NCERT Solutions for Class 12 Biology Chapter 4: NCERT Solutions for Class 12 Biology Chapter 4 Principles of Inheritance and Variation provide detailed explanations of fundamental genetic concepts, including Mendelian genetics, laws of inheritance, and the mechanisms of genetic variation.

These solutions cover topics such as dominant and recessive traits, genetic disorders, and the importance of genetic variation in evolution. With clear and concise answers these solutions help students strengthen their understanding of genetics ensuring they are well-prepared for exams. By practicing these solutions students can improve their problem-solving skills and gain a deeper insight into the principles of inheritance.

NCERT Solutions for Class 12 Biology Chapter 4 Overview

NCERT Solutions for Class 12 Biology Chapter 4 Principles of Inheritance and Variation explain the foundational concepts of genetics, which govern how traits are passed from one generation to the next. This chapter explores the work of Gregor Mendel and his laws of inheritance: the Law of Segregation and the Law of Independent Assortment. It also discusses dominant and recessive traits, genotypes, phenotypes, and the concept of alleles.

The chapter further examines genetic disorders like sickle cell anemia and cystic fibrosis, caused by mutations in genes. Students will learn how these genetic traits are inherited and the role of variations in organisms' genetic makeup. The chapter covers the chromosomal theory of inheritance and how the environment influences gene expression leading to the variation observed in organisms. This chapter is important for understanding how heredity works and why genetic diversity is essential for the survival and adaptation of species.

NCERT Solutions for Class 12 Biology Chapter 4 PDF

The NCERT Solutions for Class 12 Biology Chapter 4 Principles of Inheritance and Variation provide a detailed explanation of the key concepts related to inheritance and genetic variation.

You can access the PDF of NCERT Solutions for Class 12 Biology Chapter 4 below for a comprehensive study guide to help you prepare for exams and deepen your understanding of the topic.

NCERT Solutions for Class 12 Biology Chapter 4 PDF

NCERT Solutions for Class 12 Biology Chapter 4 Principles of Inheritance and Variation

Here is the NCERT Solution for Class 12 Biology Chapter 4 Principles of Inheritance and Variation:

1. Mention the advantages of selecting a pea plant for the experiment by Mendel.

Solution:

Mendel chose pea plants for his experiments because:

- Pea plants show clear, contrasting traits (e.g., tall vs. short, round vs. wrinkled seeds, yellow vs. green pods), making it easier to study inheritance patterns.
- Pea plants have bisexual flowers, allowing for self-pollination, which helps in controlling the genetic cross.
- Cross-pollination can be easily controlled through emasculation.
- They have a short life cycle, producing many seeds quickly, which facilitates the study of multiple generations.

2. Differentiate between the following.

(a) Dominance and Recessive

(b) Homozygous and Heterozygous

(c) Monohybrid and Dihybrid

Solution:

(a) **Dominance and Recessive:**

- **Dominance:** A dominant allele expresses itself in the presence of a recessive allele.
- **Recessive:** A recessive allele only expresses itself in the absence of a dominant allele.

(b) **Homozygous and Heterozygous:**

- **Homozygous:** An individual has two identical alleles for a trait (e.g., TT or tt).
- **Heterozygous:** An individual has two different alleles for a trait (e.g., Tt).

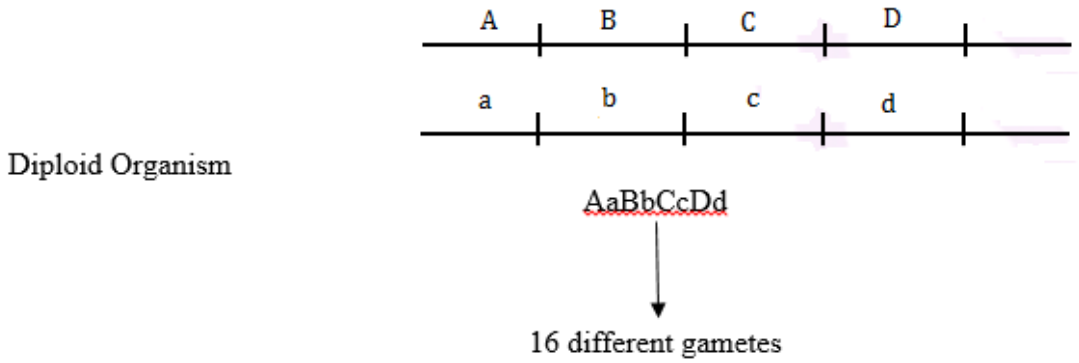
(c) **Monohybrid and Dihybrid:**

- **Monohybrid:** A cross between two organisms differing in a single trait (e.g., seed color).
- **Dihybrid:** A cross between two organisms differing in two traits (e.g., seed color and seed shape).

3. A diploid organism is heterozygous for 4 loci; how many types of gametes can be produced?

Solution:

A diploid organism heterozygous at four loci (e.g., Mm, Nn, Oo, Pp) can produce 16 different types of gametes, as each pair of alleles can produce two types of gametes (e.g., M or m for the first locus, N or n for the second, etc.).



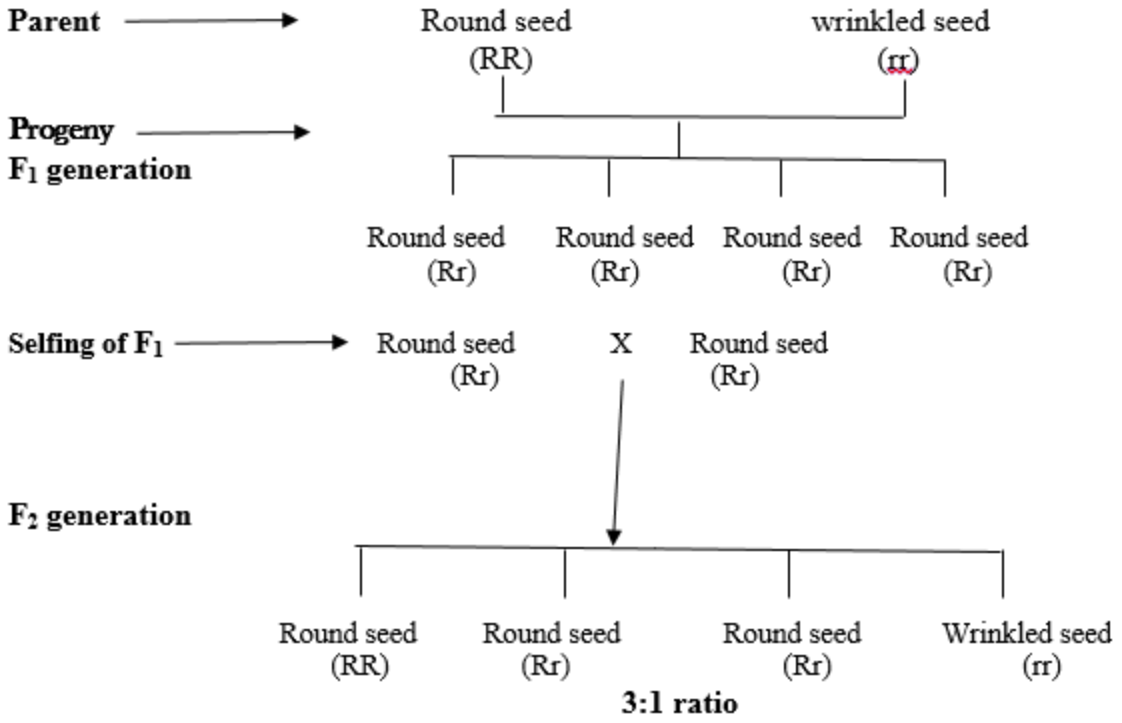
4. Explain the Law of Dominance using a monohybrid cross.

Solution:

The Law of Dominance, proposed by Mendel, states that when two different alleles for a trait are present, the dominant allele will express itself while the recessive allele will be suppressed. The recessive trait may reappear in the next generation.

Example:

In a cross between a tall plant (RR) and a short plant (rr), all offspring in the F1 generation will be tall (Rr), as the tall allele (R) is dominant.

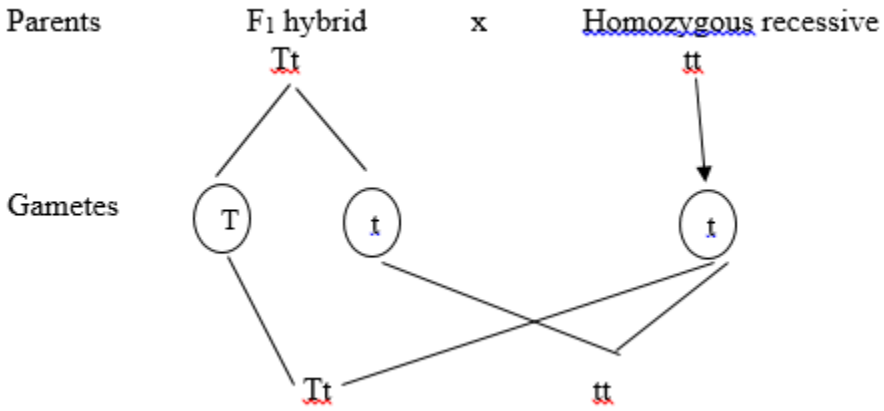


5. Define and design a test cross.

Solution:

A test cross is used to determine the genotype of an individual displaying a dominant phenotype. This is done by crossing the individual with a homozygous recessive individual.

Example:
Cross a tall (Tt) plant with a dwarf (tt) plant. If the offspring include both tall and dwarf plants, the tall parent is heterozygous (Tt). If all offspring are tall, the tall parent is homozygous (TT).

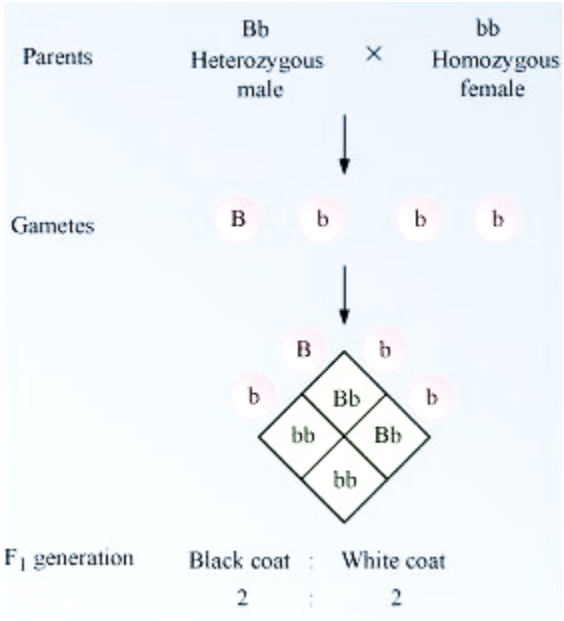


6. Using a Punnett Square, work out the distribution of phenotypic features in the first filial generation after a cross between a homozygous female and a heterozygous male for a single locus.

Solution:

In a cross between a homozygous female (bb) and a heterozygous male (Bb), using a Punnett square would show the following possible genotypes for the offspring:

50% Bb (black coat color) and 50% bb (white coat color). The phenotypic ratio will be 1:1.



7. When a cross is made between a tall plant with yellow seeds (TtYy) and a tall plant with green seeds (Ttyy), what proportions of phenotype in the offspring could be expected to be

(a) tall and green.

(b) dwarf and green.

Solution:

The phenotypic proportions for the offspring will be:

- 3 tall and green plants
- 1 dwarf and green plant

This results from the combination of different alleles for height and seed color.

Parents	Tall yellow seed plant TtYy	x	Tall green seed plant Ttyy
Gametes	TY, Ty, ty, tY		Ty, ty

	Ty	**ty**
TY	**TT Yy** **Tall yellow**	**Tt Yy** **Tall yellow**
Ty	**TT yy** **Tall green**	**Tt yy** **Tall green**
ty	**Tt yy** **Tall green**	**tt yy** **Dwarf green**
tY	**Tt Yy** **Tall yellow**	**tt Yy** **Dwarf yellow**

8. Two heterozygous parents are crossed. If the two loci are linked, what would be the distribution of phenotypic features in the F_1 generation for a dihybrid cross?

Solution:

If the genes are linked, the phenotypic distribution in the offspring will primarily reflect the parental traits. There may be fewer recombinant phenotypes compared to the expected 16 combinations due to incomplete linkage.

9. Briefly mention the contribution of T.H. Morgan to genetics.

Solution:

T.H. Morgan made several important contributions, including:

- Proving that genes are located on chromosomes.
- Discovering sex-linked inheritance.
- Studying gene linkage and recombination.
- Developing the concept of chromosome mapping.

10. What is pedigree analysis? Suggest how such an analysis can be useful.

Solution:

Pedigree analysis is the study of family history over generations to trace the inheritance of specific traits. It is useful in:

- Identifying genetic disorders and understanding inheritance patterns.
- Helping genetic counselors assess the risk of genetic diseases.
- Understanding how certain traits are passed through families.

11. How is sex determined in human beings?

Solution:

Humans have an XX/XY sex determination pattern. Female sex chromosomes are XX, while male sex chromosomes are XY. Females can only generate gametes with X chromosomes, but males can produce gametes with both X and Y chromosomes.

When a male Y chromosome-containing gamete fertilizes with a female X chromosome-containing gamete, the result is a male fetus. When a male X chromosome-containing gamete fertilizes with a female X chromosome-containing gamete, the fetus is female.

12. A child has blood group O. If the father has blood group A and the mother's blood group is B, work out the genotypes of the parents and the possible genotypes of the other offspring.

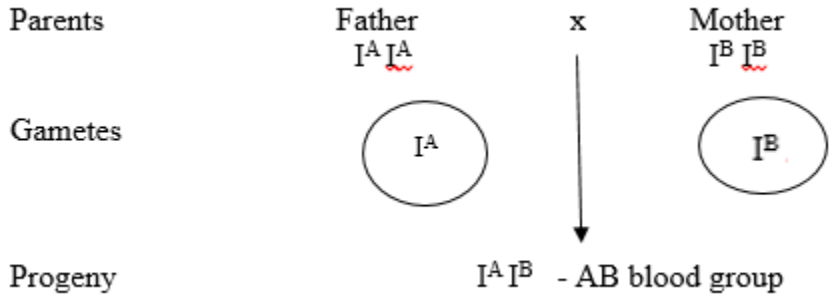
Solution:

A set of three alleles – IA, IB and i – control the blood group characteristics in humans. Where alleles IA and IB are equally dominant, and allele i is recessive to the other alleles. The table below depicts the genotypes and blood groups.

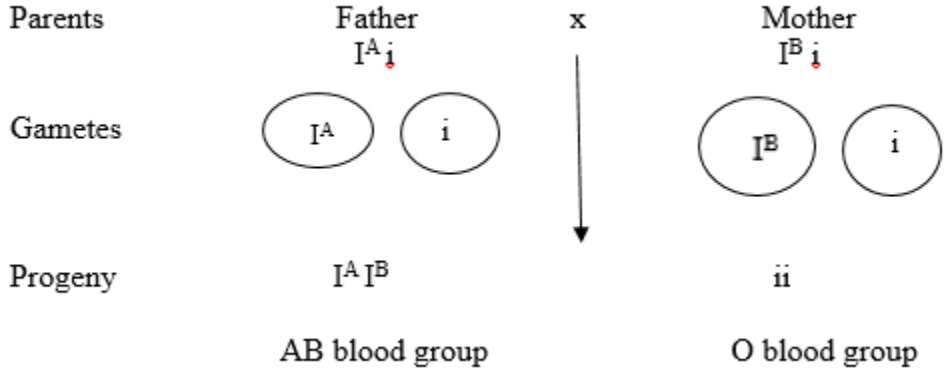
Individuals with Genotype	Blood Group They Would Possess
IA, IA, IA, i	A
IB, IB, IB, i	B
IA, IB	AB

ii O

Thus, if the father has blood group A and the mother has blood group B, then the possible genotype of the parents will be as follows:



A cross between heterozygous parents will produce progenies with AB blood group ($I^A I^B$) and O group (ii).



13. Explain the following terms with an example.

(a) Co-dominance

(b) Incomplete dominance

Solution:

Co-dominance
Co-dominance refers to the situation where both alleles in a heterozygote are fully expressed, neither being dominant over the other. Both alleles contribute equally to the phenotype.
Example: In human blood groups, the **A** and **B** alleles are co-dominant. If a person inherits the **A** allele from one parent and the **B** allele from the other, the result is **AB** blood type, where both A and B antigens are expressed on the surface of red blood cells.

Incomplete dominance
Incomplete dominance is the phenomenon where neither allele is completely dominant over the other, leading to a blending of traits in the heterozygote. In the F1 generation, the resulting phenotype is an intermediate expression of the two parental traits.
Example: In **Mirabilis jalapa** (four o'clock plant), when a red-flowered plant is crossed with a white-flowered plant, the F1 hybrid produces pink flowers, which is a blend of the red and white traits, demonstrating incomplete dominance.

14. What is point mutation? Give one example.

Solution:

Point mutation refers to a genetic mutation where there is a change in a single nucleotide base pair in the DNA sequence. This can occur due to a substitution, insertion, or deletion of a single base pair, leading to a change in the codon, which may result in a change in the protein produced. Point mutations can sometimes cause significant effects, especially if they occur in crucial regions of the gene.

Example: Sickle Cell Anaemia

Sickle cell anaemia is caused by a point mutation where a single nitrogen base, guanine, is replaced by adenine at the sixth codon of the β-globin gene. This substitution causes the amino acid glutamic acid to be replaced by valine in the hemoglobin protein. This slight change leads to the formation of sickle-shaped red blood cells instead of the normal biconcave discs. The sickle-shaped cells are less flexible and can obstruct blood flow, causing the symptoms of sickle cell anaemia, such as pain and organ damage.

15. Who proposed the chromosomal theory of inheritance?

Solution:

The chromosome theory of inheritance was proposed by Walter Sutton and Theodor Boveri in the early 20th century. They suggested that chromosomes, which carry genes, are the vehicles of inheritance and that the segregation and independent assortment of chromosomes during meiosis explain the inheritance patterns observed by Gregor Mendel.

16. Mention any two autosomal genetic disorders with their symptoms.

Solution:

Autosomal Genetic Disorders and Their Symptoms

Down's Syndrome Symptoms:

- Flat hands and short neck
- Broad forehead

- Partially open mouth with a furrowed tongue
- Mongolian-type eyelid fold and stubby fingers
- Stunted psychomotor, physical, and mental development
- Heart deformities and deformities in other organs
- Underdeveloped genitalia and gonads

Sickle Cell Anaemia Symptoms:

- The shape of red blood cells (RBCs) changes from round, biconcave discs to sickle-shaped (curved) under low oxygen tension.
- Sickle-shaped RBCs are rigid and less flexible, causing them to get stuck in small blood vessels, which can lead to pain episodes, anemia, and organ damage.
- Individuals may experience episodes of severe pain, known as "sickle cell crises."
- Increased risk of infections, fatigue, and delayed growth.

Benefits of Solving NCERT Solutions for Class 12 Biology Chapter 4

- **Conceptual Clarity**: Chapter 4 covers key concepts of genetics, such as Mendelian inheritance, genetic disorders, variations, and the molecular basis of inheritance. Solving NCERT solutions helps in understanding these complex topics in a simplified manner, making them easier to grasp.
- **Mastery Over Core Genetics Topics**: By solving the exercises, students can reinforce their understanding of Mendel's laws, Punnett squares, inheritance patterns (dominant, recessive, codominant), and genetic variations. This mastery is important for both the board exams and competitive exams like NEET.
- **Improved Problem-Solving Skills**: NCERT solutions present a variety of questions ranging from theoretical concepts to numerical problems, which helps students develop their problem-solving skills. This is especially useful for tackling problems related to genetic ratios and Punnett squares.
- **Better Exam Preparation**: Solving these solutions helps students prepare for exams by familiarizing them with the format and types of questions that are typically asked. It also provides practice with different levels of difficulty, helping students perform well in both objective and descriptive exam formats.
- **Reinforcement of Important Topics**: Regular practice with NCERT solutions ensures that students have a strong grasp of important topics like inheritance patterns, sex determination, gene mapping, and genetic disorders, which are frequently tested in exams.
- **Easy Revision**: These solutions are concise and structured, making it easier to review and revise the chapter. Students can quickly revise key points, formulas, and inheritance laws in a short period, which is especially useful during exam time.
- **Application of Theoretical Knowledge**: Solving the problems helps students apply theoretical knowledge to practical scenarios, deepening their understanding of how

inheritance works in real-life contexts, such as in genetic disorders and agricultural breeding.

- **Self-Assessment**: After solving the NCERT questions, students can evaluate their own understanding and identify areas where they need further clarification. This encourages independent learning and better retention.
- **Stronger Foundation for Future Studies**: Genetics is a fundamental topic in biology, and a strong understanding of inheritance principles is essential for students pursuing careers in medicine, genetics, biotechnology, and other related fields.
- **Builds Confidence**: Mastery over NCERT solutions boosts confidence in students, as they feel well-prepared to face the exam questions and any related discussions in future academic or professional settings.