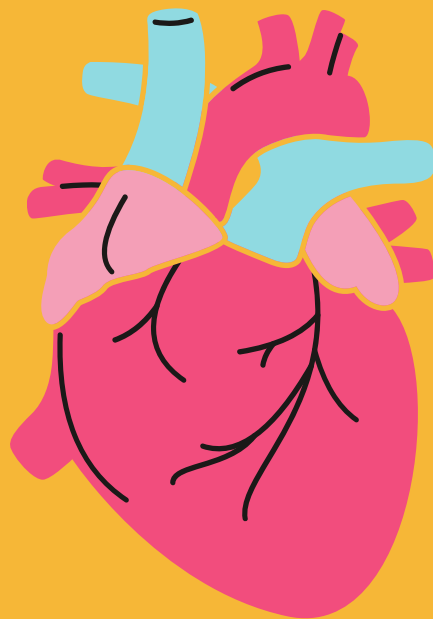
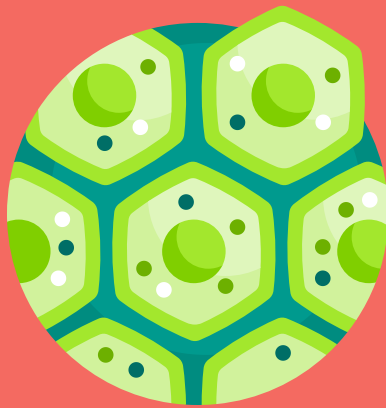
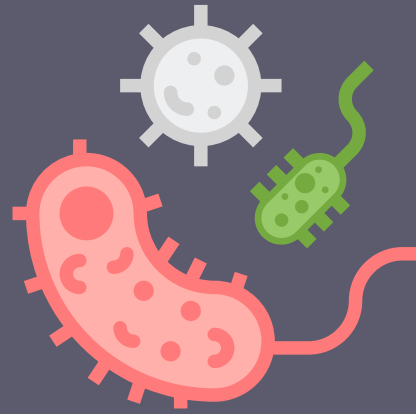




CLASS 10 NOTES

SCIENCE

Heredity and evolution

PRASHANT KIRAD

Heredity

Introduction:

- Heredity involves the transmission of characteristics from one generation to the next, as traits are passed down from parents
- Heredity is the result of genes being inherited.
- Study of Heredity and Inheritance is term Genetics
- A trait that is Genetically passed down from one generation to another is termed as Inherited trait.



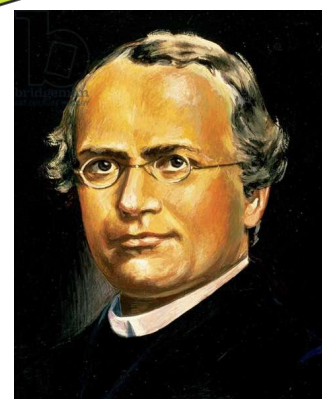
Variations -> Variations in traits among individuals in a species arise from genetic mutations and environmental factors, such as diet, chemicals, and pollution.

Inherited Traits -> Inherited traits are characteristics passed from parents to offspring through generations, controlled by genes. Examples include height and skin color.

Gregor Johann Mendel:

He is credited with establishing fundamental laws of inheritance, earning him the title "Father of Genetics" worldwide.

Exam me aayega



He chose garden peas for his experiments for the following reasons:

- Pea plants have Several Contrasting Characteristics like height, flower Colour, Seed Colour a Shape.
- Self-pollinated plant in nature.
- Cross-pollination can be done Artificially.
- Short life Span
- Easy to cultivate



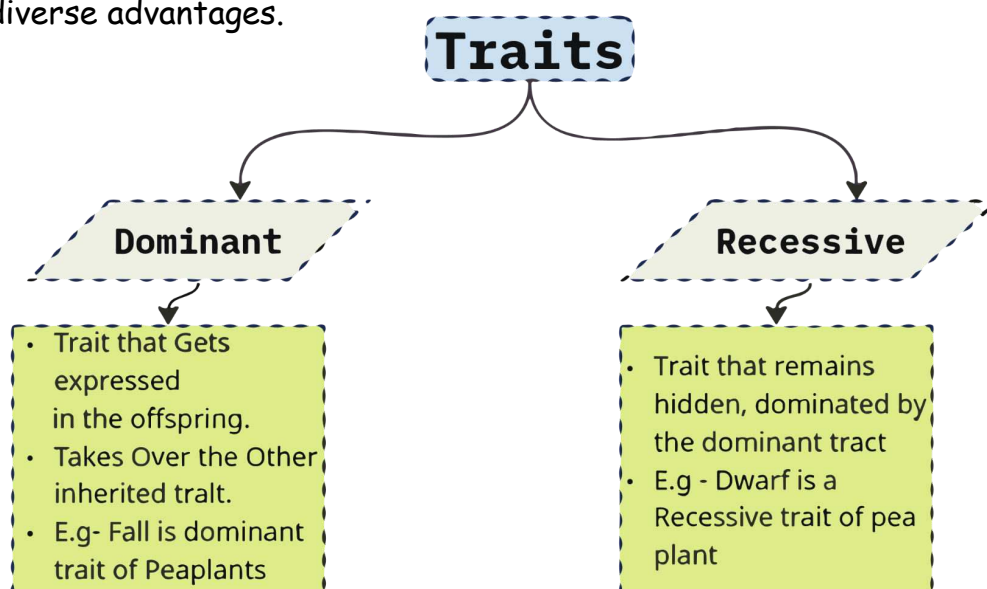
*Note: The scientific name of peas is *Pisum sativum*.*

Important Terms:

E.M.A

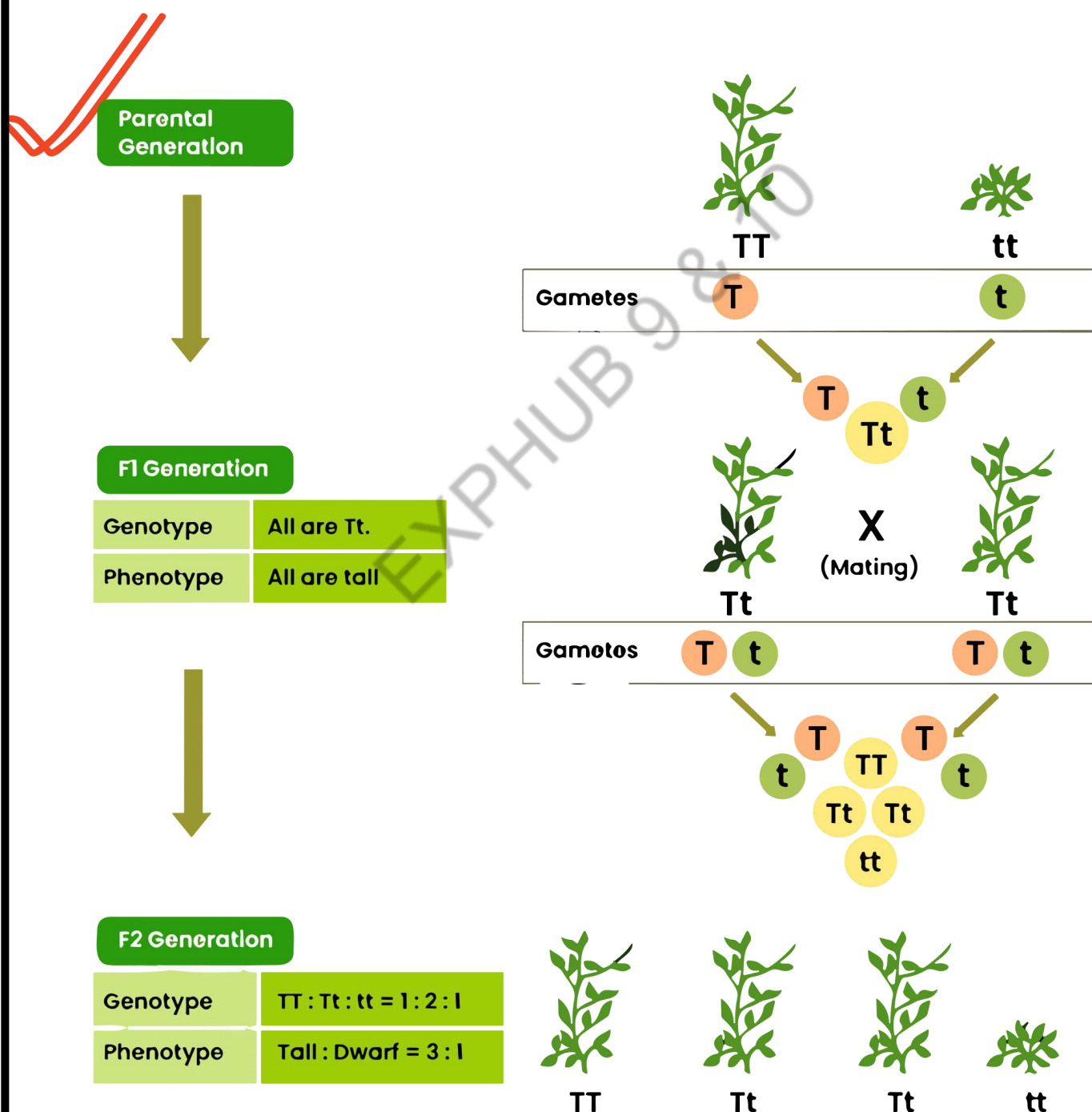
- **Allele**-> An allele is one of the various versions of a specific gene, such as for height.
- **Dominant Allele**-> A dominant allele, indicated by a capital letter (e.g., "T"), expresses its phenotype even when another allele is present.
- **Recessive Allele**-> The phenotype is expressed only when both alleles are present, and it is represented by a lowercase letter, as in "t."
- **Genotype**-> The genetic recipe of a person, like whether they are entirely tall or a mix of tall traits.
- **Phenotype**-> Phenotype is an organism's visible traits resulting from its genes and environment. **E.g**- tall or dwarf
- **Chromosomes**-> Chromosomes are thread-like structures in the cell nucleus that carry genetic information (DNA).
- **Hybrid**-> An individual with two distinct alleles for the same trait, like "Tt" for height (tall).

- **Monohybrid Cross**-> A cross that focuses on one pair of contrasting traits is referred to as a monohybrid cross, resulting in a 3:1 ratio known as the monohybrid ratio.
- **Dihybrid cross**-> A cross that involves two pairs of contrasting traits is termed a dihybrid cross, and it yields a 9:3:3:1 ratio, which is known as the dihybrid ratio.
- **Dominant Trait**-> The trait that can be visibly expressed in the first generation.
- **Recessive Trait**-> The trait that is not able to express itself in F1 generation but reappears in f2 generation.
- **Homozygous**-> Homozygous means having two identical alleles for a particular gene.
- **Heterozygous**-> It refers to having two different alleles for a specific gene.
- **Dominant ene**-> The gene that can be expressed in both homozygous and heterozygous conditions.
- **Recessive Gene**-> A gene that can only express itself in the homozygous condition.
 - Inherited traits from previous generations provide a shared body plan and introduce subtle modifications for the next generation.
 - Depending on the nature of variations, various individuals may possess diverse advantages.

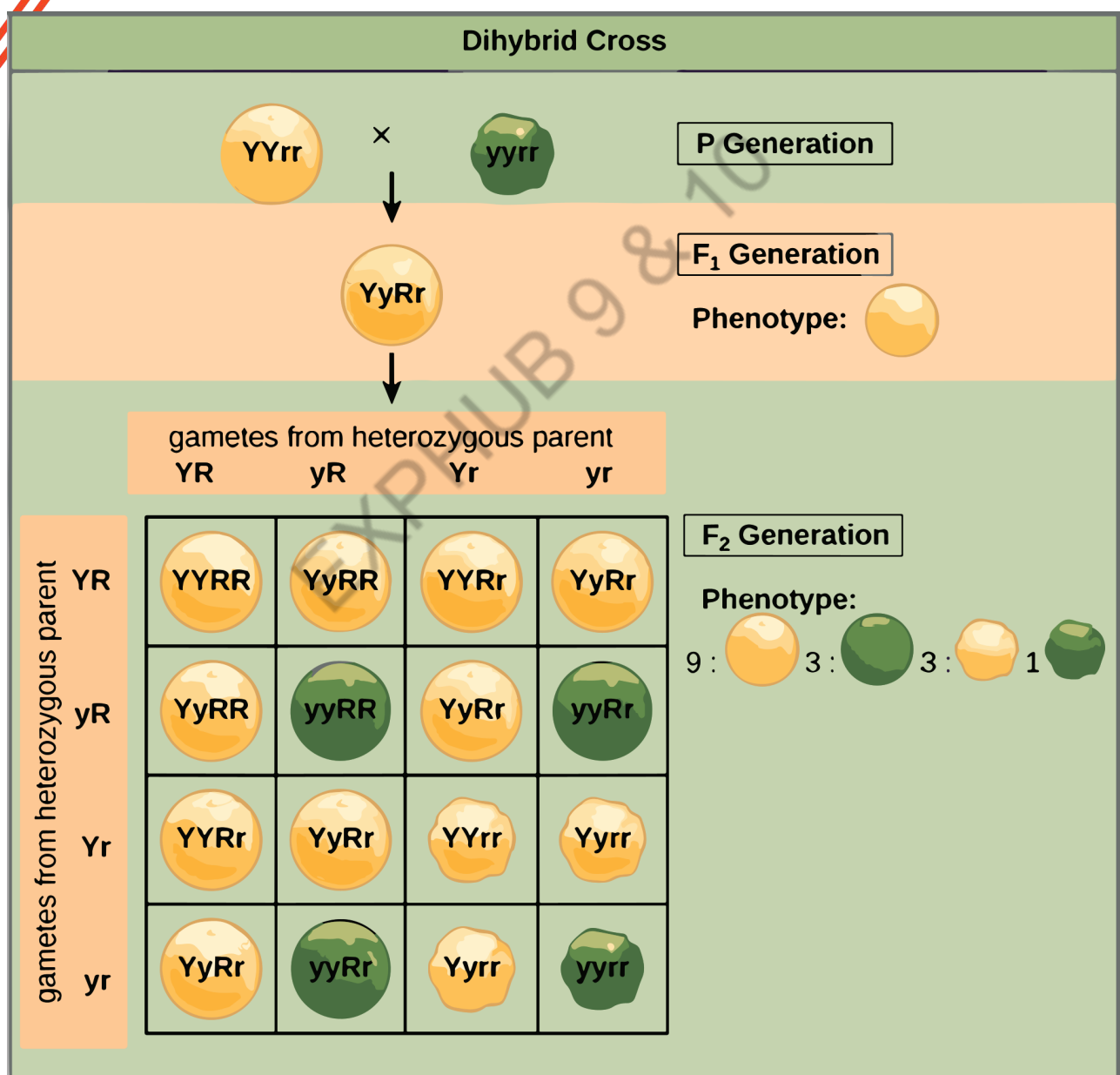


Mendel 's Experiment:

Mendel found that traits can be dominant or recessive. When he crossed a tall pea plant with a short one, all offspring in the first generation were tall. To understand what happened to the short trait, he self-pollinated the first-generation plants and observed that in the second generation, both tall and short plants were present in a 3:1 ratio. This led Mendel to conclude that the short trait was present in the first generation but unable to express itself.



Mendel crossed round and yellow seed pea plants with green and wrinkled seed pea plants. In the parent generation, all offspring had a round shape and yellow color. To understand what happened to the wrinkled and green traits, he self-pollinated the first-generation plants. In the second generation, he observed new combinations alongside the parental traits, showing that shape and color traits are inherited independently.



Secret Questions:

1) Explain Mendel's concept of heredity, by giving three points.

Solution:

Mendel's work on pea plants led to the discovery of three fundamental laws of inheritance:

1. Law of Segregation: Genes come in pairs, and during gamete formation, these genes segregate randomly so that each gamete receives only one gene from the pair.
2. Law of Independent Assortment: Genes for different traits are sorted independently during gamete formation, meaning the inheritance of one trait is not dependent on the inheritance of another.
3. Law of Dominance: When an organism has alternate forms of a gene (alleles), one form (the dominant allele) will be expressed in the phenotype if present.

These laws laid the foundation for our understanding of genetics and inheritance.

2) A pea plant with a blue color flower denoted by BB is cross-bred with a pea plant with a white flower denoted by ww.

- a. What is the expected color of the flowers in their F1 progeny?
- b. What will be the percentage of plants bearing white flowers in F2 generation, when the flowers of F1 plants were selfed?
- c. State the expected ratio of the genotypes BB and Bw in the F2 progeny.

Solution:

- a. F1 generation — blue.
- b. 25%
- c. BB : Bw = 1 : 2.

3) In a pea plant, find the contrasting trait if:

- a. the position of the flower is terminal.
- b. the flower is white in color.
- c. shape of the pod is constricted.

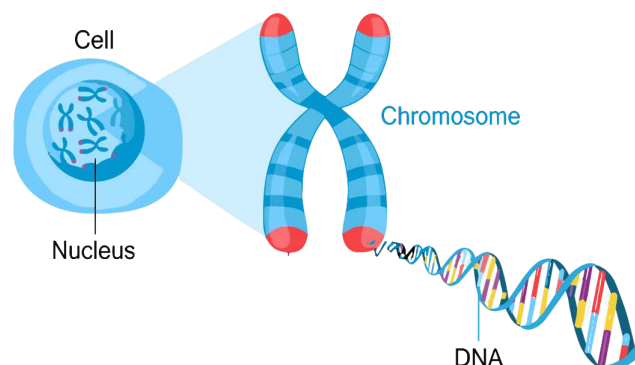
Solution:

In a pea plant, find the contrasting trait if:

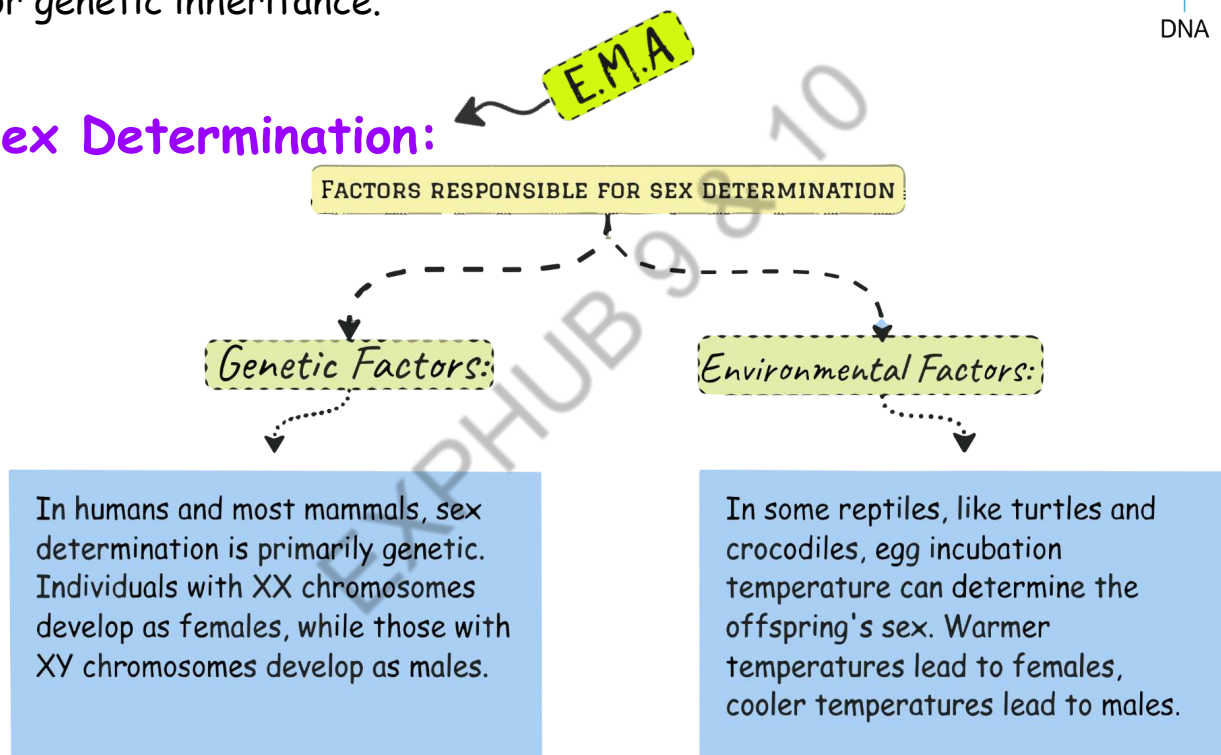
- a. the position of the flower is terminal.
- b. the flower is white in color.
- c. shape of the pod is constricted.

Chromosomes:

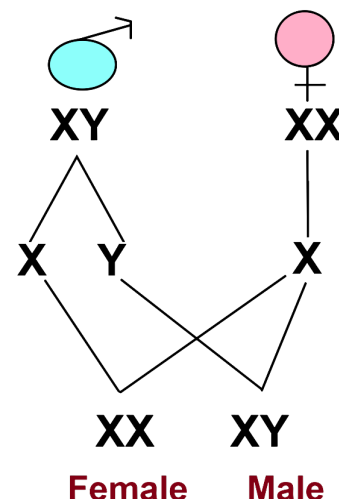
Chromosome pairs refer to the two sets of chromosomes present in most human cells. Each set consists of 23 individual chromosomes, with one set inherited from the mother and the other from the father. These pairs include sex chromosomes (X and Y in humans) and autosomes, which carry genetic information and are essential for genetic inheritance.



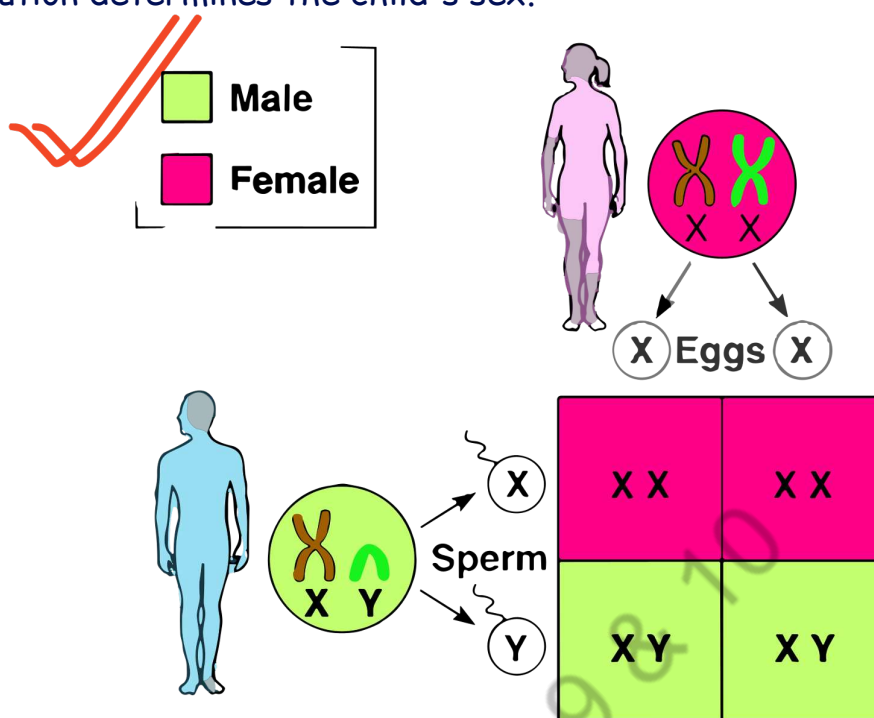
Sex Determination:



In humans, there are 23 pairs of chromosomes, making a total of 46 chromosomes. Among these, 22 pairs are autosomes, and one pair is sex chromosomes. In males, the sex chromosomes are XY, and in females, they are XX. The sex of a child is determined during fertilization. If an X-carrying



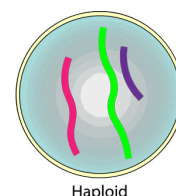
sperm fertilizes the egg, the child will be female (XX), and if a Y-carrying sperm fertilizes the egg, the child will be male (XY). Therefore, the sperm's genetic contribution determines the child's sex.



Haploid & Diploid Cells:

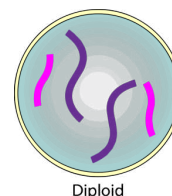
Diploid:

Diploid means having two sets of paired chromosomes in a cell or organism.



Haploid:

Haploid means having a single set of unpaired chromosomes in a cell or organism.

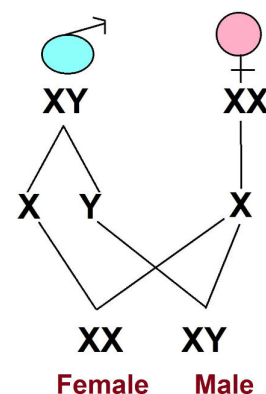


TOP 7 QUESTIONS

- 1) "It is a matter of chance whether a couple will have a male or a female child." Justify this statement by drawing a flow chart. (Foreign 2015, 2017)

Solution:

Women produce only one type of ovum (carrying X chromosome) and males produce two types of sperms (carrying either X or Y chromosome) in equal proportions. So the sex of a child is a matter of chance depending upon the type of sperm fertilizing the ovum.



- 2) Why traits such as intelligence and knowledge cannot be passed on to the next generation?

Solution:

Traits such as intelligence and knowledge are not heritable traits, which do not bring upon any changes in the DNA of the germ cells and, therefore, cannot be passed on to the progeny.

- 3) Distinguish between inherited traits and acquired traits in a tabular form, giving one example of each. (All India 2017)

Solution:

	Acquired Trait	Inherited Trait
1.	Experiences of an individual during its lifetime.	Genetically inherited
2.	It cannot be passed on from one generation to the next.	They can be passed on from one generation to the next.
3.	Example: power to lift weights and reading French	Example: Eye colour or height

- 4) What is a dominant trait with respect to height in pea plants? Give any two examples.

Solution:

Characters/Traits like 'T' are called dominant trait (because it express itself)
't' are recessive trait (because it remains suppressed).

Character	Dominant Trait	Recessive Trait
Seed shape	Round	Wrinkled
Pod shape	Inflated	Constricted
Pod colour	Green	Yellow
Height of plant	Tall	Dwarf

5) What are chromosomes? Explain how sexually reproducing organisms the number of chromosomes in the progeny is maintained. (Outside Delhi 2015)

Solution:

Chromosomes - Thread-like structures made up of DNA found in the nucleus. The original number of chromosomes becomes half during gamete formation. Hence, when the gametes combine, the original number of chromosomes gets restored in the progeny

6) Rekha has a dark complexion and seeks beauty products to lighten her skin. Her friend Lila tells her that skin color is determined by birth and advises against excessive use of such products. (All India 2013)

- What might have caused Rekha's color to be dark?
- Is it possible that all the family members of Rekha's family were dark?
- What value do you learn?

Solution:

- Her dark colour may be due to genetic inheritance.
- All may not be dark, depending upon the genes inherited and the environmental conditions that each one of them living in.
- Awareness, logical thinking, and scientific temperament.

7) How do Mendel's experiment show that traits are inherited independently?

Solution:

Mendel performed dihybrid crosses by mating pea plants with different traits in two characteristics, like yellow round seeds with green wrinkled seeds. In the F₂ generation, he observed both parental (yellow round and green wrinkled) and recombinant (yellow wrinkled and green round) phenotypes. This showed that these traits separated from their original combinations and were inherited independently.

COMPETENCY-BASED QUESTIONS

1. Gregor Mendel conducted hybridisation experiments on garden peas for seven years and proposed the laws of inheritance in living organisms. He investigated characters in the garden pea plant that were manifested as two opposing traits, e.g., tall or dwarf plants, yellow and green seeds, etc.

(i) Among the seven pairs of contrasting traits in pea plant as studied by Mendel, the number of traits related to flower, pod and seed respectively were

(a) 2, 2, 2 (b) 2, 2, 1 (c) 1, 2, 2 (d) 1, 1, 2.

(ii) The colour based contrasting traits in seven contrasting pairs, studied by Mendel in pea plant were

(a) 1 (b) 2 (c) 3 (d) 4.

(iii) Refer to the given table of contrasting traits in pea plants studied by Mendel.

Character	Dominant trait	Recessive trait
(i) Seed colour	 Yellow	 Green
(ii) Flower colour	 Violet	 White
(iii) Pod shape	 Full	 Constricted
(iv) Flower position	 Axial	 Terminal

Which of the given traits is correctly placed?

- (a) (i), (ii) and (iii) only
 (b) (ii), (iii) and (iv) only
 (c) (ii) and (iii) only
 (d) (i), (ii), (iii) and (iv)

(iv) Some of the dominant traits studied by Mendel were

- (a) round seed shape, green seed colour and axial flower position
 (b) terminal flower position, green pod colour and inflated pod shape
 (c) violet flower colour, green pod colour and round seed shape
 (d) wrinkled seed shape, yellow pod colour and axial flower position.

(v) Which of the following characters was not chosen by Mendel?

- (a) Pod shape
 (b) Pod colour
 (c) Position of flower
 (d) Position of pod

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

(i) In garden pea, round shape of seeds is dominant over wrinkled shape. A pea plant heterozygous for round shape of seed is selfed and 1600 seeds produced during the cross are subsequently germinated. How many seedlings would have non-parental phenotype?

(a) 1600 (b) 1200 (c) 400 (d) 800

(ii) If 'A' represents the dominant gene and 'a' represents its recessive allele, which of the following would be the most likely result in the first generation offspring when Aa is crossed with aa?

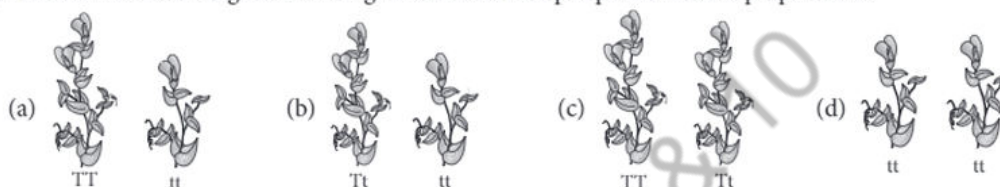
(a) All will exhibit dominant phenotype.

(b) All will exhibit recessive phenotype.

(c) Dominant and recessive phenotypes will be 50% each.

(d) Dominant phenotype will be 75%.

(iii) Which of the following crosses will give tall and dwarf pea plants in same proportions?



iv) What result Mendel would have got, if he self pollinated a homozygous tall F_2 plant?

(a) TT and Tt (b) All Tt (c) All TT (d) All tt

(v) In plant, tall phenotype is dominant over dwarf phenotype, and the alleles are designated as T and t, respectively. Upon crossing one tall and one dwarf plant, total 250 plants were obtained, out of which 124 displayed tall phenotype and rest were dwarf.

Thus, the genotype of the parent plants were

(a) TTx TT (b) TTx tt (c) Ttx Tt (d) Ttx tt