair of genes, one is dominant and other is recessive.
53. The main function of gene is that it - 
(a) helps in transmission of characters.
(b) determines the characters.
(c) helps in the formation of chromosomes.
(d) determines the nature of gamete.

54. The paired factors are located on - 
(a) the body of a single chromosome.
(b) homologous chromosomes.
(c) two different chromosomes.
(d) at the two ends of a chromosome.

55. Relationship between paired factors and heredity is that - 
(a) paired factors help in transmission of characters.
(b) paired factors determine the characters.
(c) it helps in hybrids formation.
(d) heredity deals with paired factors only.

56. Principle of dominance may be explained in the following way:
(a) out of the two contrasting allelomorphic genes, only one expresses itself in an individual, the other factor remains unexpressed.
(b) when both the genes of a pair express together in an intermediate form in the offspring.
(c) when both the factors of a homozygous pair express themselves in the offspring.
(d) when a character can express at $F_2$ generation not at $F_1$ when a cross between two different plants of true breeding groups.
57. According to the principle of dominance, dominant character is that character which:
   (a) can express over the recessive character.
   (b) remains unexpressed at $F_1$ but expressed at $F_2$ generation.
   (c) can express at $F_2$ generation only but not at $F_1$.
   (d) can express its character only in pure form.

58. The principle of 3:1 ratio is observed at $F_2$ generation of a -
   (a) Monohybrid cross.
   (b) Dihybrid cross.
   (c) Mono and dihybrid cross both.
   (d) Polyhybrid cross.

59. A cross between a pure red (dominant character) with a white (recessive character) flowered plant. At $F_1$ all the offsprings are with red flowers. After selfing of these $F_1$ plants ($F_1 \times F_1$), offsprings at $F_2$ generation will be -
   (a) all red flowered offsprings.
   (b) out of 4 offsprings, 3 with red flowers and one with white flowers.
   (c) all with white flowers.
   (d) one with red flower and 3 with white flower.

60. A cross between a red flowered plant with a white flowered plant where red colour is dominant over the white colour. According to the principle of complete dominance, the colour of flower among the offsprings at $F_2$ generation will be -
   (a) White
   (b) Red
   (c) Pink
   (d) Both Red and White.
61. Incomplete dominance may be explained in the following way:

(a) When both the factors or genes express themselves in the hybrids and the expressed character is an intermediate form of the two factors.

(b) When one factor (gene) expresses itself over the other in the offsprings.

(c) When only dominant character can be expressed the offsprings.

(d) When dominant character is completely expressed over the recessive character.

62. Here is an example of incomplete dominance. A cross between a redflowered variety of *Mirabilis jalapa* with a white variety of flowers. Hybrids at $F_1$ generation will be:

(a) red flowered plants only.
(b) both red and white flowered plants.
(c) white flowered plants only.
(d) pink flowered plants.

63. A cross between a red variety of dog flowered plant with a white flowered variety of the same flower. At $F_1$ generation all the offsprings are white flowered plant. This phenomenon is explained through the -

(a) Principle of complete dominance.
(b) Incomplete dominance.
(c) Mosaic Inheritance.
(d) Principle of dominance.

64. Here is an example of mosaic inheritance. A cross between a red variety of short horned cattle with a white variety of the same cattle. At $F_1$ generation all the offsprings are:

(a) white in colour.
(b) red in colour.
(c) white and red mixed i.e. roan in colour.
(d) white and red both the colours.
65. The principle of segregation is also called -

(a) Mendel's first law.
(b) Mendel's second law.
(c) Blending theory.
(d) Blending inheritance.

66. Pure tall \( TT \) x \( tt \) pure dwarf plant .... Step (1)

\[ \begin{align*}
\text{Tall Plant} & \quad \text{Dwarf Plant} \\
TT & \quad tt \\
T & \quad t
\end{align*} \]

At \( F_1 \) = \( Tt \) .... Step (2)

\[ \begin{align*}
Tt & \quad Tt
\end{align*} \]

*Step (3)*

In the above diagram, there is a cross between a tall plant and a dwarf plant. In this cross, segregation takes places at the steps:

(a) 1 and 2
(b) 2 and 3
(c) 3 only
(d) 2 only.

67. Genotypic ratio is explained as -

(a) the ratio which is based on the genotype of the offsprings.
(b) genetic constitution of the offsprings for a particular character.
(c) the ratio which is based on the external appearance of the offsprings.
(d) the ratio which is found at \( F_2 \) generation of a monohybrid cross.

68. 

\[ \begin{align*}
\text{Tall Plant} & \quad \text{Dwarf Plant} \\
TT & \quad tt \\
T & \quad t
\end{align*} \]

At \( F_1 \): \( Tt \) x \( Tt \)

At \( F_2 \): \( Tt \) x \( tt \)

\[ \begin{align*}
Tt & \quad tt
\end{align*} \]
In the above diagram, at F2 generation there are:

(a) only one type of genotype i.e. genetic constitution.
(b) two types of genetic constitution.
(c) three different types of genotypes.
(d) four different types of genotypes.

SECTION 'B'

In the following items two sets are given under columns A and B. You have to match the two columns by writing the numbers of column B in the blanks given against column A:

<table>
<thead>
<tr>
<th>Column A</th>
<th>Column B</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Genetics deals with this branch.</td>
<td>C. Heredity</td>
</tr>
<tr>
<td>2. This is the study about the resemblances between parents and offspring; among the offspring of the same parents.</td>
<td>D. Variation</td>
</tr>
<tr>
<td>3. This is the study which explains why two individuals of the same parents are not exactly alike.</td>
<td></td>
</tr>
<tr>
<td>4. It is the transmission of characters from parents to offspring.</td>
<td></td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Column A</th>
<th>Column B</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Both the gametes are motile and similar in size and shape.</td>
<td>C. Isogamous</td>
</tr>
<tr>
<td>2. Female gametes are non-motile and the male gamete is motile.</td>
<td>D. Oogamous</td>
</tr>
<tr>
<td>3. Both the male and female gametes are motile but female gamete is larger than the male gamete.</td>
<td></td>
</tr>
<tr>
<td>4. Female gamete is larger and non-motile than the male gamete which is motile</td>
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</tr>
<tr>
<td>Column A</td>
<td>Column B</td>
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</tr>
<tr>
<td>71.</td>
<td></td>
</tr>
<tr>
<td>1. It is diploid in nature. ( )</td>
<td>C. Gamete</td>
</tr>
<tr>
<td>2. It is haploid in nature ( )</td>
<td>D. Cell</td>
</tr>
<tr>
<td>3. It is the structural and functional unit of the body. ( )</td>
<td></td>
</tr>
<tr>
<td>4. These are produced through reduction cell division ( )</td>
<td></td>
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<tr>
<td>72.</td>
<td></td>
</tr>
<tr>
<td>1. This cell undergoes both meiosis and mitosis. ( )</td>
<td>C. Diploid cell</td>
</tr>
<tr>
<td>2. This cell contains a single set of chromosomes in each nucleus. ( )</td>
<td>D. Haploid cell.</td>
</tr>
<tr>
<td>3. This cell contains double sets of chromosomes in each nucleus. ( )</td>
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<tr>
<td>4. This cell is also called reproductive unit. ( )</td>
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<tr>
<td>73.</td>
<td></td>
</tr>
<tr>
<td>1. A cross between a tall and a dwarf plant. ( )</td>
<td>C. Monohybrid cross.</td>
</tr>
<tr>
<td>2. A cross between a tall plant with red flowers and a dwarf plant with white flowers. ( )</td>
<td>D. Dihybrid cross.</td>
</tr>
<tr>
<td>3. A cross between a round seeded plant with wrinkled seeded plant. ( )</td>
<td></td>
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<tr>
<td>4. A cross between a red flowered plant with a white flowered plant. ( )</td>
<td></td>
</tr>
<tr>
<td>74.</td>
<td></td>
</tr>
<tr>
<td>1. This is the cross which involves more than two contrasting characters. ( )</td>
<td>C. Monohybrid cross.</td>
</tr>
<tr>
<td>2. A cross between a tall plant with a dwarf plant. ( )</td>
<td>D. Polyhybrid cross.</td>
</tr>
</tbody>
</table>
3. This is the cross which considers only one contrasting character. ( )

4. This is the cross which considers three contrasting characters. ( )

<table>
<thead>
<tr>
<th>75.</th>
<th>Column A</th>
<th>Column B</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. 3:1 ratio at ( F_2 ) generation.</td>
<td>( )</td>
<td>C. Monohybride cross.</td>
</tr>
<tr>
<td>2. 1:2:1 ratio at ( F_2 ) generation.</td>
<td>( )</td>
<td>D. Dihybrid cross.</td>
</tr>
<tr>
<td>3. 9:3:3:1 at ( F_2 ) generation.</td>
<td>( )</td>
<td></td>
</tr>
<tr>
<td>4. 9:7 at ( F_2 ) generation.</td>
<td>( )</td>
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<table>
<thead>
<tr>
<th>76.</th>
<th>Column A</th>
<th>Column B</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. ( R^+ ) (Red colour of flowers).</td>
<td>( )</td>
<td>C. Homozygous pair of genes.</td>
</tr>
<tr>
<td>2. ( R^w ) (Red colour of flowers).</td>
<td>( )</td>
<td>D. Heterozygous pair of genes.</td>
</tr>
<tr>
<td>3. ( w^+ ) (white colour of flowers).</td>
<td>( )</td>
<td></td>
</tr>
<tr>
<td>4. ( T^+ ) (tallness) of flowers.</td>
<td>( )</td>
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<table>
<thead>
<tr>
<th>77.</th>
<th>Column A</th>
<th>Column B</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Hybrids those are produced from a cross which considered two contrasting characters.</td>
<td>( )</td>
<td>C. Monohybrids.</td>
</tr>
<tr>
<td>2. Hybrids those are produced from a cross between a red flowered plant and a white flowered plant.</td>
<td>( )</td>
<td>D. Dihybrids.</td>
</tr>
<tr>
<td>3. Hybrids those are produced from a cross which considers more than one contrasting character.</td>
<td>( )</td>
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<tr>
<td>4. Hybrids those are produced from a cross which considers only one contrasting character.</td>
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<tr>
<td>Column A</td>
<td>Column B</td>
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<td>78.</td>
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</tr>
<tr>
<td>1. The character which expresses at (F_1) generation over the other character. ( )</td>
<td>C. Dominant character.</td>
<td></td>
</tr>
<tr>
<td>2. The character which (A) expresses only in homozygous form. ( )</td>
<td>D. Recessive character.</td>
<td></td>
</tr>
<tr>
<td>3. The character which (B) expresses both in homozygous and heterozygous form. ( )</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. The character which remains suppressed in presence of other character. ( )</td>
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<thead>
<tr>
<th>Column A</th>
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<tbody>
<tr>
<td>79.</td>
<td></td>
</tr>
<tr>
<td>1. Phenotypic ratio of this generation is 3:1 of a monohybrid cross. ( )</td>
<td>C. (F_1) generation.</td>
</tr>
<tr>
<td>2. This generation is formed from parental generation. ( )</td>
<td>D. (F_2) generation.</td>
</tr>
<tr>
<td>3. Genotypic ratio is 1:2:1 of a monohybrid cross. ( )</td>
<td></td>
</tr>
<tr>
<td>4. All the offsprings will have same phenotype and genotype of a monohybrid cross. ( )</td>
<td></td>
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<thead>
<tr>
<th>Column A</th>
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<tbody>
<tr>
<td>80.</td>
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</tr>
<tr>
<td>1. Determined by paired factors (genes). ( )</td>
<td>C. Genotype</td>
</tr>
<tr>
<td>2. External appearance of characters. ( )</td>
<td>D. Phenotype</td>
</tr>
<tr>
<td>3. It may be homozygous or heterozygous. ( )</td>
<td></td>
</tr>
<tr>
<td>4. It is the genetic constitution of character. ( )</td>
<td></td>
</tr>
</tbody>
</table>
### Column A

1. Red colour of flowers. ( )
2. TT, Tt ( )
3. Rw, RR ( )
4. White colour of flowers ( )

### Column B

C. Genotype.
D. Phenotype.

### Column A

1. When a monohybrid cross gives 3:1 ratio at F₂ generation. ( )
2. Both the genes of a character express in an intermediate form. ( )
3. In a heterozygous pair of genes, dominant gene expresses its character and the other gene remains unexpressed. ( )
4. It is an exception of the principle of dominance. ( )

### Column B

C. Complete dominance.
D. Incomplete dominance.

### Column A

1. This is also called blending inheritance. ( )
2. This is observed in animals only. ( )
3. Out of two genes of a pair for a character, only one gene will express its character and the other gene will remain unexpressed. ( )
4. Both the genes for a character will express into an intermediate character. ( )

### Column B

C. Mosaic Inheritance.
D. Complete dominance.
### Column A
1. The ratio which is based on the genetic constitution of character. ( )
2. The ratio which is based on the external appearance of the characters. ( )
3. 3:1 ratio at F\(_1\) generation of a monohybrid cross. ( )
4. 1:2:1 ratio at F\(_2\) generation of a monohybrid cross. ( )

### Column B
C. Phenotypic ratio.
D. Genotypic ratio.

---

**SECTION 'C'**

**Note:** COMPLETE THE FOLLOWING SENTENCES

85. Mendel is called the father of ________ (Biology/Heredity).
86. He conducted a series of experiments with ________ (Pea Plant/Bean Plant).
87. In Mendel's experiment he considered ________ contrasting characters (four/seven).
88. The first diploid cell in a new life is called ________ (zygote/gamete).
89. The diploid cell always contains ________ (double sets of chromosomes/single set of chromosome).
90. The diploid cell undergoes ________ (meiosis/mitosis and meiosis both).
91. The diploid cells are only ________ (somatic cells/somatic and reproductive cells both).
92. At F\(_1\) generation, the character which will express in the offsprings is called ________ (dominant/recessive).
93. Offsprings at F\(_1\) generation of a cross will be ________ (heterozygous/homozygous).
94. F\(_2\) generation is also called ________ (first filial generation/second filial generation).
95. The paired factor is also known as ________ (pair of genes/pair of characters).
96. Each paired factors determines _________ (a single character/a pair of characters).

97. The paired factors are located on _________ (the same chromosome/the homologous chromosome).

98. When both the factors of a pair are same then they are called _________ (heterozygous paired factors/homozygous paired factors).

99. The character which is determined by a pair of homozygous genes is known as _________ (pure character/hybrid character).

100. Dominant character is always denoted by _________ (capital letters/small letters).

101. Recessive character is denoted by _________ (small letters/capital letters).

102. Hybrid character is also known as _________ (Homozygous character/Heterozygous character).

****

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INSTRUCTIONS

This is a new type of instructional book called a "Programmed Text", developed on new methods of learning. In the text, the content is presented bit by bit. Each bit of content is written within two parallel lines. A bit of content confined in parallel lines and accompanied by response situation(s) and their answers is termed a FRAME.

In order to study through the text, you will read the content matter given in each frame and respond to problem situation which is either given in the form of BLANK(S) or DIRECT QUESTION(S). You will respond on the basis of the knowledge of content presented in the corresponding frame, you will write your response on a separate response sheet provided to you. Don't write on the programmed text.

- There can be one blank towards the end of the frame which shows that here a response (answer) of one or more than one word is required e.g. if there is a sentence that "somatic variation is not permanent nor it is ______", here the answer is inheritable.

- There can be more than one blank in a frame where more than one responses are required e.g. if there is a sentence, there is a general resemblance between ______ and ______", here answers are parents and offsprings.

- In most of the frames you will be required to respond by writing at the response sheet and check by comparing it with the answers provided on the left side of the next frame. This is necessary. The word or group of words written on the left side of the next frame is the correct answer.

- If your response is incorrect, read the same frame again and proceed to the next frame only when it is correct.
Do not make haste. Take your own time to reach each frame and write responses.

After completing the programme you will be given the criterion test. This will tell you how much you have learnt through the text.

Do not skip over any frame, otherwise you will lose the link and possibly commit more errors.

Do not feel scared, for this is not a test of your performance. Now, please start with it.

GOOD LUCK
Similarities between parents and offsprings are common in nature. We have never heard that a human mother gives birth to a calf or a kitten or anything other than a human baby. It means living beings (plants and animals) produce offsprings like their own. In the following frames we will discuss about these similarities between parents and offsprings which is technically known as heredity.

You will observe that no two living beings are exactly alike although they resemble in a general way. If you observe yourself you will notice that you are not exactly like either of your parents. You are not exactly like your sister or brother, besides a general resemblance between you and your parents, you and your sister and brother. These differences between parents and offsprings: offsprings of the same parents will also be discussed in the following frames which is technically known as variation.

So similarities between parents and offsprings as well as dissimilarities between them both are common in plants and animals. Both these terms i.e. similarities which is called heredity and dissimilarities which is called variation will be discussed in the following frame.
In the nature we observe that living beings produce offsprings resembling in a general way to their parents: e.g.
A human mother gives birth to a human baby.
A cow gives birth to a calf.
In the above examples basic characteristics of the offsprings resemble with their parents. So
A dog gives birth to a ____________________
A cat gives birth to a ____________________

Puppy
A dog gives birth to a puppy.
Kitten
A cat gives birth to a kitten.
A cow gives birth to a calf.
A human mother gives birth to a human baby.
It means there is a general resemblance between ___________ and ___________.

Parents, This principle that is observed in the animal kingdom, offsprings means the living beings produce offsprings resembling in a general way to their parents. This principle is also observed in the plant kingdom. For example, a gram seed germinates into a gram plant. A bean seed germinates into a bean plant only. In the above examples basic characteristics of offsprings ________ with their parents.
Resemble

Mrs. & Mr. Sharma have a daughter named Charu. 'Charu' has 'curly hair' like her mother. She has 'brown eyes' like her father. It means she resembles with both her parents. Characters of both the parents are acquired by offsprings. Therefore, offsprings resemble on some of the _______ of their parents.

Chars
ters

Charu resembles with her father on 'brown eyes'. She resembles with her mother on her 'curly hair'. Offsprings resemble on their basic characteristics with their parents. It is because Charu's 'curly hair' resemble with her _______ and 'brown eyes' with her _______ that she resembles with both her parents.

Mother, Offsprings resemble with their parents in a general way. It is not that they resemble only on a single character. They may resemble in more than one character. Charu resembles with her mother with respect to her 'curly hair'. She also resembles with her mother on her 'height'. Offsprings may resemble with their parents with respect to more than one _______.

Charac
ter

Same principle holds good for plants also. A 'tall plant' produces another tall plant. A 'white flowered' plant produces another plant with white flowers.
There are similarities (resemblances) between parental plant and its offsprings. In the first example 'tall' is a character which resembles between parental plants, and offsprings. In the second example offsprings resemble with their parental plants with regard to character of

---

**Hereditary**

General resemblance between parents and their offsprings (whether animals or plants) is known as Heredity. So resemblance between Charu and her parents, that of Amit to his parents; Sheela to her parents also known as resemblance due to

---

**Heredity**

Similarities of characters between parental plants and offsprings is also termed as heredity.

A seed of Bean plant germinates into a bean plant.

A seed of Mango plant germinates into a mango plant.

These resemblances between parental plants and their offsprings are called

---

**Heredity**

Shelly is Charu’s friend. She is 'tall' like her father. She also resembles with her father with regard to 'black eyes'. She has 'fair complexion' like her mother. She also resembles with respect to 'straight hair' with her mother.

So Shelly resembles with both her parents on different characters. This resemblance between Shelly and her parents is also termed as
Heredity deals with the causes and factors responsible for general resemblances between parents and offsprings. It is same in the plant and animals.

So heredity, i.e. resemblance between parents and offsprings is common in both _______ and _______

Plants, Animals
Heredity deals with the causes and factors responsible for similarities between parents and offsprings.

So heredity also deals with _______ and _______ responsible for similarities and dissimilarities between Charu and her parents, Shelly and her parents etc.

What is heredity and what it deals with?

It is now the question comes what causes and factors are the responsible for this resemblance between parents and offsprings? First we shall consider the causes of this resemblance between parents and offsprings. For example, Charu has 'curly hair' like her mother. So this character has been transmitted from mother to Charu. Charu has with the 'brown eyes' like her father. This character (Brown eyes) causes & factors has been transmitted from father to Charu. This resemblance result of transmission of characters from _______ to _______ offsprings.
Parents... Charu resembles with her mother on her 'curly hair'.
This resemblance between offsprings and parents is due to
transmission of characters from parents to offsprings.
Here the character 'curly hair' has been transmitted
from Charu's mother to ____________.

Charu
She resembles with her father on her 'brown eyes'.
This resemblance between father (parent) and Charu is due
to transmission of character. So, the character "brown
eyes" has been ____________ from Charu's father to Charu.

Trans-mitted
Shelly, Charu's friend, has similarities with her
parents. She has 'fair complexion' like her mother
and 'black eyes' like her father. This resemblance between
parents and offsprings is due to the transmission of
characters from parents to their offsprings. So this
resemblance between Shelly and her parents is due to the
transmission of ____________ from her parents to Shelly.

Characters
In the above examples, both Charu and Shelly have
resemblance with their parents on some characters. This
is due to the transmission of characters from parents to
offsprings. So both Charu and Shelly resemble with their
parents due to ____________ of ____________ from parents
of offsprings.
Trans-
mission
Characters

The main cause of resemblance between parents and offsprings is the transmission of characters from parents to offsprings. When Charu resembles with her parents, Shelly resembles with her parents, Amit resembles with his parents and so on. What is the cause of these resemblances between parents and their offsprings?

It is known that living beings (plants and animals) produce offsprings resembling their parents. This resemblance is due to the transmission of characters. This principle of heredity is common for both plants and animals.
and animals. Now the question is how the transmission takes place and what is the unit of character transmission? (No response is required)

For example a tall plant produces another tall plant. A dwarf plant produces another dwarf plant. These characters i.e. tallness and dwarfness have been transmitted from parents to offspring. This transmission of characters takes place through the reproductive unit called gamete. So gamete is the unit which _____ the character from parents to offspring.

Each living being has a reproductive unit called gametes. It is through these gametes that the characters are transmitted from parents to offspring. Red flowered plant produces another plant with red flowers. The transmission of 'red colour' of flower takes place through the reproductive unit called _________.

The character, tallness of a tall pea plant is transmitted from parental pea plant to its offspring. This transmission of 'tallness' from parental plants to offspring takes place through the ______ called _______.

A plant with 'compound leaves' produces another plant with compound leaves. A plant with simple leaves' produces another plant with simple leaves. What is the unit which transmits these characters?
Reproductive unit, called gamete. Now the question arises although offsprings resemble with their parents in a general way yet they are not exactly alike. No two individuals or plants are exactly alike. They differ in a number of ways from their parents and also among the offsprings of the same parents. In the following frame we will discuss the differences between parents and offsprings, among the offsprings of the same parents.

(No response is required)

Charu resembles with her mother on her curly hair and height but at the same time she differs from her mother on some other characters. So she is not exactly like her mother. Difference between parents and their offsprings is termed as variation so the difference between Charu & her mother is also termed as ________.

Dissimilarities between Shelly and her parents is also known as ________.
Variation

When you observe yourself, you will find that you have some similarities with your mother and father with regard to some characters but you are not exactly like either of them because at the same time you have similarities with your parents on other characters. These between you and your parents are also termed as variation.

(33)

Dissimilarities

Not only that you differ from your parents but also from your brother & sisters. You have similarities with them on some character and dissimilarities on some other characters. Due to these dissimilarities you are not exactly like either of your brothers or sisters. The dissimilarities among the offsprings of the same parents are also termed as variations. So dissimilarities among you and your brothers or sisters are because of _________.

(34)

Variation

Charu differs from each of her parents on some characters. She also differs from her sister and brother. For example, her sister has 'straight hair' and 'black eyes', whereas Charu has got 'curly hair' and 'brown eyes'. This difference between Charu and her sister is also known as variation. So when offsprings of the same parents differ from each, then this ________ is known as _________.

(35)
Offsprings of the same parents are not alike. They differ from each other although they are the offsprings of the same parents. These differences are also known as variation. For example, if we consider a character i.e. height, we will observe that two sisters or two brothers of the same parents are also different sometimes in their height. They are not exactly like each other. This difference between two brothers or two sisters of the same parents is also known as variation.

It is also common that one sister is fair in her complexion and other is dark although they are the offsprings of the same parents. This ________ between two sisters on their complexion is also known as ________.

So, offsprings not only differ from their parents but also among them. Both these dissimilarities i.e. dissimilarities between parents and offsprings and among the ________ of the same parents is known as variation.

Dissimilarities between parents and offsprings among the offsprings are also common in plant kingdom. In nature, you will find no two plants of the same variety or parents exactly alike but they differ from their parental plants with regard to some characters. This dissimilarity, which is observed in Plant Kingdom is also known as variation.
A tall plant may produce a dwarf plant. A redflowered plant may produce a white flowered plant. Dissimilarity between parents and offsprings is termed as variation. These dissimilarities between tall plant and its offspring, which is dwarf, and Redflowered plant and its offspring, which is with white flower, are also known as variation.

Not only these dissimilarities are observed between parental plants and its offsprings but also among the offsprings of the same parents. No two plants of the same parental plants are exactly the same. For example, when we sow some seeds of the same plant, we observe that all the germinating new plants are not exactly same in their height, size, colour etc. This difference among the same parental plants is also termed as variation.

So, no two plants of the same variety are exactly alike. Offsprings differ from the parental plants and also among the offsprings of the same parental plants. These are all variations of characters. Variation deals with the causes and factors responsible for all these dissimilarities.
Different causes or influences bring variation in characters and it affects living beings in different ways. Depending on the types of cells which have been affected through different causes or influences, variation can be divided into two categories, somatic and germinal variation.

(No response required)

Depending on the types of cells which are affected through different causes or influences, variations are classified into two broad categories, somatic and germinal variations.

There are _____ of variations. These are somatic and germinal variations.

What are the two broad categories of variations?

This classification of variations is based on the types of _______ which are affected through different causes and factors.

Variations, which affect only somatic cells (body cells) and are neither permanent nor inheritable are called somatic _________.

_________________________
Varia-
tion

Somatic variation affects only somatic cells and this variation is not permanent nor it is permanent.

(49)

Inheri-
table

Somatic variation affects only somatic cells and such variation is not inheritable nor it is inheritable.

(50)

Perma-

Somatic variation affects the somatic cells whereas germinal variation affects the germ cells which is also called reproductive cells. So, variation which occurs in the reproductive cells is called germinal variation.

(51)

Ger-

Germinal variation is that variation which affects reproductive (germ) cells. Such variation is permanent and inheritable. Germinal variation is inheritable and also inheritable.

(52)

Perma-

Germinal variation takes place in the germ cells and such variation is permanent and permanent.

(53)

Inheri-

The characteristic features of germinal variation are that such variation is permanent and inheritable (transferable). What are the two characteristic features of germinal variation?

(54)

Perma-

So, now it is clear that there are two broad categories of variation. One is somatic variation which is not permanent nor transferable and other is germinal which is permanent and inheritable. (No response required)

(55)
Now if we summarize the above frames it is clear that there are similarities between parents and offsprings and also among the offsprings of the same parents. Besides, these similarities there are dissimilarities between two individuals, parents and offsprings and also among the offsprings of the same parents. So both similarities and dissimilarities are common in the living beings. The first one is technically termed as Heredity and deals with the causes and factors responsible for similarities. The latter one is termed as variation which deals with the causes and factors responsible for dissimilarities.

In the preceding frames, two different branches of heredity and variation have been explained. Now you are able to distinguish between these two branches.

In the following frames we shall discuss a new branch of biology named genetics which deals with heredity and variation together.

Genetics is the branch of biology which deals with both similarities and dissimilarities between two individuals, parents and offsprings, among the offsprings of the same parents. So genetics is the branch which encompasses both the and between two living beings.
Heredity is the branch of genetics that deals with the similarities between parents and offspring. Variation is the branch of genetics which deals with dissimilarities between two living organisms. 'Genetics' deals with both these similarities and dissimilarities together. So genetics deals with the branches Heredity and Variation.

Genetics is the branch of Biology which deals with both i.e. heredity and variation that means similarities and dissimilarities between two living organisms.

Sheela has long hair like her mother. She has similarities with her mother with regard to hair character. Which is the branch which deals with this type of similarities between Sheela and her mother?

Sheela has similarities with her mother on her 'hair'. But at the same time she differs from her mother on her 'height'. She is taller than her mother. So Sheela resembles with her mother at the same time she also differs from her on some other characters. Both these similarities and dissimilarities will be studied under the branch named:

(a) Heredity .... Go to frame (62)
(b) Variation .... Go to frame (63)
(c) Genetics .... Go to frame (64)
Your answer is Heredity. No, it is not a correct answer. Perhaps you did not devote much time in thinking about your answer. Heredity is the branch which deals with only similarities between two individuals or plants, not the dissimilarities. But in the above example of frame 61, both the similarities and dissimilarities between Sheela and her mother were mentioned. Heredity deals with only the similarities, not both the similarities and dissimilarities. Now think once again and go through the frame 61 and select another alternative.

Your answer is variation. No, it is not a correct answer. You may remember that variation deals with the dissimilarities between two living organisms but not similarities, or both similarities and dissimilarities. But the question was regarding both similarities and dissimilarities between Sheela and her mother. Variation deals with the dissimilarities part, not both. So please think once again and go through the frame 61 and select the correct alternatives.

Your answer is genetics. Very good. You have done well. It is the correct answer. Genetics is the branch which deals with both the similarities and dissimilarities. The question was regarding the branch which deals with both similarities and dissimilarities between Sheela and her
Genetics is the branch which deals with the both.
So you are on right track. Now go for the next frame.

Now you are able to differentiate among these three branches i.e. Heredity, Variation and Genetics and what they deal with.

there are
Suppose two brothers of the same parents. One is having black eyes and other is with brown eyes. They are not exactly alike although they are the offsprings of the same parents. What is the branch which deals with this difference between offsprings of the same parents?

(a) Heredity ... Go to the (67)
(b) Variation ... Go to the (68)
(c) Genetics ... Go to the (66)

Your answer is genetics. It is not correct response.
Genetics deals with both similarities and dissimilarities between two living beings. But the above frame has asked about the differences between two offsprings of the same parents. That means dissimilarities between them only. So please go through the frame once again and think over the answer and select another alternative.

Your answer is Heredity. No, You are not on right track.
Heredity deals with similarities between parents and offsprings. It does not deal with the differences between two offsprings of the same parents. So please think again and go through the frame once again for the correct alternative.
Your answer is variation. Very good. You have done well. It is the correct answer. Variation is the branch of genetics which deals with the differences among the offsprings of the same parents. So you are on the right track and now to go the next frame.

Gregor Johann Mendel, an Austrian Monk and naturalist laid the foundation of science of genetics and formulated the basic principles of genetics in 1866.

Who formulated the principles of genetics?

The results of Mendel's experiment were published in the year 1866. But his work went on unnoticed for more than 30 years. In 1900, three other biologists rediscovered the same phenomena which was discovered by Mendel of in 1866. These three biologists were Hugo de Vries, Holland, Tschemark of Austria and Correns of Germany, independently rediscovered the same phenomena of Mendel. Hugo de Vries also found unnoticed papers of Mendel. Thus Mendel's work was rediscovered and established in 1900 by those three biologists.

Who formulated the principles of genetics first?

(a) Hugo de Vries .... Go to frame (75)
(b) Correns .... Go to frame (71)
(c) Mendel .... Go to frame (72)
(d) Tschemark .... Go to frame (77)
Your answer, Corren is the first scientist who formulated principles of genetics. It is not correct. It seems you have not devoted much time on thinking your response. Corren is the biologist from Germany who independently rediscovered the phenomena in 1900 which was already discovered earlier in 1860. So read the frame 70 carefully and choose another alternative.

Your answer, Mendel is the first scientist who formulated the principles of genetics. It is correct. Very good. You have been able to find the correct name of the scientist. Now go for the next frame.

So, now you are able to state the name of the first scientist who formulated the principles of genetics in 1866. But his published work went on unnoticed for many years till 1900. In 1900, the same principles were rediscovered by three other Biologists independently. These biologists are Hugo de Vries of Holland, Tschemark of Austria and Correns of Germany. Mendel's work was thus established after independent rediscovery of the same principles by three other Biologists in 1900. Who rediscovered Mendel's work in 1900?

(a) Hugo de Vries and Correns .... Go to frame (74)
(b) Tschemark & Hugo de Vries .... Go to frame (76)
(c) Hugo de Vries, Correns & Tschemark .... Go to frame (78)
Your answer Hugo de Vries and Correns are the scientists who rediscovered the same principles of Mendel in 1900. It is not a complete answer of the question. So please read the frame carefully and choose another alternative for correct response.

Your answer is Hugo de Vries. But it is not a correct answer for the question. Hugo de Vries is one of the biologists who rediscovered the principles of genetics, but not the first scientist who discovered these principles. So please read the frame 70 carefully and choose another alternative for correct answer.

Your answer is Hugo de Vries and Tschemark. This is not a complete answer for the question. Hugo de Vries and Tschemark are the biologists who rediscovered Mendel's work but they are not the only two scientists who rediscovered Mendel's work. So please go back and read the frame 73 carefully and make another attempt for correct alternative.

Your answer is Tschemark. This is not correct. He is not the first scientist who formulated the principles of genetics. He is one of the scientists who rediscovered the phenomenon which was already discovered by other scientist. So go back to frame 70 and read the frame carefully and choose the correct alternative for answer.
Your answer is Hugo de Vries, Correa and Tschemark are three scientists who rediscovered the principles of genetics in 1900 which were already discovered by Mendel in 1866. So you are correct. Now go for the next frame.

After conducting a series of experiments on pea plants, Gregor Johan Mendel formulated some principles of genetics. This principle of Genetics which were formulated by Mendel are collectively known as Mendelism. The principles those were formulated by ________ are collectively known as Mendelism.

So, Mendelism is the collective term for the principles of Genetics together formulated by Gregor Johan Mendel in 1866.

Principles of Genetics those were formulated by Mendel in 1866 are collectively known as ________.

The principles of genetics which were formulated by Mendel in 1866 after conducting a series of experiments are collectively known as Mendelism. What is Mendelism?
Mendel formulated his principles of Genetics (Mendelism) based on a series of experiments with the garden pea plant. The botanical name of this garden pea plant is *Pisum sativum*. So *Pisum sativum* is the botanical name of *Pisum sativum*.

Mendel conducted his famous experiments on a species of Garden Pea. The botanical name of this plant is *Pisum sativum*. 

*Pisum sativum* is the _______ of a species of Garden Pea Plant.

Mendel took into consideration, seven contrasting characters of Pea Plant for his experiment. Contrasting character means each of the character has two extreme alternatives. For example, 'Height of Plant' is a character which has two extreme alternatives i.e. "tallness" and "dwarfness" of *Pisum sativum*. Each of the seven characters, those were considered in Mendel's experiment had two extreme ________.

Mendel considered seven contrasting characters in his experiment. Contrasting character means the character which has ________ extreme alternatives.
Two "Height of Plant", "Colour of Flowers", "Colour of Seeds", these are three contrasting characters out of the seven characters which were considered by Mendel in his experiment. Each of these contrasting characters has two extreme alternatives. For example, "colour of flower" is a contrasting character which has two extreme alternative of red and white colour. So Red & White are two extreme alternatives of the contrasting character "colour of flower".

Alternatives

So, contrasting character has two alternatives. For example, Red and White colour of flowers are two extreme alternatives of the contrasting character of "colour of flower".

Extreme

In the same way, tallness and dwarfness are two extreme alternatives for the character "height of plant". The character, which has two extreme alternatives, is called contrasting character. So, here "height of plant" is a character because it has two extreme alternatives i.e. tallness and dwarfness.

Contrasting

The seven characters of garden Pea Plant which were considered by Mendel for his experiment have a typical characteristic feature that each character has extreme alternatives.

Two alternatives

Out of those seven contrasting characters of Pisum sativum, "height of the plant", and "colour of flower" are two most common characters which have been considered
in this experiment, Height has two extreme alternatives i.e. Tallness and Dwarfness. In the same way 'colour of flower' has two extreme alternatives i.e. redness and whiteness.

So redness and whiteness are two forms of the character 'colour of flower'.

What are the two extreme alternatives of the character 'height' of *Pisum sativum*?

What was the characteristic feature of those seven characters of Pea Plant which were considered by Mendel in his experiment?

Out of many importances of Mendelism or principles of genetics, few are that it tells us about the mechanism of inheritance of characters, it helps to improve the quality of plant or animals of useful races and through these principles we can explain the new traits in the organisms.

That means Mendelism helps to explain the mechanism of inheritance of characters, to improve the quality of plants and animals and it explains the new traits of the organism etc. These are the three importances of Mendelism.

These principles help us to improve the quality of plants and animals.
Inheritance

There are the three importance of Principles of genetics or Mendelism. Through these principles we can (i) explain the mechanism of inheritance of characters, (ii) improve the quality of animals and plants, and (iii) explain the new traits in the organisms.

Organisms

What are the main importance of Mendelism? English three of them:

(1) ........................................

(2) ........................................

(3) ........................................

It is

(i) Explains the mechanism of inheritance; branch of genetics, the scientists who discovered and rediscovered the principles of genetics. We have also discussed about Mendelism, experiments of Mendelism, characteristic features of the Mendal experimental plant and at the end we have discussed about few new traits in the organisms.

(No response required)

So now you are able to distinguish between the study of Heredity and Variation, and also able to define the branch of genetics under which both these heredity and variation are studied. Now in the following frames we shall discuss about the mechanism of inheritance.

(No response required)
In the preceding frames we have discussed about Mendel's i.e. Principles of genetics which have been formulated by Mendel and re-established by other three biologists later on. We know that the branch genetics includes both heredity and variation. Heredity deals with the factors and causes responsible for similarities. The similarities between parents and offsprings are due to the transmission of characters which is also called inheritance. So heredity mainly deals with the inheritance and mechanism of inheritance. The principles of genetics those related with the mechanism of inheritance are known as Principles of Heredity. So Principles of Heredity explains the mechanism of 

Inheritance of offsprings, resemble with their parents. These resemblances (similarities) are due to the inheritance of characters i.e. transmission of characters from parents to offsprings.

So if 'Charu' resembles with her parents or Shelly resembles with her parents, these resemblances are due to the ________ from parents to offsprings.

If, red flowered plants products a plant with red flowers, this resemblance is due to the inheritance of characters from parental plant to offsprings. Principles of Heredity explain this mechanism of Inheritance which is same for plants and animals. Now the question comes how this transmission of characters from parents to offspring takes
place? What is the unit of inheritance? Following frame will give the answers to these questions.

(No response required)

According to Mendel's principles of heredity inheritance of characters take place through the reproductive units called gametes, the reproductive units which ______ characters from parents to ___________.

Transmit, Offsprings.

For example, 'red colour of flower', is a character of a plant. This plant produces another plant with red flower. Here, this character (red colour) has been transmitted from parental plants to its offsprings through the reproductive unit called ___________.

Gamete

So gamete is the unit of inheritance i.e. characters are transmitted from parents to offsprings through gametes. Due to this inheritance of characters, offsprings resemble with their parents in a general way. This phenomenon of inheritance is same in animals and plants. In this programme, we shall emphasise on plants than the animals and more examples will be cited from plants than the animals.

(No response required)
Before Mendel's Principles of Heredity, there were many prevailing concepts regarding inheritance of characters and mechanism of inheritance. All these prevailing concepts before Mendel are known as Pre-Mendelian concepts of Heredity. What are Pre-Mendelian concepts?

All the prevailing concepts of Inheritance before Mendel are those concepts regarding inheritance which prevailed before Mendel established his principles of heredity in terms of genes.

Mendel explained heredity in terms of genes which are carried by the reproductive units, called gametes. For example, a tall plant produces another tall plant, a red flowered plant produces another red flowered plant etc. According to Mendel's principles of Heredity, these characters (tall and red) have been transmitted from parental plant to offsprings through the reproductive units called gametes.

Resemblance of the offsprings with the parents is due to transmission of characters. This transmission takes place through the units called gametes.
For example, "compound leaves" is a character of a plant. If this plant produces another plant with compound leaves, that means the produced offspring (plant) resembles with its parental plant on this character (compound leaves). This character has been transmitted through the called gamete.

Reproductive unit: gamete is the reproductive unit which characters from parents to its offsprings.

According to the principles of Heredity, characters are transmitted from parents to offsprings through gametes.

What is the unit of character transmission?

Shelly resembles with her mother on her "fair complexion" and with her father on her 'blue eyes'. This resemblance between Shelly and her parents is due to transmission of characters (inheritance) which takes place through gametes. Characters are transmitted from both the parents i.e. male and female parents. So there are two types of gametes. One type of gamete transmits character from male parents (father) and other from female (mother) parents.

How many types of gametes transmit characters?
Two

The gamete which transmit characters from mother to offsprings (female parent) is called female gamete. Shelly has similarities with her mother on her "fair complexion". This character i.e. "fair complexion" has been transmitted through female gamete from mother to Shelly.

Female

Female gamete transmits characters from _______ to its offsprings.

Mother

In a cross between a female tall plant and a male dwarf plant, offsprings of this cross are all tall plants. Here this character "tallness" has been transmitted through _______ gamete.

Female

Shelly not only resembles with her mother but also with her father. She resembles with her father with regard to her 'blue eyes'. Transmission of characters from male parents to their offsprings takes place through male gamete. This character 'blue eyes' has been transmitted from father (male parent) to Shelly through _______ gamete.

Male

In a cross between a male and flowered plant and a female white flowered plant. All the offsprings in the next generation are with red flowers. This character "redness" has been transmitted from _______ red flowered plants to offsprings through _______ gamete.
Male, Male
Male gamete transmits the characters from
parent to their
---

Male, offspring
So now it is known to you that gamete is the unit
which transmits the characters from parents to offspring.
These gametes are of two types, male and female gamete and
both the gametes take part in the inheritance. Now the
question comes how these gametes are produced in the male
and female parents and what are the characteristics of
these gametes? what are the differences between a reproduc-
tive cell and a gamete? In the following frames we will
discuss the answer of the above questions.
(No response required)
---

Each living organism has a reproductive organ. Gametes
are produced in that reproductive organ. Reproductive cell
of the reproductive organ undergo a special cell division
and produce 4 gametes from each reproductive cell. So 4
gametes are produced from each ________ through a special
cell division.
---

Reproductive cell
Gametes are produced from reproductive cells through
a special cell division. This division is called reduction
cell division or meiosis. So gametes are produced from
reproductive cells through reduction cell division which
is also called ________
---
Meiosis What is the name of cell division which takes place in the reproductive cell during gametes formations?

Reduction It has been mentioned that each living organism cell division has a reproductive organ. Male parent has male reproductive organ and female parent has female reproductive organ. Male gametes are produced in the male reproductive organ and female gametes are produced in the female reproductive organs. Both these types of gametes are produced through reduction cell division or meiosis.

Reduction cell division which is also called meiosis, takes place during gametes formation. This cell division reduces the number of chromosomes in the new cells i.e. in the gametes.

What is the characteristic of Meiosis?

Meiosis Reduction cell division (meiosis) reduces the number of chromosomes in the new cells. Gametes are the new cells which are produced only through meiosis. So number of chromosomes are in the gametes.

In the plants or animals, there are two types of cells, somatic (body) cells and germ (reproductive) cells. Both the cells have the same number of chromosomes for a...
particular species i.e. number of chromosomes are fixed in the body and reproductive cells for a definite species.

Reproductive and body cells of a particular species have number of chromosomes.

The cell which contains double sets of chromosomes are called diploid cells. The body cells contain double sets of chromosomes in its nucleus. So body cells are diploid cells.

What is the characteristic feature of diploid cells?

Reproductive cells also contain double sets of chromosomes. The cells which contain double sets of chromosomes are diploid cells. So, reproductive cells are diploid cells.

Gametes are produced from reproductive cells. Reproductive cells contain double sets of chromosomes. So reproductive cells are diploid cells. These reproductive cells undergo reduction cell division and produce gametes. Reduction cell division reduces the number of chromosomes in the new cells i.e. gametes. So gamete contains number of chromosomes in its nucleus.
During gamete formation, diploid reproductive cells undergo reduction cell division. During reduction cell division (meiosis) number of chromosomes becomes half in the new cells. Gametes contain half number of chromosomes than the reproductive cells.

Now we can conclude that body and reproductive cells are diploid in nature. The cell which contains double sets of chromosomes in its nucleus is called diploid cell. Then each reproductive cell undergoes reduction cell division and produces 4 haploid gametes. Haploid cell is that cell which contain single set of chromosomes in its nucleus. In this way 4 gametes are produced from each reproductive cell and number of chromosomes in gametes is always half than the reproductive cells. Single set of chromosomes are found in:

(a) Reproductive cells ........ go to frame (139)
(b) Body cells ........ go to frame (136)
(c) Gametes ........ go to frame (137)

Your answer is diploid. It is not correct. Gamete is the cell which contain single set of chromosomes in its nucleus. But diploid cells are those cells which contain double sets of chromosomes. So gamete is not a diploid cell. Go to the original frame number 138 and read it carefully for the correct alternative.
Your answer is body cell. This is not correct answer. You may remember that body cells are diploid in nature. It has also mentioned that diploid cells are those cells which contain double sets of chromosomes. So body cells are not the cells which contain single set of chromosomes. Go to the original frame i.e. 134 and read it again carefully to choose correct alternative.

Your answer is gamete. Very good. This is the correct answer. Gametes are produced from reproductive cells through reduction cell division. Reproductive cells are diploid i.e. contain double sets of chromosomes and due to reduction division, chromosomes number are reduced in the new cells i.e. in the gametes. So gamete contains single set of chromosomes. Now go for the next content which is given below.

Now you are able to state the nature of gamete. Gamete is the cell which contains single set of chromosomes and the reproductive and body cells do not contain single set of cells chromosomes. These body and reproductive cells contain double sets of chromosomes. Cells which contain single set of chromosomes are called haploid cells and those contain double sets of chromosomes are called diploid cells. Now the question is what type of cell is gamete?

(a) Diploid ...... go to frame (135)
(b) Haploid ...... go to frame (141)
(c) Other than diploid & haploid.... go to frame (140)
Your answer is reproductive cell. This is not correct answer. Reproductive cells are diploid cells which always contain double sets of chromosomes. So it is not the cell which contains single set of chromosomes. So please go to the original frame i.e. frame number 134 and read the content carefully for the correct alternative.

Your answer is other than diploid and haploid. This is not the correct answer. It has been mentioned that 4 gametes are produced from a reproductive cell. These reproductive cells contain double sets of chromosomes i.e. these are diploid cells. But when these diploid cells undergo meiosis, the number of chromosomes is reduced (become half) in the new cells i.e. in the gametes. So gametes contain single set of chromosomes. Your answer is not correct. Read the frame 138 for the correct alternative.

Your answer is haploid. Very good. It is the correct answer. Gamete contains single set of chromosomes. The cells which contain single set of chromosomes are known as haploid cells.

Now go for the new content which is given in the next frame.

Now you know that gametes are haploid cells which contain single set of chromosomes. There are two types of gametes, male and female gametes. Both these are haploid and each of them contain a single set of chromosomes. Fusion between these male and female gamete is called fertilization. So fertilization is the fusion between _______ and _______.
As a result of fusion between a male and female gamete, a single new cell is produced, which is called Zygote. Fertilization results into formation of a cell called

A single Zygote is produced as a result of fusion between a male and a female gamete. We know that each of the gametes contains a single set of chromosomes. But a zygote is produced as a result of fusion of male and female gametes. So zygote contains ______ sets of chromosomes.

Zygote contains double sets of chromosomes. Out of these double sets of chromosomes, one set is received from male gamete and other from female gamete. You know that the cell which contains double sets of chromosomes is called diploid cell. So zygote is a _______ cell.

Observe the fig. No. 1, which is given in this frame. It has drawn a fusion between a male and a female gamete. In this fig. each of the male and female gamete contain two chromosomes in its nucleus. After their fusion, a single zygote is produced which contains 4 number of chromosomes in its nucleus. Out of these 4 chromosomes in the nucleus of zygote, 2 chromosome are from male and 2 from female gamete. So chromosomes number in the zygote is ______ than the gamete.
Fusion of gamete can be of three different types namely isogamous, anisogamous and oogamous. These isogamous anisogamous and oogamous are three different types of

There are three types of fusion, namely, isogamous, anisogamous and ________________.

The classification is based on the size and motility of gametes. Usually male gametes are smaller than the female gamete and male gametes are motile i.e. having flagella. What are the characteristic features on which classification of fusion has been made?

The fusion which takes place between two motile male and female gametes those are similar in size and shape is called Isogamous. So isogamous is the fusion which takes place between two male and female gamete those are similar in size and both are

The gametes those have flagella are motile in nature and those which have no flagella are non-motile. So gametes with flagella are __________ in nature

Isogamous is that fusion which takes place between two male and female gamete those are __________ in size and __________ in nature.
Male and female gametes may be dissimilar in their size also. When a fusion takes place between a smaller male gamete with a larger female gamete but both are motile, it is called Anisogamous. So anisogamous is the fusion which takes place between a larger ___________________ female gamete with a smaller ___________________ male gamete but both are motile.

In anisogamous both the gametes are dissimilar in their size (male is smaller than the female gamete) but both the gametes are ____________________.

Gamete may be non-motile also. When there is a fusion between a motile and smaller male gamete with a non-motile and a larger female gamete that is called Oogamous. Oogamous is the fusion that takes place between a ___________________ female gamete which is larger than a ___________________ male gamete which is smaller.

In oogamous fusion female gametes are ___________________ than the male gamete. In this fusion female gametes are ___________________ whereas male gametes are motile.

So now you are able to define isogamous, anisogamous, and oogamous. You know their characteristics also. In this frame three diagrams are given namely a, b, and c. These three figures represent three different types of fusions. Which is the fig. that represents oogamous
Observe the Fig. No. 3 which is given in the above frame.

It is a fusion between two similar sizes of male and female gametes. Both the gametes are motile also.

What type of fusion it is?

Observe the Fig. No. 4 given in the frame No. 157. It is a fusion between a smaller male gamete with a larger female gamete but both the gametes are motile in nature.

What type of fusion it is?

Summary can be made from the preceding frames that the transmission of characters (inheritance) takes place through the reproductive units called gametes. There are two types of gametes, male and female which are produced in the respective reproductive organs. Gametes are produced from reproductive cells which are diploid in nature. These reproductive cells undergo meiosis (reduction cell division) and the number of chromosomes is reduced in the new cells i.e. in the gametes. These gametes are haploid in nature.

(No response required)
The cells which contain double sets of chromosomes are called diploid cells. Reproductive and body cells are diploid. The cells which contain single set of chromosomes are called haploid cells. Gamete is the haploid cell.

(No response required)

During reproduction, these male and female gametes fuse together and a new cell is produced which is called zygote. Zygote is the first cell of a new life which is diploid in nature. There are three types of fusion, isogamous, anisogamous and oogamous. This classification is based on the size and motility of male and female gamete.

(No response required)

Zygote is the first cell of a new life. All the offsprings start their life from a zygote which is a product of fusion between a male and a female gamete. These male and female gametes transmit the characters to their offsprings (zygote is the first cell of a new offspring) from male and female parents and this is why offsprings resemble with their parents. So gamete is the unit which transmits characters from parents to offsprings.

(No response required)
Preceding frames have explained the function of gametes, different types of gametes, characteristic features of gametes, distinction between a haploid and a diploid cell and distinction among three types of fusion etc. Now in the following frames we will discuss in detail the structure of gamete (internal) and its function in terms of chromosomes and genes.

Gametes are produced from reproductive cells which are diploid in nature. Main parts of a diploid cell are the cell wall, cytoplasm and nucleus. Here we shall concentrate on the part of the cell i.e. nucleus. Nucleus is the central body of a cell. Observe the Fig. 5 given in this frame. It represents a diploid plant cell. It consists of three main parts in its structure. These are cell wall, cytoplasm and nucleus. Which part of the cell contains these elongated thread like bodies known as chromosomes?

So, nucleus is the central part of a cell. This nucleus again contains a number of elongated thread like bodies known as chromosomes. Which part of the cell contains these elongated thread like bodies?
A number of elongated thread like bodies are found in the nucleus. These are called chromosomes. Nucleus contains a number of elongated thread like bodies called chromosomes.

Observe the Fig. 6 given in this frame. It is a diagram of cell (Plant). Three different parts are shown with the indication a, b, c, and d. Out of these a, b, c and d, which one indicates the chromosomes? Chromosomes are the elongated thread like bodies found in the nucleus. So chromosomes are located in the central part of the cell which is called chromosomes.

Nucleus contains a number of elongated thread like bodies in its body which are called chromosomes.

The number of chromosomes those are located in the nucleus are definite (fixed) for each species. Each species has number of chromosomes.

The number of chromosomes for each species are definite or fixed. For example, in one species of wheat, chromosomes number is 14. This number of chromosomes is same for all the cells of wheat plants of that species. That means all the nuclei of this species of wheat have chromosomes.
But different species have different number of chromosomes in their nuclei. The chromosomes number for a particular species of wheat plant will be different from that of other species of bean plant or sunflower plant and so on. It means chromosomes number are \[\text{different} \] for different species.

So nucleus contains a number of chromosomes in its body. This number of chromosomes is fixed for each species, i.e. different species have different number of chromosomes. For example, each human body cell and reproductive cell contains 46 chromosomes in its nucleus. Chromosomes number are \[\text{different} \] for a particular species and different species have \[\text{different} \] number of chromosomes.

Number of chromosomes for different species are different and definite for a particular species. For example, chromosomes number of gram cells, wheat cells, rice cells are different from each other. But chromosomes number are same for the same species. So chromosomes number of wheat cells are \[\text{same} \] for all wheat plant of the same species.

During gamete formation, reproductive cells undergo meiosis and as a result of meiosis, chromosomes number in the gametes become half than the reproductive cells. If chromosomes number of wheat cells are 14, what will be the chromosomes number of the gamete of wheat plant.
Number of chromosomes in the nucleus of gametes are always _______ than the number of chromosomes of a reproductive cells (diploid) of that species.

In this Fig. 7, there is a diploid reproductive cell containing 4 chromosomes in its nucleus. This diploid reproductive cell undergoes meiosis and produces 4 haploid gametes. Each of these gametes contains chromosomes in its nucleus _______ half than the reproductive cell.

So gametes contain half the number of chromosomes than the reproductive cells. Again these chromosomes contain a number of hereditary units known as genes. So genes are the hereditary units located on the body of.

Chromosomes are the elongated thread like bodies contained by the nucleus and these chromosomes contain hereditary units called _______ in its body.

According to Johansen, genes are the elementary units of inheritance which can be assigned for a particular character. What is the elementary unit of inheritance which can be assigned for a particular character?
Inheritance: What is the definition of genes given by Johansen?

According to the principles of heredity, genes are the elementary unit of inheritance which can be assigned for a particular character. Each of these genes is the unit which is transmitted from parents to offspring. Again, these genes contain nuclei, chromosomes and genes in their body. So chromosomes are also transmitted from parents to offspring through gametes.

Gametes are the unit through which the characters are transmitted from parents to offspring. Chromosomes and genes are located in the nucleus of gametae. So chromosomes and genes are also transmitted from parents to offspring.

An organism is the sum total of characters. Each of these characters functions as a unit for the total organism. For example, the human body consists of a number of characters like size, shape and colour of face, ears, eyes, head, nose, lips, teeth, chin, limbs etc. All these characters represent as unit for the total organism. Each of these characters is known as unit character. So here "colour of eyes" is a character and acts as a unit for the total body.
Each of the character for the total organism (plant or animal) functions as a unit. "Height of the plant", "colour of flower" are two __________ for the total plant.

"Shape of the leaves", colour of seeds, shape of the fruits, etc. are __________ unit characters for the total plant those act as three different units for the total plant.

According to the principles of heredity, each of the unit characters is determined by a pair of genes known as paired factors. Here "colour of flower" is a unit character which is determined by a pair of __________ and also known as paired factors.

"Height of the plant" is another unit character of a plant. This character is also determined by a __________ of genes which is known as _________.

What is paired factors?

Each pair of genes which determines the character is located on a pair of chromosomes known as Homologous chromosomes. So, the pair of genes which determines the character height of plant' is also located on a pair of chromosomes known as _________.
The pair of genes which determines a character is known as 'paired factor'. This pair of genes is located on a pair of homologous chromosomes which are known as homologous chromosomes. Each character is determined by a pair of genes. Where is this pair located?

Homologous chromosomes are found only in the diploid cells. Diploid cells contain double set of chromosomes. This double set of chromosomes make pairs known as homologous chromosomes.

Homologous chromosomes are found only in diploid cells only. Diploid chromosomes of a homologous pair are similar in their size and shape. Homologous pairs are made by two chromosomes which are of the same size and shape.
Similar Both the chromosomes of a Homologous pair are always similar in_____________ and ____________.

Size, shape During reproduction, when reproductive cells undergo reduction division, the homologous pair of chromosomes in the reproductive cells separate from each other and single chromosome from a pair goes to a gamete. So gamete contains a ______________ chromosome of a homologous pair of chromosomes.

Single During reduction division, chromosomes of a homologous pair separate from each other and go to different gametes. So single chromosome of a homologous pair is contained by each ____________________.

Gamete Gametes contain single chromosomes of a homologous pair. During fertilization male and female gametes fuse together and form a single cell called zygote. So the zygote contains homologous chromosomes in its nucleus, is one chromosome from male and other is from female parent. Zygote contains ______________ pair of chromosomes.

Homologous What type of cell contains homologous pair of chromosomes?
(a) Gamete (b) Zygote
(select the correct response)
In the preceding frames it has been discussed that each unit character is determined by a pair of genes, which is located on a homologous pair of chromosomes. Gamete contains only one chromosome of this pair and ultimately a single gene from a pair which determines a character. So in the gamete, characters cannot be expressed because gamete does not contain a pair of genes for a character but a single gene of a pair. Characters are expressed in plants and animals which contain diploid cells and not in the gametes.

(No response required)

A pair of genes which determines a unit character may be similar or different in nature. When both the genes are similar in nature then it is called homozygous pair of genes. Hence genes will be denoted by alphabets. For example "tallness" is a character which is determined by a pair of genes which are similar in nature i.e. TT, such pair of genes is known as pair of genes.

The character which is determined by a pair of homozygous genes is called homozygous character. Homozygous character is determined by a pair of genes.

For example "red flower colour" is a character determined by homozygous RR i.e. both the genes are similar. So it is a character and this pair of genes is known as pair of genes.
Homozygous, "Dearness" is another character of a plant. If this character is determined by a pair of genes which is denoted by 'tt' i.e. similar pair of genes. What type of character it is?

(209) Homozygous A character may be determined by dissimilar pair of genes - Such pair of genes is called Heterozygous pair of genes. When "red colour" is denoted by "Rw" i.e. both the genes of this pair are not similar, one is 'R' and other is 'W', so this is a _______________ pair of gene.

(210) Heterozygous Genes of a heterozygous pair are _____________ from each other.

(211) Dissimilar When tallness is a character which is determined by a dissimilar pair of genes i.e. Tt, so it is a _______________ pair of genes.

(212) Heterozygous Characters those are determined by heterozygous pair of genes are called heterozygous characters. If "redness" is determined by Rw, tallness by Tt, etc. These are _______________ characters.

(213) Heterozygous Similar pair of genes are called homozygous pair of genes and characters are homozygous characters. Whereas dissimilar pair of genes and characters are heterozygous characters. If tallness is determined by Tt, tallness is a _______________ character.
tallness is determined by Tt and redness by RR, then

Heterozygous, Homozygous

When "black colour" of guineapig is determined by a
pair of genes which are dissimilar i.e. Bb, what type
of character it is?

Heterozygous

When "yellow colour of seed", is determined by YY i.e.
similar pair of genes. This is a __________ character.

Homozygous

Now we can summarize the above Arenes in this way that
although gamete is the unit which is transmitted from
parent to offsprings yet it is not the smallest unit
which determines a character. There are the smallest
units (chromosomes and genes) than the gametes which
determine the characters and these units are carried
through these gametes.

Genete contains a number of chromosomes in its body
like other diploid cells (but this number is half
in a
the number of chromosomes/diploid reproductive cells).
Again these chromosomes contain a number of smallest
units called genes. These genes are the smallest
units which determine the characters.

(No response required)
A pair of genes determines a character which is also called paired factors. This pair of genes, located on a pair of homologous chromosomes. Again, this pair of genes may be homozygous, i.e. similar in nature or heterozygous i.e. dissimilar in nature. Thus there are two types of characters. Homozygous and heterozygous characters.

(No response required)

Now in the following frames we shall discuss the nature of these characters in relation to their external appearance and rule of their external expression.

(No response required)

In the preceding frames it has been explained that a character may be determined by a homozygous pair of genes or a heterozygous pair of genes. When a character is determined by a homozygous pair of genes that character is called homozygous character. This homozygous character is also known as pure character. When the "white colour of flower" is determined by a homozygous pair of genes i.e. \( vv \). This is a homozygous character which is also known as _pure_ character.

(No response required)

Homozygous characters are also called pure characters. Homozygous characters are determined by similar pair of genes. So, pure character is determined by _pair of genes._
<table>
<thead>
<tr>
<th>Homozygous (Similar)</th>
<th>Pure character is also called homozygous character which is determined by a pair of homozygous genes.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>When a character is determined by a heterozygous pair of genes then it is called heterozygous character. This heterozygous character is also known as hybrid character. When &quot;tallness&quot; is determined by a heterozygous pair of genes i.e. Tt. This is a heterozygous character which is also known as hybrid character.</td>
</tr>
<tr>
<td>Hybrid Character</td>
<td>Heterozygous characters are also called hybrid characters which are determined by a dissimilar pair of genes (heterozygous pair of genes). Hybrid characters are determined by _______ pair of genes.</td>
</tr>
<tr>
<td>Heterozygous (dissimilar)</td>
<td>&quot;Whiteness&quot; and 'dwarfness' are two characters of a plant. &quot;Whiteness&quot; is determined by 'ww' (homozygous) and dwarfness is determined by another pair of homozygous genes i.e. tt. These whiteness and dwarfness are two examples of hybrid character which is determined by a pair of heterozygous genes.</td>
</tr>
<tr>
<td></td>
<td>(a) Pure Characters</td>
</tr>
<tr>
<td></td>
<td>(b) Hybrid Characters</td>
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</tbody>
</table>
When 'Tallness' is determined by Tt, that means a dissimilar pair of genes. 'Redness' is determined by RW, i.e. another dissimilar pair of genes. Here these "tallness" and "redness" are two:

(a) Pure characters
(b) Hybrid characters

(Select the correct response)

So it is found that each character has an external expression which is determined by a pair of genes. For example "tallness", "dwarfness", "redness", whiteness", round seed", "wrinkle seed", etc. These are the features which are externally expressed. These external appearance of an organism (plants and animals) with regard to one or more characters is called its phenotype. A plant is 'tall' with 'red flower'. Here "tallness" and "redness" are two characters of this plant which are externally expressed. 'Redness' and tallness are the ________ of these two characters.

A pea plant which is 'tall' with "red flowers". Here 'tallness' and "red colour" are two characters. Both these characters are externally observed. External appearance of these two characters (tall & red) are called ________ of the characters.

Phenotype is the ________ of an organism (plant or animal) with regard to one or more characters.
External appearance of an organism (animal or plant) with regard to one or more characters is called phenotype.

The character is determined by a pair of genes, and the nature of this gene pair determines the external appearance. For example; "Height" is a character. It may be 'tall' or 'dwarf.' These are the phenotype of characters i.e. external expression of characters. But these phenotypes depend on the pair of genes. When "height" is determined by TT, then it's phenotype is tall. When 'tt' then it is dwarf. This genetic make up or constitution of organism or plant regarding one or more characters is known as Genotype.

(no response required)

A plant is tall. Tallness, a character which is determined by a pair of genes. We know that characters those are externally observed, each of these characters is determined by a pair of genes. This genetic make up or constitution of characters is called genotype.

'Tallness' is the external appearance which is determined by a pair of genes i.e. TT. This TT is the \( \text{phenotype} \) of the character 'tallness.'
A plant is 'dwarf' with 'white flower'. Here 'dwarfness' and 'white colour' are two characters which are externally observed. But the character 'dwarfness' is determined by another pair of genes (ww).

So 'tt' and 'ww' are two ___________ of the two phenotype of characters i.e. dwarfness and whiteness.

A plant may be tall or dwarf. It depends upon the nature of genotype of the characters. When the character 'height' is determined by TT, then it gives 'tall' external appearance. Whereas the same character (height) is also determined by another pair of genes i.e. tt, but it gives 'dwarf' external appearance.

It means external appearance i.e. tallness and dwarfness depends on the genotype of the character i.e. TT and tt.

So phenotype of the character depends upon ___________ of the character.

When "colour of flower" is determined by "RR" then it gives red phenotype. When it is determined by "ww" then the phenotype is white. It means Phenotype of characters depends upon their genotype.

'Colour of flower' which is external appearance of the plant depends upon genetic constitution or make up which is known as ___________
"Height of pea plant" is a character. Height may be tall or dwarf. Both the types of pea plants are observed. But whether plant will be tall or dwarf it depends on the pair of genes. If this pair of genes are TT, then it will show tallness when pair of genes are tt, then it will show dwarfness. Tallness and dwarfness depends upon the genotype. Genotype determines the of characters.

Whether a plant will be tall or dwarf i.e. "Height" of the plant depends upon the genotype of the character. "Colour of the flower" also depends upon the genotype of the character. What determines the phenotype of characters?

Characters may be homozygous or heterozygous. Tallness is a character. This tallness may be determined by a homozygous pair of genes or heterozygous pair of gene i.e. TT or Tt. TT is a homozygous pair and Tt is a heterozygous pair. But both (TT and Tt) the genotype give the same phenotype i.e. tallness.

Different genotypes may give the same phenotype. These two genotypes i.e. TT and Tt have same i.e. tallness is observed.
Redness is determined by a homozygous pair of genes i.e. RR. Redness is also determined by a heterozygous pair of genes i.e. Rw. Both these genetic make up (genotype) i.e. FR and Rw give the same external appearance (phenotype) which is Redness. So different \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ may give the same phenotype.

A character may be determined by homozygous pair of genes or heterozygous pair of genes. For example tallness is a character which can be determined by "TT" (homozygous) or Tt(heterozygous) genotypes. Both the genotypes give the same phenotype i.e. tallness. So, different \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ may have the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_phenotype.

One of the question is that how heterozygous characters are formed. Heterozygous characters are determined by dissimilar pairs of genes. Heterozygous characters are formed from a cross between male and female organism those are genetically different.

For example, a cross (Fig.8) between a male tall plant with a female dwarf plant, tallness is determined by a homozygous pair of genes (TT) and dwarfness by the another homozygous pair of genes ('tt'). TT pair of genes are different form tt pair of genes. Offspring of this cross will be having heterozygous characters i.e. Tt. Here the gene 'T' comes from male plant and 't' from female plant. Heterozygous characters are formed when there is a cross between two different organisms.
In a cross (Fig:9) between a male Red flowered plant with a female white flowered plant, if 'red' is determined by RR and white by ww. Then they are genetically different.

\[
\begin{array}{c}
\text{(male)} \quad \text{RR} \\
\text{male gamete}
\end{array}
\quad x
\quad
\begin{array}{c}
\text{(female)} \quad \text{ww} \\
\text{female gamete}
\end{array}
\quad
\begin{array}{c}
\text{offspring: } \quad \text{Rw (heterozygous red)}
\end{array}
\]

In the offsprings, one gene (R) comes from male and the other gene (w) from female plant. The gene 'R' is different from the gene 'w'. Here offsprings are having characters and their genotype is Rw.

Heterozygous character is determined by dissimilar pair of genes. Heterozygous character has two different types of genes. Now the question is that out of these two different genes of a heterozygous character which one will be expressed phenotypically?

In a heterozygous pair of genes, the gene which can express its character externally over the other gene is called dominant gene and the expressed character is called dominant character.

(No response required)
Consider a cross between a male homozygous (pure) tall (TT) with a female homozygous dwarf plant (tt). The Fig-10 is showing the cross:

Offsprings in such case are having one gene for tallness and other for dwarfness. But offsprings are all tall. It means tall character can express over the dwarfness and dwarf character remains suppressed. The characters, those are expressed over the others are called dominant characters.

Out of these two characters, dwarfness and tallness which one is dominant character?

(a) tallness  (b) dwarfness

(The character which cannot express its phenotype in the presence of other character is called recessive character.)
A cross (Fig. 11) between a Pure red (PR) and a pure white (ww) flowered plant. During gametes formation, Red flowered plant will produce single type of gametes containing a single Red gene i.e. R and white flowered plant will produce gametes containing single white gene (w). After fusion between these two gametes Offsprings will be all Red in colour (although they have both the type of gene, one for Red colour and other for white. In the offsprings only the Red character is expressed over the white character. So, here Red is a __________ character which can express over the white character and white is a __________ character which can not express in presence of red gene.

It is a general rule that the genotypes of dominant characters are denoted by Capital Letters and recessive characters are denoted by small letters. For example: tallness, redness, are two dominant characters. Tallness is denoted by TT (Capital) and redness is denoted by RR. Whereas whiteness is denoted by "ww" (small letters) and dwarfness by "tt" (small letters) which are two recessive characters. 

(No response required)
Genotypes of dominant characters are denoted by ______ letters and genotype of recessive characters are denoted by ______ letters.

Genotype of Black colour of eyes are denoted by BB, and genotype of "Brown colour of eyes" are denoted by 'bb'. Out of these two character (Black colour and brown colour) which one is the dominant character?

In the preceding frames it has been explained that out of two contrasting factors (heterozygous pair of genes) only one gene can express itself in an organism, the expressed factor (genes) is known as dominant gene, while the other gene, which one cannot express its phenotype in presence of the dominant gene is termed as Recessive gene. This principle is known as Principle of complete dominance. A heterozygous tall plant is determined by Tt i.e. which has two contrasting factors (one from tall plant and other from dwarf plant), but only one gene (factor) can express itself in the offsprings, the other gene remains unexpressed. This phenomenon is known as the principle of ______ dominance.

We know that a heterozygous character is determined by a pair of dissimilar genes. Out of these dissimilar genes, only one can express its character and the other one remains unexpressed. The character which can

...
expresses over the other is known as dominant character and the other character is known as recessive character.

This phenomenon of complete expression at heterozygous stage is called principle of complete dominance.

So according to this principle, the character which can express over the other is known as _______.

character and the unexpressed character is known as recessive___________________.

---

"Colour of Seed" is a character which is determined by a pair of heterozygous genes i.e. Yg. Out of this pair of genes, only yellow colour of seed can be expressed and green colour of seed will remain unexpressed in the presence of yellow colour. So, out of yellow and green characters, ________ is the dominant character and __________ is the recessive character.

---

Yellow, Green Complete domination of one character over the other is called complete dominance. Here yellow colour completely dominates over the green colour. So it is an example of __________ dominance.

---

Out of two dissimilar genes (heterozygous) Complete for a character, character of one type of gene is externally expressed and the character of other gene remains suppressed or unexpressed.

This phenomenon of expression of dominant gene over the expression of other gene is known as ____________________________.
When a tall plant is crossed with a dwarf plant, resultant offsprings of this cross have both the types of genes (Tt), one from the tall plant i.e. 'T' and other from the dwarf plant i.e. 't'. Offsprings of this cross will express tall character only. It means tall character is completely dominating over the dwarf character. When one character completely dominates over the other character that is called _______ dominance of the character.

Complete What is the principle of complete dominance?

The phenomenon of complete dominance is observed when the organism has heterozygous character. For example, in a heterozygous pea plant, tallness(T) is completely dominated over dwarfness(t), Redness(R) of flower completely dominates over whiteness(w), Yellow seed(y) completely dominates over green seeds(y), Smooth seed(s) completely dominates over wrinkled seed(s) etc. Here these tallness, Redness, Yellowness and smoothness of seeds etc. these are the _______ characters and whiteness, dwarfness, green seed and wrinkled seed are the Recessive characters.

The Characters, Tallness, Redness, Yellow seed colour and smooth seed etc. completely _______ over the dwarfness, whiteness, green seeds and wrinkled seeds.
Principle of complete dominance is common, but it is not universal. There are exceptions where this principle of complete dominance is not followed. When a heterozygous character instead of giving phenotype of the dominant character, gives an intermediate expression of the two contrasting characters, it is called incomplete dominance.

For example, a cross between two varieties of *Mirabilis jalapa* (8 O'clock flowers), one variety is with red flowers and the other variety with white flowers. Offsprings of this cross will be all with pink flowers. This pink colour of flower is an intermediate expression of the parental two colours (Red & white). When both the genes of a heterozygous character express into an intermediate character, it is called incomplete dominance.

Incomplete dominance is that dominance which gives an intermediate phenotype of the two dissimilar genes of a character.

Incomplete dominance is also found in animals. Incomplete dominance which is observed in animals is called MOSAIC INHERITANCE. When a red-haired and a white-haired varieties of short horned cattle are crossed, the offsprings of this cross are roan in colour which is an intermediate colour due to mixing of red and white hairs. This is an incomplete dominance which is observed in animals. Incomplete dominance which is observed in animals is called MOSAIC INHERITANCE.
Incomplete dominance which is observed in the animals is called Mosaic inheritance. Now we can conclude the preceding frames in this way that the Principle of dominance is one of the important principles of heredity. But this principle is not universally applicable for all the plants and animals. There are some exceptions of this principle also. According to this principle, when there is a cross between two contrasting (alternative) characters, only one character can express over the other at F₁ generation and the other character remains unexpressed. This complete expression of one character over the other character is called complete dominance. But there are exceptions also. Sometimes there are some characters of plants and animals which do not follow this complete dominance. Instead of this complete dominance it expresses into an intermediate form of the both parental characters. This is known as incomplete dominance. Incomplete dominance which is observed in animals is known as Mosaic inheritance. If a cross between two varieties of dog flowered plants, one is with white flowers and other is with red flowers. At F₁ Generation all the offsprings are with pink flowers i.e. neither red nor white. This expression of pink colour i.e. in the form of an intermediate character
at F_1 generation is known as -
(a) Complete dominance ...... go to frame : 268
(b) Incomplete dominance ...... go to frame: 266
(c) Mosaic inheritance ...... go to frame: 270

If your answer is Mosaic inheritance it is not the correct answer. You might not have read the frame carefully. Mosaic inheritance is the incomplete dominance which is observed in the animals only. But the example, which is given in the frame 267 that is not an example of animal cross but a cross between two plants. So it is not an example of mosaic inheritance at all. You please go to the original frame 267 and read it carefully for the correct alternative.

Your answer is incomplete dominance. Very good. Your answer is correct. Well done. Incomplete dominance is that dominance when out of two contrasting factors no one completely dominates over the other in the organism but expressed into an intermediate character of the two extreme factors.

... The example which is given in frame 264, the cross is between a red and a white coloured flowering plant. White and red colour are two extreme characters which are determined by different factors (genes). Red by RR and white by ww. In the offsprings, one factor (gene) comes from Red (R) and other factor (gene) from white (w). So their genotype is RW and they express into pink.
colour. It means neither red character nor white character is expressed completely over the other in the organism, but an intermediate character i.e. pink colour is expressed in offsprings. So this is an incomplete dominance. Now go for the next frame.

From the preceding frames, hope now you are able to distinguish among the complete dominance, incomplete dominance and mosaic inheritance. So when there is a cross between a variety of yellow seeded plant with another variety of green seeded plant. As a result of this cross all the plants at F1 generation are yellow seeded only. The phenomenon of this expression of yellow colour of the seed over the green colour which remain unexpressed at F1 generation is known as:

(a) Incomplete dominance .... go to frame 269
(b) Complete dominance .... go to frame 271
(c) Mosaic inheritance .... go to frame 266

Your answer is complete dominance. Your answer is not correct.

Complete dominance is that phenomenon when out of two contrasting factors (heterozygous characters) only one factor can express itself in the plants or organism. The factor (gene) that can express in the organism is called dominant while the other which has not shown its effect on the organism is termed as recessive.

In that example, a cross was between a red and a white flowered plants. Red and white colour are two contrasting forms and determined by different factors. Offsprings have got one factor i.e. 'R' from red flowered plant and 'w' from white flowered plant
External appearance of this pair of genes (factors) expressed into pink in colour which is an intermediate colour between red and white. So here neither red nor white colour is completely dominating but they give an intermediate colour. So it is not a complete dominance. It would be complete dominance if it would express red colour over the white colour. But here the colour is pink which is an intermediate colour. Go to the original frame 264 and read it carefully again to make another attempt for the correct alternative.

Your answer is 'Incomplete dominance'. It is not a correct answer. You might remember that incomplete dominance is that dominance when both the characters express in an intermediate form and none of the characters completely dominates over the other character. But in the original frame (267) the example has shown that in F1 generation, which it is not an intermediate character has expressed among the offsprings but one of the parental character i.e. yellow colour. So it is not an incomplete dominance. Please go to the frame (267) and read it carefully for the correct alternative.

Your answer is Mosaic Inheritance. You are not correct. Because Mosaic Inheritance is observed only in the animals. Incomplete dominance which is observed in the animals that is called Mosaic Inheritance. But in this example, cross is between a red variety of dogflowered plant with a white
variety of dogflowered plant. Here the offsprings are neither red nor white flowered plant but expressed in an intermediate colour i.e. pink. Here none of the parental character (red or white) dominates over the other character. So this is an example of incomplete dominance which is observed in plants not in animals. It is incomplete dominance but not mosaic inheritance. Incomplete dominance which is observed in animals is called Mosaic Inheritance. Go to the original frame i.e. 264 and make another choice for the correct response.

Your answer is complete dominance. Very good. It is the correct answer. The cross which is given in the frame 267 that is between a yellow seeded plant with another variety of green seeded plant. At F₁ generation, all the offsprings are with yellow seeds. So here yellow colour completely dominates over the green colour. So it is a complete dominance. Now go for the next frame.

Now before proceeding for the next unit, we can summarise the preceding frames in these few lines. There are two types of characters, pure and hybrid. Hybrid character is determined by heterozygous pair of genes. When a character is determined by a heterozygous pair of genes, it follows a principle in expressing characters over the other. This principle is called principle of dominance. When one parental character completely dominates over the other alternative parental character which remains
unexpressed is called principle of complete dominance. But there are exceptions to this principle of complete dominance. These exceptions are known as incomplete dominance. Incomplete dominance, which is observed among animals, is known as Mosaic dominance. All these have been explained in detail in the preceding frames with the help of different examples. Now go for the next unit.

In the preceding frames you have been familiarised with the concept of heterozygous character. Heterozygous characters are also called Hybrid characters. The organisms (plants or animals) having hybrid characters (heterozygous characters) are called hybrids.

But now the question is how hybrids are formed? In the following frames we will discuss the formation of hybrids and different types of hybrids and their formation.

Here is a diagram of a cross between a tall male plant with another tall female plant. Both the male and female plants have the same genotype i.e. TT. Such fertilization between a male and female organism which are genetically same is called selfing or self-fertilization. Selfing or self-fertilization takes place between male and female organisms which are genetically
In another cross between a dwarf male and a dwarf female plant both the plants have the same genotype. Here dwarfness is determined by "tt".

This fertilization between two genetically same plants is also called selfing or ____________.

Here is a diagram where fertilization takes place between a tall plant with a dwarf plant. Tall character is determined by 'TT' and dwarf by 'tt'. This fertilization takes place between two genotypically different plants. This is called a cross. Cross is that fertilization which takes place between two genetically different plants or animals.

When a fertilization takes place between a red flowered plant and a white flowered plant where red colour is determined by 'RR' and white colour by 'ww' pair of genes (Diagram represents the same fertilization), both the male and female plants are genetically different. What is such fertilization called? (a) Selfing or self-fertilization. (b) Cross. (Select the correct response)
Fertilization between two genetically different plants or organism is called a cross. Offsprings which are resulted from a cross is called hybrids. Hybrids are produced as a result of -

(a) Selfing or self-fertilization.
(b) Cross (Select the correct response)

Cross What is a cross?

Diagram represents a cross between a tall (TT) and a dwarf plant (tt).

Offsprings produced as a result of this cross.

are called...

In the above frame, resultant offsprings of a cross between a tall (TT) and a dwarf plant (tt) are all tall. But genotype of the offsprings are different from parents. Observe the above diagram given in frame 280, what is the genotype of the offsprings?

Hybrids

'Tt' Suppose offsprings are all tall in character and have genotype 'Tt'. Out of this genotype Tt, one gene (T) is from tall plant and other (t) from dwarf plant. So this character i.e. tallness in the offsprings is a

(a) homozygous character
(b) Heterozygous character (Select a correct response)
Each Heterozygous (hybrid) character is determined by a pair of contrasting (dissimilar) genes. Out of this pair, one gene comes from female plant or animal through female gamete and the other gene comes from male animal or plant through male gamete. Both these genes are different i.e. alternate form (contrasting).

Offspring with heterozygous character can be formed only when there is a cross between two plants or animals those are different in their genotype or genetic make up.

Heterozygous characters are also known as hybrid characters. So, Hybrid characters are formed when there is cross between two plants or organisms which are different in their genetic make up. 

Heterozygous characters are known as hybrid characters. Plants or animals which contain heterozygous characters are called Hybrids. Hybrids are therefore, those plants or animals which contain characters and are produced as a result of cross.

Hybrids are the plants or animals which contain heterozygous or hybrid characters. These characters are formed when there is a cross between two plants or animals those are genetically different.
Hybrids contain heterozygous character. So hybrids are produced from a cross between the plants or animals that are different in their...

---

**Genotype**

<table>
<thead>
<tr>
<th>Hybrids</th>
<th>Now it is clear to you that, cross is the fertilization of plants or animals. Offsprings which are produced as a result of a cross are called hybrids and hybrids always contain heterozygous characters.</th>
</tr>
</thead>
<tbody>
<tr>
<td>plants</td>
<td>In the following frames we shall discuss different types of crosses and different types of hybrids.</td>
</tr>
<tr>
<td>animals</td>
<td>(No response required)</td>
</tr>
</tbody>
</table>

Based on the number of contrasting characters which are involved in a cross, these crosses have been classified into mono hybrid cross, dihybrid cross and polyhybrid cross. Hybrids are also classified into monohybrid, polyhybrids and dihybrids.

Following frames will explain them with examples.

(No response required)

---

When a cross considers only one contrasting character this cross is called monohybrid cross and hybrids those are produced from a monohybrid cross are called MONOHYBRIDS. For example, a cross between a yellow seeded plant and a green seeded plant, Here colour of the seed is a character which has two contrasting forms i.e. yellow and green.
This cross considers only one contrasting character i.e. colour of the seed. So this is a ___________cross.

(291)

Monohybrid
Another cross is between a tall and a dwarf plant. "Height of the plant" is a character which has two contrasting forms i.e. tall and dwarf. This is a monohybrid cross because, this cross considers only ________

contrasting character.

One
So, monohybrid cross involves only one contrasting character. Contrasting character means the character which has two extreme alternative forms. For example, tall and dwarf are two extreme alternatives for the character "height". So here height is a ________ character.

Contrasting
In a cross between a redflowered plant with a white flowered plant. Here red and white are two extreme alternatives of colour of flower. That means this cross involves one contrasting character. So it is a ________ cross.

(293)

Monohybrids
What is monohybrid cross?

(294)

This is the cross which considers only one contrasting character i.e. the character which has extreme two alternative forms. Hybrids produced from a Monohybrid cross (295)

are called monohybrids.

In a cross between a pure tall plant and a dwarf plant, all the hybrids are tall with Tt genotype. These hybrids are called _________.

(295)
In a cross between a "black guineapig" with a "white guineapig", the colour of skin is a character which has two extreme alternatives. All the offspring are black in colour. This cross is known as _________ and the offspring (Hybrids) are known as _______.

What are monohybrids?

In a cross between a male Red flowered plant with those are produced a female white flowered plant. Red flowered plant as a result of a Monohybrid cross. Hybrids produced in the next generation from a cross between two parental organisms is called first filial generation ($F_1$).

First filial generation is the generation which results from a cross between two parental______ or _______.

Offspring: $BB$ (Red) --- This generation which is produced from a cross between two parental plants is known as _______ generation.
This is a cross between a pure tall male parental plant with a dwarf female parental plant (Fig.). Resultant plants are all tall with Tt genotype. What is the genotype of this cross at first filial generation?

Resultant generation which is produced from a selfing between two offsprings of the first filial generation are called second filial generation. In this diagram we find that at first filial generation all offspring are tall having Tt genotype. When first filial generation (F₁) is allowed for selfing they produce both tall and dwarf plants. This generation where both tall and dwarf plants are produced is known as filial generation.

Second filial generations is the generation which is produced when second filial generation are allowed for selfing.

In the preceding few frames parental generation, first filial generation and second filial generation have been explained. So, the generation which is produced from a cross between a parental male red variety of rose with a parental female white variety of rose is called generation.
First When the first filial generation is allowed for selfing the resultant generation of this selfing is known as ________________________________

Second Second filial generation is the generation which results from selfing of the ____________ generation.

First In a cross between a tall and a dwarf plant of the parental generation, at F₁ generation all tall offsprings are produced. When these tall plants of F₁ generation are allowed for selfing these will produce the plant which forms the ____________ filial generation.

Second So first filial generation is produced from parental and second filial generation is produced from ________ filial generation.

First In this diagram, three different steps have been marked namely, a, b, c. This is a cross between a red flowered plant with a white flowered plant. All the offsprings are heterozygous red in the next generation. Now, these heterozygous red offsprings are allowed for selfing, then they produce next generation with Rr, Rw and ______ genotypes. Among these three steps which one is called second filial generation?
The above examples of fertilization represent some monohybrid crosses which considers only single contrasting characters. Besides these monohybrid crosses there are other different crosses which consider more than one contrasting characters. Based on the number of contrasting characters they can be classified into dihybrid and polyhybrid cross. Following frames will deal with those types of crosses.

(310)
The cross involving two contrasting characters is known as dihybrid cross. If a cross takes place between a "tall" pea plant with red flowers and a dwarf pea plant with "white flower". Here "height of the plant" and "colour of flowers" are two contrasting characters. Height has two extreme alternative forms i.e. tall and dwarf; "colour of flower" also has two extreme alternatives i.e. red & white colours. This cross between a tall plant with red flowers and a dwarf plant with white flowers is a

(311)
The dihybrid cross involves ______contrasting characters.

(312)
Consider a cross between a Red flowered pea plant with yellow seeds and a white flowered pea plant with green seeds. Here "colour of flowers" and "colour of seeds" are two contrasting characters. This is a dihybrid cross. The character "colour of flower", has two extreme alternatives, these are red and white. The other contrasting character colour of seed", has also two extreme alternatives. These are

... and...
Out of these two figures; one is representing monohybrid cross the other is dihybrid cross.

Fig (a) represents ___________ cross
Fig (b) represents ___________ cross

Dihybrid, So it is clear that dihybrid cross involves two contrasting characters. The hybrids those are produced from a dihybrid cross are called dihybrids. Hybrids that are produced from a cross between a tall pea plant with red flowers and a dwarf pea plant with white flowers are known as

Dihybrids From the above frames, it is clear that monohybrid cross involves one contrasting character whereas dihybrid cross considers ______ contrasting characters.

Two A cross between a yellow seeded plant with a green seeded plant. Here "colour of seed" is a character.

Another cross between a tall plant with red flowers and a dwarf plant with white flowers. Out of these
two crosses, first one considers one contrasting character and second one two contrasting characters. So the first example is an example of _______ cross and second example is an example of _______ cross.

(317) Monohybrid
Dihybrid
So the difference between a monohybrid and dihybrid cross is that monohybrid cross involves _______ contrasting character and the dihybrid cross involves _______ contrasting characters.

(318) One, What is the difference between a Monohybrid cross and two --- dihybrid cross?

(319) A Monohybrid cross considers only one contrasting character whereas a dihybrid cross considers two contrasting characters. Dihybrids are produced from a _______ cross which involves two contrasting characters.

(320) Dihybrid
Polyhybrid cross involves more than _______ contrasting characters.

(321) In a cross between a male pea plant with red & flowers and yellow seeds and a female dwarf pea plant with white flowers and green seeds. This cross involves three contrasting characters i.e. "Height"(tall and dwarf) 'colour of seed'(Yellow and green), "colour of flower"(Red & White), which type of cross it is?
Polyhybrid cross involves more than \( n \) contrasting characters.

The resultant hybrids of a polyhybrid cross are known as polyhybrids.

Resultant hybrids from a cross between a male tall pea plant with red flowers and yellow seeds with a female dwarf pea plant with white flowers and green seeds are known as \( m \) and the cross is known as \( m \).

In the above frames all the three types of crosses i.e. monohybrid, dihybrid and polyhybrid cross have been explained with few examples. The cross which involves only one contrasting character is known as monohybrid cross and the hybrids are monohybrids, the cross which involves two contrasting characters is known as dihybrid cross and the hybrids are known as dihybrids and the cross which involves more than two contrasting characters is known as polyhybrid cross and the offsprings are polyhybrids. So if there is a cross between a male pure black, short haired guineapig with a pure white, long haired guineapig. The resultant offsprings of this cross are called as:

(a) Monohybrids

(b) Dihybrids

(c) Polyhybrids
Your answer is dihybrid cross. It is not correct answer.
It seems you have not devoted much time with the previous frames and in thinking of your response. Dihybrid cross involves two contrasting pairs of characters. But the example which is given in the frame '328' that does not involve two contrasting pairs but only 'Colour of the grain' which has two contrast alternatives i.e. Reddish colour and brownish colour. So it is not a dihybrid cross. Please go to the frame 328 and read the frame carefully for the correct alternative.

Your answer is polyhybrid cross. This is not a correct response.
Polyhybrid cross is that which involves more than two pairs of contrasting characters. But the cross which is given in the frame 328 does not involve more than two contrasting characters. The cross consider only a single character i.e. "colour of the wheat" grain, which has two contrast forms i.e. Reddish colour and brownish colour. So it is not a polyhybrid cross. Please go to the frame 328 and read the frame carefully for a correct response.

Your answer is dihybrids. Very Good. This is a correct answer for the question. Dihybrids are produced from a dihybrid cross which involves two contrasting characters. In this cross which is mentioned in frame 324 that also involves two contrasting pair of characters. These are 'colour of body hair' (which has two contrast form i.e. black and white) and "length of the hair" (which also has two contrasting forms i.e. long & short). So it is a dihybrid cross and produced offsprings are dihybrids.
Now you are able to distinguish among the three types of hybrids i.e. monohybrids, dihybrids and polyhybrids. All these three hybrids are produced from the respective type of crosses i.e. Monohybrid cross, dihybrid cross and polyhybrid cross.

A cross between two varieties of wheat. One variety with reddish colour wheat grain and other is brownish colour wheat grain. A cross between these two varieties of male and female plant is known as

(a) dihybrid Cross  ...  go to frame 325  
(b) Polyhybrid cross  ...  go to frame 326  
(c) Monohybrid cross  ...  go to frame 331

Your answer is Monohybrid. This is not correct. Monohybrids are produced from a cross which considers only one contrasting character. But here "colour" (white and black contrast form) and "length and hair" (short hair and long hair are two contrast form) are two contrasting characters. So the resultant hybrids are not monohybrids.

(Go back to the original frame 324 and select another response.)

Your answer is polyhybrid. This is not the correct answer. Because polyhybrids are produced when a cross involves more than two contrasting characters. But the above cross, which is given in the frame 324 considers two contrasting characters, i.e. "colour of hair" and "length of hairs". It does not consider
more than two contrasting characters but only two. So it is not a polyhybrid cross and the hybrids are also not polyhybrids.

Go to the original frame 324 and read it carefully again and make another response for the correct alternative.

Your answer is Monohybrid cross. Very good. It is the correct response. Monohybrid cross involves only one contrasting character. The example which is given in frame 328 that also involves only one contrasting character i.e. "colour of wheat" grain which has two contrasting alternative: Reddish and brownish colour. So it is a monohybrid cross. Now go for the next content given in the next frame i.e. 332.

In the above frames, we have discussed selfing, 3 different types of crosses and their resultant offsprings (hybrids). So now you know what is hybrid and different types of hybrids and their characteristics.

The process of hybrid formation is known as hybridization.

Hybridization is the process of obtaining...

Hybrids. The process of hybrid formation is called hybridization. These hybrids may be mono, di or polyhybrids. So the process of monohybrid formation is also called...
Hybridization

Dihybrids are the hybrids which are produced from a dihybrid cross. The process of these hybrids formation is known as ________________________________ (334)

Hybridization

What is hybridization ?

Hybridization is The process of hybridization is employed to improve the process of obtaining hybrids. There is a cross between two varieties of wheat plants to improve the quality of wheat grain. This process is known as ________________________________ (335)

Hybridization

The process of hybridization is used to improve the different qualities of economic plants or animals. (Select the right response)

(a) plants only

(b) animals only

(c) Plant and animals both. (Select the right response)  (336)

Plants and animals both

In the above frames it has been mentioned that the process of hybrid formation is used to improve the quality of plants and animals, and to develop a new variety of plant and animals. So hybridization is used to improve the quality of plants and animals and also to develop a ______ variety of plant and animals. (337)

New

It is also found that on hybridization sometimes quality of the resultant hybrids are better than their parents. Such resultant hybrids are called hybrid:

______________________________ (338)
vigours and the process is of hybridization that results into such hybrids is called heterosis. So, when the resultant hybrids of a cross are better than their parents, such process of hybridization is called 

---

Heterosis

So, heterosis results into hybrids those are 

---

(340)

better than either of the parents.

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Sometimes the hybrids possess qualities better than either of the parents. Such process of hybridization is called Heterosis.

Heterosis results into those hybrids which possess qualities better than the 

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Parents

Heterosis results into hybrid vigours which are better than either of the parents.

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There is a cross between two varieties of rice plants. The resultant plants (hybrids) of this cross are with better qualities than the parental plant. Those resultant hybrids those are better than their parent are called 

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Hybrid Vigours

Hybrid vigours are observed in all types of characters like weight, size of plant, size of fruit, seeds, flowers etc. The exact reason of hybrid vigour is not known.

When a cross between two different varieties of wheat plants takes place and it produces the offsprings having larger wheat grains than either of the parents, these
vigours are called to be the result of

Heter- Hybrids vigour forms those hybrids which are in their qualities than either of the parents.

better For example, if in cross between two different species of wheat plant, the resultant hybrids of this cross show better qualities than either of the parental plants, the resultant hybrids are called to be result of ________________ and the hybrids are called ________________

In another example, if a cross between two different species of horses takes place, the resultant hybrids are taller in size and faster than either of the parental species. So these hybrids are called ________________ because they possess better qualities than either of their parents.

Heterosis results into those hybrids which are ______than either of the ______and hybrids are called hybrids vigour.

What is heterosis?

Heterosis is a process of hybrid formation which results into hybrids those are better than either of the parents.
between two genetically different plants or animals is called cross. Resultant offsprings of a cross are called hybrids and hybrids contain heterozygous characters. There are different types of crosses and hybrids. Based on the number of contrasting characters, the crosses can be classified into monohybrid cross, dihybrid cross and polyhybrid cross. Resultant hybrids of these crosses are subsequently known as monohybrids, dihybrids and polyhybrids. Total process of hybrid formation is called hybridization. This hybridization is employed to improve the quality of plants and animals. Hybrids, those are better in their qualities than either of the parents the formation of are called hybrid vigour and the process of hybrids vigour is called heterosis. Now in the following frames new content will be discussed.

In the previous frames it has been discussed that each character is determined by a pair of genes. This pair of genes may be homozygous or heterozygous in nature. These genes again are located on a pair of chromosomes known as homologous pair of chromosomes. The cells which contain homologous chromosomes are called diploid cell. Body cells and reproductive cells are called diploid cells and contain homologous pair of chromosomes. During gametes formation these reproductive cells in the reproductive organs undergo a special cell division known as reduction cell division (Meiosis). Due to this
meiosis (reduction cell division), chromosomes number in the cells resultant i.e. in the gametes become half in number i.e.
out of a homologous pair of chromosomes, only one chromosome goes to a gamete and other chromosome goes to the other gamete. Thus the chromosomes of a homologous pair separate from each other and go to separate gametes. We know that genes are located on chromosomes and a pair of genes which determine a single character are located on a pair of homologous chromosomes. So when homologous chromosomes of a pair separate from each other during gamete formation, genes of a pair are also separate from each other and go to two different gametes.

So each pair of genes which determine a single character separate from each other during gamete formation. The principle of this segregation of genes of a pair from one another during the gamete formation is known as Principle of segregation. Following frames will discuss about the principle of segregation.

(No response required)

The principle of segregation is one of the basic principles of heredity. It has maximum reliability and validity than the other principles of Heredity. This principle is also known as Mendel's first Principle of Heredity. Principle of segregation and Mendel's first Principle of heredity are the synonyms of:

(a) two different principles.
(b) the same principle (Select the right response)
The Principle of segregation is also known as Mendel's first principle of heredity. Mendel's first principle of heredity is also called the Principle of Segregation.

According to the Principle of segregation, two factors from each character segregate (separate) from each other during gamete formation and go to two different gametes.

Each character is determined by a pair of genes (factors). These two genes of a pair segregate from each other during gamete formation.

According to the principle of segregation, both the gametes of a pair for each character separate from each other during gamete formation.

According to the principle of segregation, both the factors (genes) for each character separate from each other during and go to the different gametes.

When do both the factors (genes) of a character segregate from each other?

(a) during gamete formation
(b) during fertilization.

(Select the right response)
According to the principle of Segregation, two factors, for each character _________ from each other in pure form during gamete formation.

The principle of Segregation explains that _________ factors for each character _________ from each other in pure form during gamete formation.

Pure form means, when both the factors of a character remain together they do not mix or lose their identity. So genes or factors of a character segregate in _________ form during gamete formation, but otherwise remain together in chromosomes without mixing together.

For example in a plant with red flowers, where "red colour" is determined by genes R w i.e. heterozygous paired factors. According to the principle of segregation both these genes i.e. R w will segregate from each other in pure form during gamete formation. That means the character of 'R' and 'w' will not _________ together.

So the principle of segregation is that which _________ explains that factor for each character segregates in _________ form and goes to two different gametes during gamete formation.

What is the principle of Segregation?
A pair of genes determine a character and they separate from each other during gamete formation. For example, 'RR' a pair of genes which determines a character 'colour of red flower.' This pair of genes which determines a character 'colour of red flower'. This pair of genes (RR) is located on a pair of homologous chromosomes. Diagram represents a pair of homologous chromosomes denoted by 'A' and 'a'. This pair of genes (RR) which represents the red colour of flower are located on this homologous pair of chromosomes i.e. 'Aa'; Homologous chromosomes segregate from each other during gamete formation and go to different gametes. This pair of homologous chromosomes i.e. 'Aa' also segregate from each other during gamete formation.

Diploid reproductive cells contain homologous chromosomes. This diploid reproductive cell undergoes meiosis (reduction cell division) during gamete formation. As a result of meiosis homologous chromosomes separate from each other and each gamete contains a single chromosome of a homologous pair.

A pair of genes for each character is also located on the homologous pair of chromosomes. Homologous chromosomes segregate during gamete formation. So this pair of genes which is located on a homologous pair of chromosomes is also segregate from each other during gamete formation.
Paired factors of each character segregate from each other during gamete formation. So each gamete contains a single gene of a pair. "Tallness" is a character which is determined by a pair of genes donated by "TT", During gamete formation the pair of genes i.e. 'TT' will segregate from each other and each gamete will contain ________.

(a) both the genes i.e. 'TT'
(b) single genes of a pair i.e. 'T' only.

'T'(Single 'White colour of flower' is another character of a pair plant which is determined by 'ww' Pair of genes. When they will segregate and how many genes will be contained by a single gamete?

During Character is determined by a pair of genes, but gamete contains only single gene of a pair. So character cannot be expressed in the gametes because it contains:

(a) Single gene of a pair
(b) Both the genes of a pair

(Select the right response)

Each gamete contains a single gene out of a pair of genes. A character is determined by a pair of genes. So in the gamete, characters cannot express because gamete contains a single gene of a pair.

Why characters cannot express in the gametes?
Characters are determined by a pair of genes but each gamete contains only a single gene. So they cannot express the character. Tallness, redness, are two characters. Both the characters can express in the plant body cell only i.e. in the diploid cell. Because body cells (diploid) contain both the genes for each character together in the body cells which are diploid. So, tallness which is determined by 'TT' remains together in the body cells.

(a) gamete which are haploid
(b) body cell which are diploid.

--- Select the right response ---
'Redness' which is determined by RR pair

Body cells which are diploid cells.

(a) haploid cells
(b) diploid cells

--- Select the right response ---
Paired factors (genes) for each character remain together in the reproductive diploid cells and segregate from each other during gamete formation. According to the principle of segregation, pair of genes for a character remaining together in the diploid cells without mixing the character of both the genes.

So each character is determined by a pair of genes. These genes do not _______ their character but remain together in the diploid cells.

--- Select the right response ---
If a plant is with Red flowers. 'Red colour' is determined by a Homozygous pair of genes i.e. RR. This pair of genes (RR) will remain together in the diploid cells without
When red colour is determined by a heterozygous pair of genes i.e. \( \text{Rw} \). In this pair of genes i.e. \( \text{Rw} \), one gene is for red colour i.e. \( \text{R} \) and other for white colour i.e. \( \text{w} \). According to the principle of dominance only red colour (dominant) can express, which is a dominant character over the white colour.

According to the principle of segregation both the genes of a pair remain together without mixing both of these characters i.e. red and white. So this pair of genes i.e. \( \text{Rw} \) will remain _______ without mixing their characters.

According to the principle of segregation both the factors for each character remain together in the diploid cells but they segregate from each other during gamete formation. So this pair of genes i.e. \( \text{Rw} \) will remain together in the diploid reproductive cells without mixing and segregate from each other during _______

Now it is clear that a pair of genes for each character remains together in the diploid cell without mixing the character of both the genes and segregate from each other during gamete formation.

This can be arrived at only when we consider a monohybrid cross and explain the results of this cross upto \( F_2 \) generation. Then the above conclusion can be arrived.

Following frames will consider a cross (monohybrid) and will explain the result of this cross.

(No response required)
According to the principle of segregation, both the factors (genes) of a character segregate at the time of formation of gametes. So if we consider a heterozygous character i.e. when tallness is determined by 'Tt', according to the principle of segregation, half of the gametes will carry the factor L.

In another example, where a plant with red flowers. Here 'Redness' is a character determined by a pair of heterozygous genes i.e. Rw.

According to the principle of segregation both the genes (Rw) will segregate during gamete formation and half the gametes will carry the gene 'R' and half of the gametes will carry the other gene i.e. the gene Rw.

The principle of segregation can be deduced from a monohybrid cross. Here we shall discuss one of the Mendel's original experiment. For example, a monohybrid cross involving a pure tall and a dwarf garden pea plants, the hybrids at F1 generation are all tall showing that factor for tallness is dominant over the factor for dwarveness. When the hybrids of F1 generation are allowed to self-breed, the plants in the second filial generation (F2) will be both tall and dwarf in the ratio 3:1. On further self breeding of F2 hybrids (F2xF2) it will be seen that the dwarf plant of F2 generation breeds true. But out of 3 tall plants at F2 generation only one breeds true while the other two
behave as hybrids giving the ratio of tall and dwarf as 3:1. It means out of 4 offsprings in the F₂ generation, 1 is pure tall, 2 heterozygous tall and 1 pure dwarf. This can be described only when factors for tallness and dwarfness separate from each other at the time of formation of gametes and this separation of factors of the characters from each other during gamete formation is known as principle of segregation. The above conclusion can be arrived at mathematically by taking two factors for each extreme of character, and representing them by alphabets. The dominant character (tallness) being shown in Capital letters i.e. TT and recessive (dwarfness) being shown in small letters i.e. 'tt'. The diagram is given here. Observe the diagram carefully. In the parental cross where one is pure tall and other is pure dwarf, factors for each extreme character segregate from each other during gamete formation. The factors for tall pure plant (parent) segregate from each other and produce:
(a) **Single type of gametes containing 'T' gene only**

(b) **Two types of gametes, one containing 'T' gene and other 't' gene**

(c) **Single type of gametes containing 't' gene only**

Your answer is "pure in nature". This is not correct. If you observe the diagram which is given in frame 378, you will notice that at $F_2$ generation there are three tall plants. Out of 4 offsprings three have TT,Tt,Tt genotypes. You also know that pure character is that character which is determined by a similar pair of genes. Out of these three tall plants of $F_2$ generation, only one plant is having similar pair of genes i.e. "TT". Remaining two tall plants are having 'Tt' genotypes i.e. dissimilar pairs of genes. So all the three tall plants are not pure in nature. Go to the frame 386 to read it carefully and observe the diagram given in frame 378 for the correct response.

Your answer is 'single type of gametes'. This is not correct response. In the example which is given in 378 frame, at $F_1$ generation all the plants are tall with Tt genotype. This means tall character at $F_1$ generation is hybrid in nature i.e. has one gene from tall parental plant and other from dwarf parental plant. According to the principle of segregation, during gamete formation these 'Tt' pair of genes segregate from each other and the gene 'T' go to one gamete and the gene 't' to another gamete. So they are
producing more than one types of gametes. Half of the produced 
gametes will contain the gene 'T' and other with 't' gene. 
Now go to the frame 382 and read the question carefully and 
observe the diagram which is given in frame 382 for the correct 
response.

Your answer is single type of gametes containing 'T' gene. 
Your answer is correct. Very Good. Here tall character is 
dominant over the dwarf character and is determined by a 
homozygous pair of genes which is denoted by TT and the character 
is pure in nature. That means both the factors are similar type. 
So when segregation takes place during gamete formation both the 
genes i.e. TT segregate from each other and form two gametes but 
both the gametes are same type i.e. containing 'T' gene only. 
So a pure tall plant produces only single type of gametes 
containing 'T' gene. 

Now go for the next frame where new content is given.

Observe the diagram given in this frame. This is a cross 
between a pure tall and dwarf plants. At F$_1$, all the plants are 
tall in nature which is not a pure character but heterozygous 
because both the genes for tall character at F$_1$ generation are 
a pair of dissimilar genes i.e. Tt. Now if these F$_1$ plants are allowed to 
selfing i.e. both the male and female plants have same genotype 
and i.e. Tt, during gamete formation both the genes will segregate 
from each other and go to different gametes. So each tall F$_1$
If a plant will produce:

(a) Two different types of gametes
(b) Single type of gamete
(c) More than two types of gamete

Your answer is "two types of gametes", one type of gamete containing 'T' and other type of gametes containing 't' gene. This is not a correct response. Perhaps you have not observed the diagram given in frame 378 properly or did not devote much time for the response. Pure tall character is determined by TT i.e. a pair of homozygous genes. Both these TT Segregate from each other during gamete formation. If this pair of genes there is no gene for dwarf character i.e. 't', so it can not produce any gamete containing 't' gene but all the gametes containing 'T' gene. So it cannot produce two types of gametes. Please go to the frame No.378 to read the content again and observe the diagram carefully for the correct response.
Your answer is "single type of gametes containing 't' gene".
This is not correct. It seems you have not observed the diagram carefully. Otherwise you would observe that pure tall character is determined by a pair of homozygous gene i.e. TT and tallness is a dominant character and there is no gene for dwarfness i.e. 't' gene. So this plant cannot produce any gamete to containing 't' genes. Please go to the frame 378 to read the frame carefully and observe the diagram for the correct alternative.

Your answer is 'two different types of gametes'. This is the correct answer. Very good. If you observe the diagram given in frame 382 you will find that F₁ plants are not pure but hybrid in nature i.e. here tallness is determined by Tt genotype. Here one gene is for tall character and other for dwarf character. During gamete formation these two genes separate from each other and half of the gametes contain the gene 'T' and the other half gametes containing 't'. So there are two different types of gametes out of which half contain 'T' gene and other half contain 't' gene.

Now go for the next frame.

So now you are able to state that when a character is determined by homozygous pair (pure) that will produce only one type of gametes because both the genes are of similar type. During gamete formation both the genes of a pair segregate and go to two different gametes. Observe the
diagram which is given in this frame. Where tall plants of $F_1$
generation are allowed for selfing ($F_1 \times F_1$), and at $F_2$
generation there are two types of plants. Out of four offsprings at $F_2$ generation three are tall and one is dwarf. At $F_2$ generation all the three tall plants are:

(a) Pure immature ... go to frame 379
(b) Hybrid in nature ... go to frame 388
(c) Some are pure and some are hybrid in nature... go to frame 389

Your answer is "more than two type of gametes" This is not a correct response. In the diagram given in frame 382 you will observe that all the offsprings at $F_1$ generation have 'Tt' genotype. During gamete formation these two genes (Tt) segregate from each other and go to different gametes. Half contain 'T' and others 't'. So more than two types of gametes cannot be produced. Go to the frame 382, read the content carefully, observe the diagram and find out the correct alternative.
At F2 generation, there are three tall plants but with different genotype i.e. TT, Tt and Tt. 'TT' is a pure character but the other two with 'Tt' are not pure as both the genes are not similar. So all the F2 tall plants are not hybrids in nature but 2 are hybrids in nature. Go to the frame 386 to read the frame carefully for the correct response.

Your answer is 'hybrid in nature'. This is not a correct answer. Perhaps you have not devoted much time for the response.

When F1 hybrids (Tt) are allowed for selfing (diagram is given in frame 386) then at F2 generation there are two types of generation offsprings, tall and dwarf both. Out of four offsprings at F2, 3 are tall and one is dwarf plant. The offsprings in the second filial generation (F2) will be both tall and dwarf in a certain ratio 3:1.

So when F1 tall hybrids are allowed for selfing (Tt x Tt) at F2 generation the hybrids will be tall and dwarf in a certain ratio i.e.
Observe the diagram given in frame 386. When the tall hybrids are allowed for selfing, then there will be _____ and _____ both types of plants at F₂ generation.

At F₂ generation, tall and dwarf both the types of plants will be produced in a certain ratio i.e. 3:1. When F₁ tall hybrids are allowed for selfing, out of the 4 hybrids, 3 are tall in character and one is dwarf.

(No response required)

In the same example i.e. a cross between a pure tall and a dwarf plant, at F₂ generation, tall and dwarf character will externally express in a fixed ratio i.e. 3:1.

This 3:1 ratio which is externally expressed among the offsprings is called phenotypic ratio. So phenotypic ratio at F₂ generation of the above cross is _____.

The ratio of the offsprings of a cross which is externally expressed is called _____.

Phenotypic ratio is the ratio of a cross which is _____ expressed.

If you observe the diagram which is given in frame 386, you will find that at F₂ generation there are two externally types of plants, tall and dwarf. But there are three different types of genotypes i.e. TT, Tt, tt. Out of these three different genotypes, first two will externally express into a single character i.e. tall
due to dominance but their genotypes are different. So on the basis of genotype, at $F_2$ generation this ratio is $1:2:1$ i.e. $1$ is pure tall having TT genotype and are hybrid tall i.e. Tt genotype and $1$ is dwarf having tt genotype. This is genotypic ratio. The ratio which is based on genotype is known as genotypic ratio.

The genotypic ratio is based on the ____________

What is genotypic ratio?

In a cross between a pure tall and a dwarf plant at $F_2$ generation there will be four offsprings with TT, Tt, Tt, tt genotypes. So their ____________ is $1:2:1$.

When heterozygous tall(Tt) plants are allowed for selfing (i.e. Tt x Tt), these will produce four offsprings having genotypes TT, Tt, Tt, tt. Out of these $4$ offsprings, $3$ will be tall plants and one will be dwarf. That means based on the phenotypes there are two types of offsprings i.e. tall and dwarf. But observe the genotypes of the four offsprings. There are three different genotypes i.e. TT, Tt(2) and tt. So, phenotypic ratio of the above cross is $3:1$ (three tall + one dwarf) but genotype ratio is $1:2:1$ i.e. one with TT genotype, two with Tt genotype and one with tt genotype. So, $1:2:1$ is the ____________ ratio of the above cross.
Take another example of heterozygous plants with Tt genotype. The plants on selfing will produce one RR, two Rr, and one rr plant. The physical appearance of three plants (RR & 2 Rr) will be the same i.e. they will show red flowers. Only one plant will show white flowers which means phenotype of this generation is 3:1. But the genotypic ratio is not 3:1 because two red flowered plants are hybrids. The red is pure, two hybrids and there is one white flowered plant. Therefore, genotypic ratio of this generation is 1:2:1.

So in the same cross at F₂ generation phenotypic ratio is 3:1 i.e. 3 red flowered (RR and Rr, Rr) and one is white flowered (rr) and genotypic ratio is 1:2:1 i.e. one red flowered (RR) two hybrid red (Rr) and one white (rr).

So phenotypic ratio is different from genotypic ratio.

The preceding frames have explained the principle of segregation, with examples and diagrams. They also have been explained phenotypic ratio and genotypic ratios and difference between these two ratios with examples. So now you are in a position to explain the principle of segregation which is also called Mendel's first principle of Heredity.

THANK YOU