

CLASS X - SCIENCE



# HEREDITY AND EVOLUTION

PRASHANT KIRAD

14  $\rightarrow$  Diagram

$\left[ \begin{array}{cc} 2 & 2 \\ 2 & 3 \\ 2 & 4 \end{array} \right] \rightarrow$  GOD



# RULE FOR THE INHERITANCE OF TRAITS





- ***The inheritance of traits in humans is determined equally by genetic material from both parents.***
- Each child inherits two versions of a trait, *one from the mother and one from the father.*
- The traits expressed in the child follow Mendel's rules of inheritance, established through his experiments over a century ago.

## LAW OF DOMINANCE

- When an inherited pair of two alleles is heterozygous, the allele that is called dominant while the other is called recessive.

First law of inheritance



		Heterozygous Tall (Tt)	
		T	t
Heterozygous Tall (Tt)	T	<b>TT</b> homozygous tall 	<b>Tt</b> heterozygous tall 
	t	<b>Tt</b> heterozygous tall 	<b>tt</b> homozygous dwarf 

$F_2$  geno  $\rightarrow$  ✓✓ (M) ✓✓  
1:2:1  
Pheno  $\rightarrow$  3:1

$F_2 \rightarrow$  9:3:3:1



# LAW OF SEGREGATION

This law states that **each trait consists of two alleles, which segregate during gamete formation.** → Sex cell

- During fertilization, one allele from each parent combines.

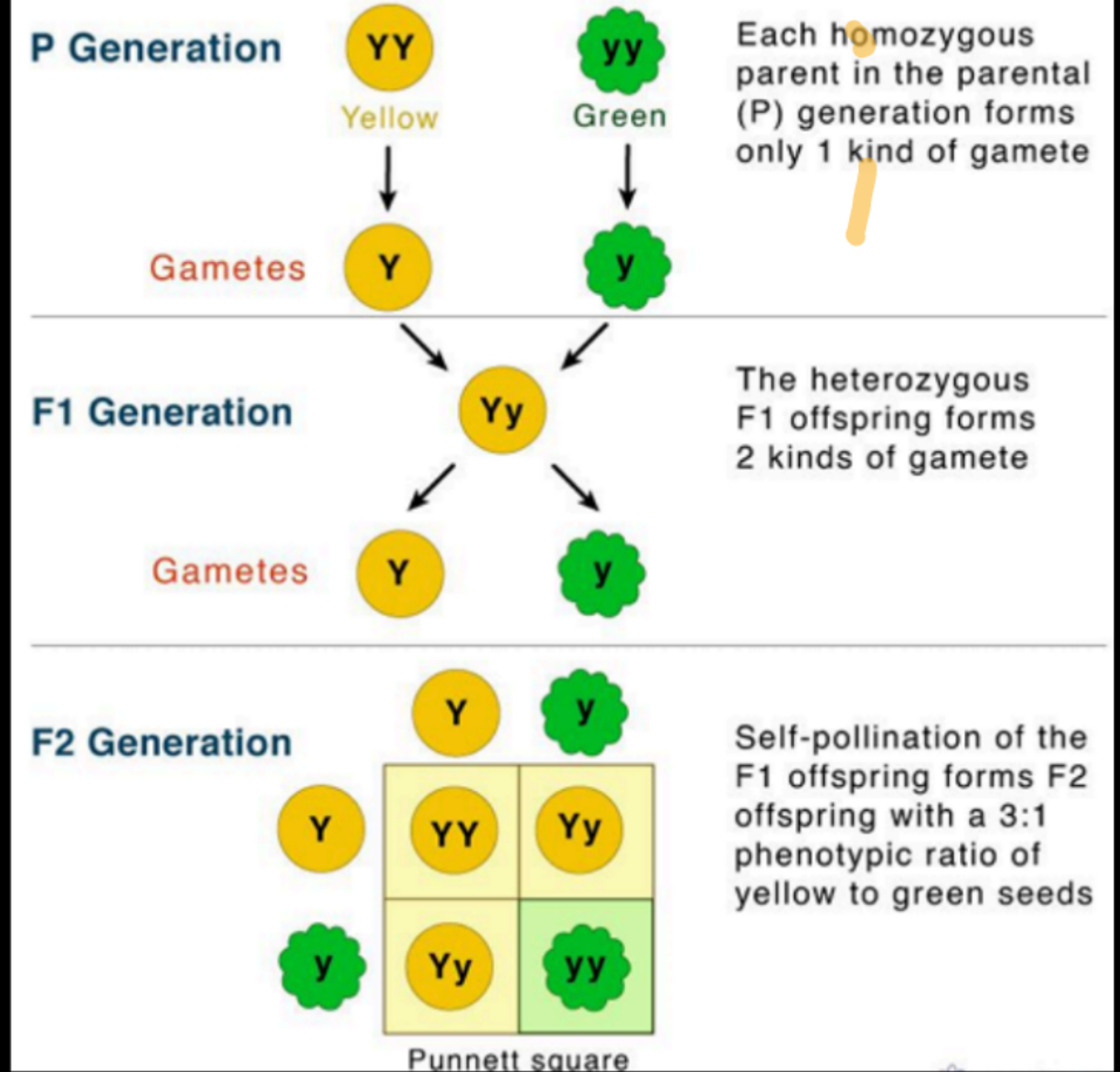
Second law of inheritance



Tt → Tall

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## Mendel's Law of Segregation

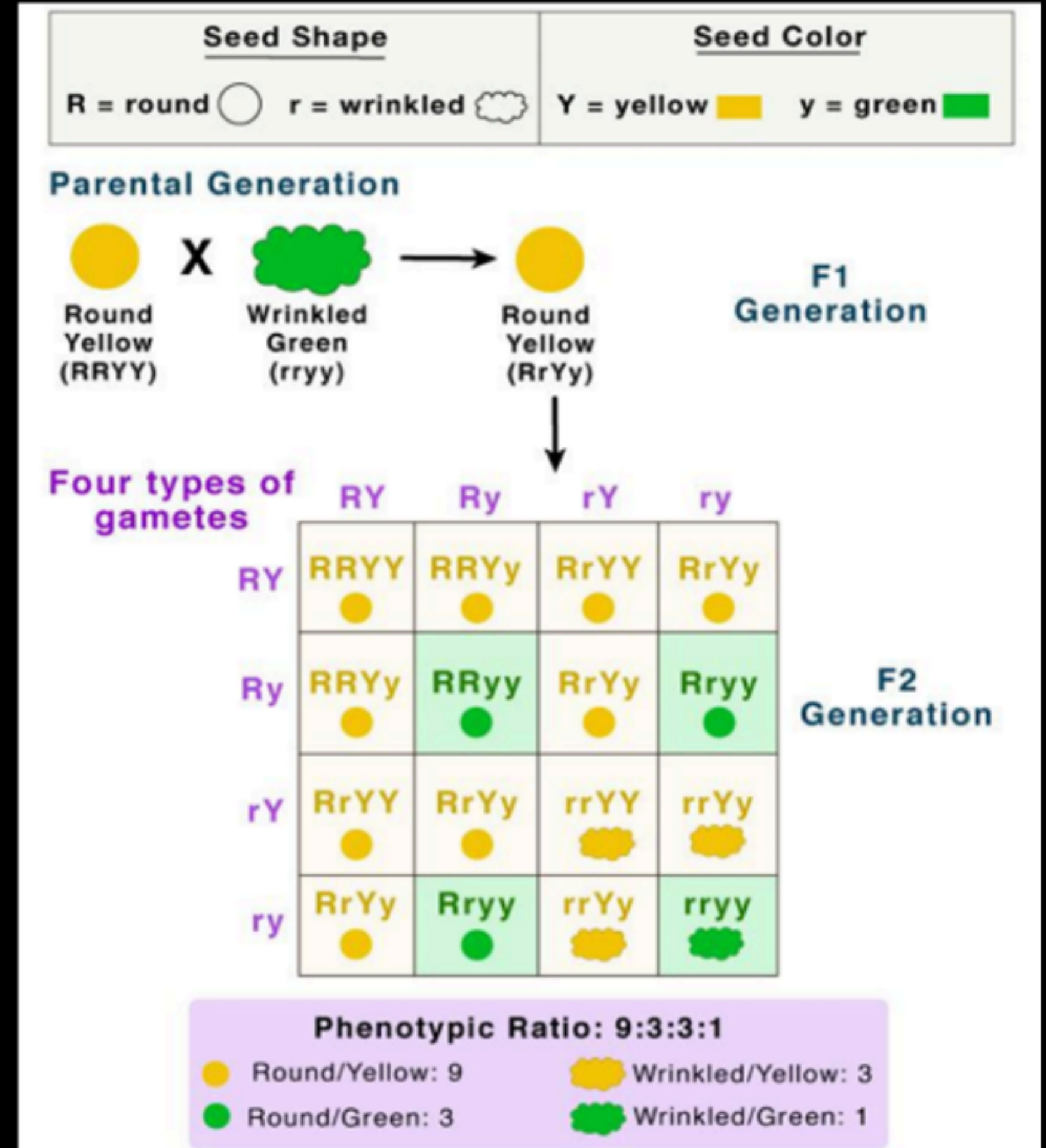
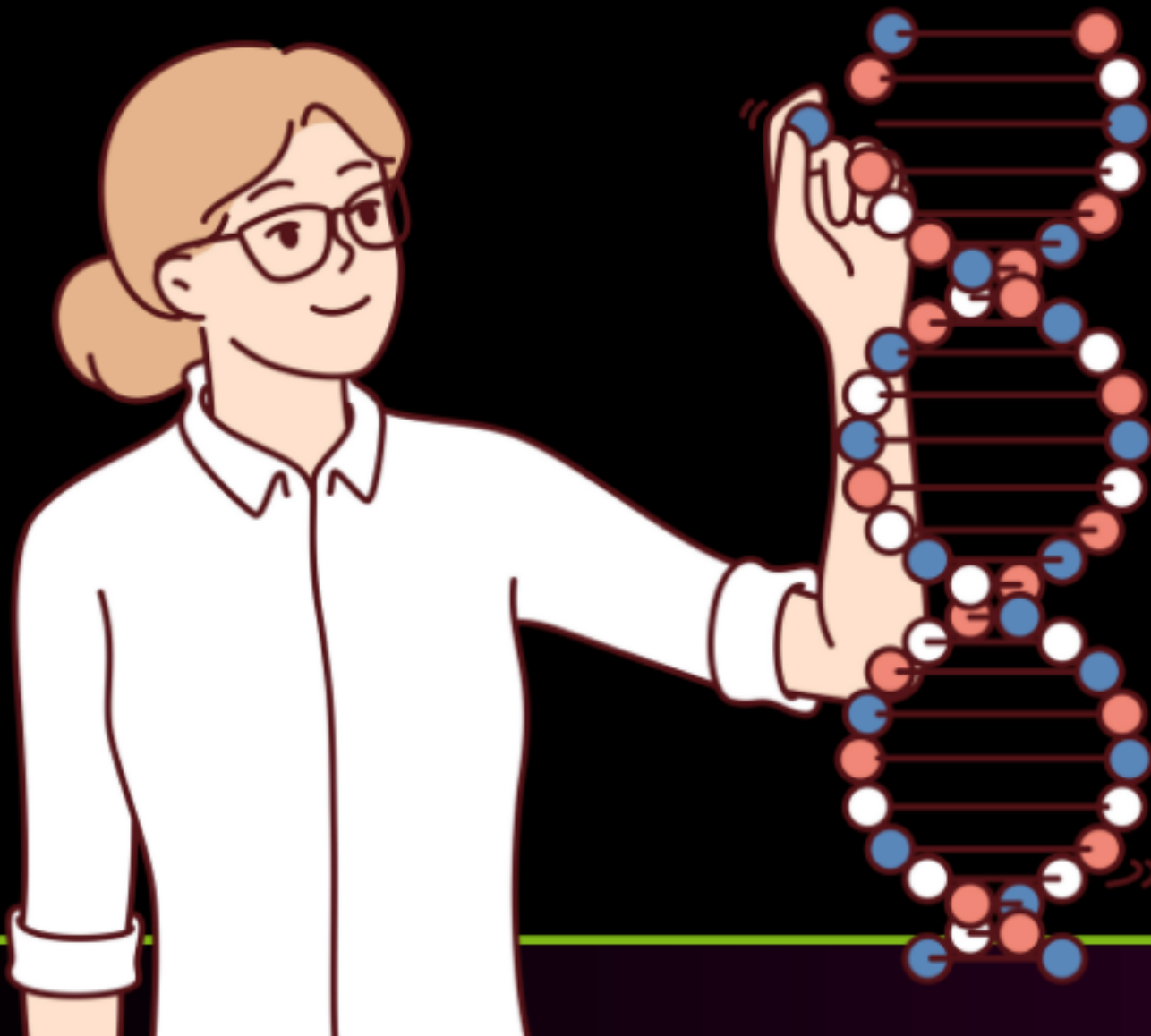




# LAW OF INDEPENDENT ASSORTMENT

$\begin{array}{cc} R & Y \\ \downarrow & \downarrow \\ R & Y \end{array}$

Alleles of two or more different genes get assorted into gametes independently of one another.



$\begin{array}{cc} \textcircled{R} \textcircled{R} & \textcircled{Y} \textcircled{Y} \\ \downarrow & \downarrow \\ R & Y \end{array}$       $\begin{array}{cc} \underbrace{m \ n} & \underbrace{g \ y} \\ m & y \end{array}$

# SEX DETERMINATION

The process by which sex of an individual is decided or determined passed on its genetic material composition is known as **Sex Determination**.

## DETERMINING FACTORS OF SEX

- **Environmental factors**

- Size of body (marine worms)
- Temperature (reptiles)

- **Genetical**

- Allelic + environment (wasps)
- Chromosomal

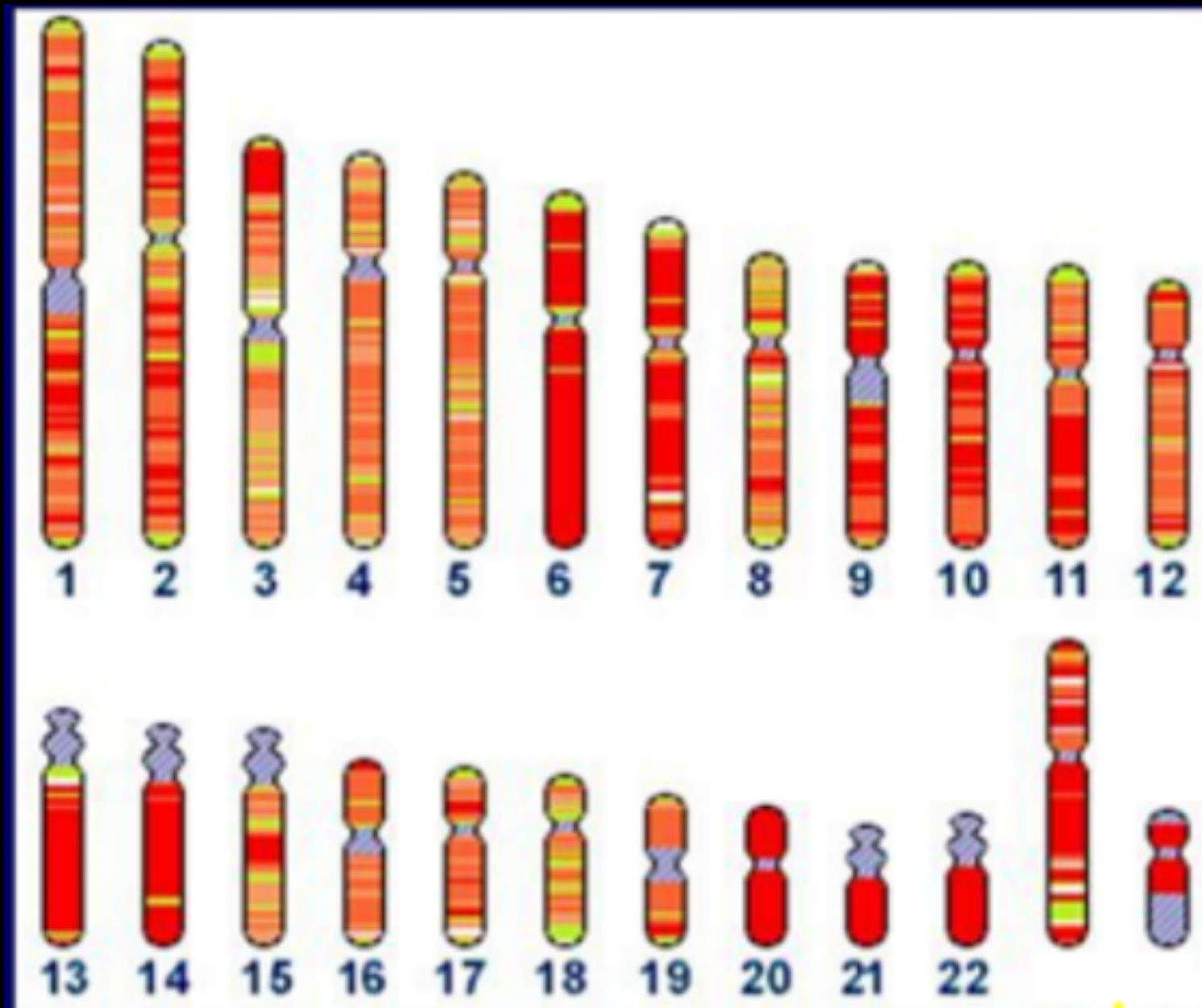




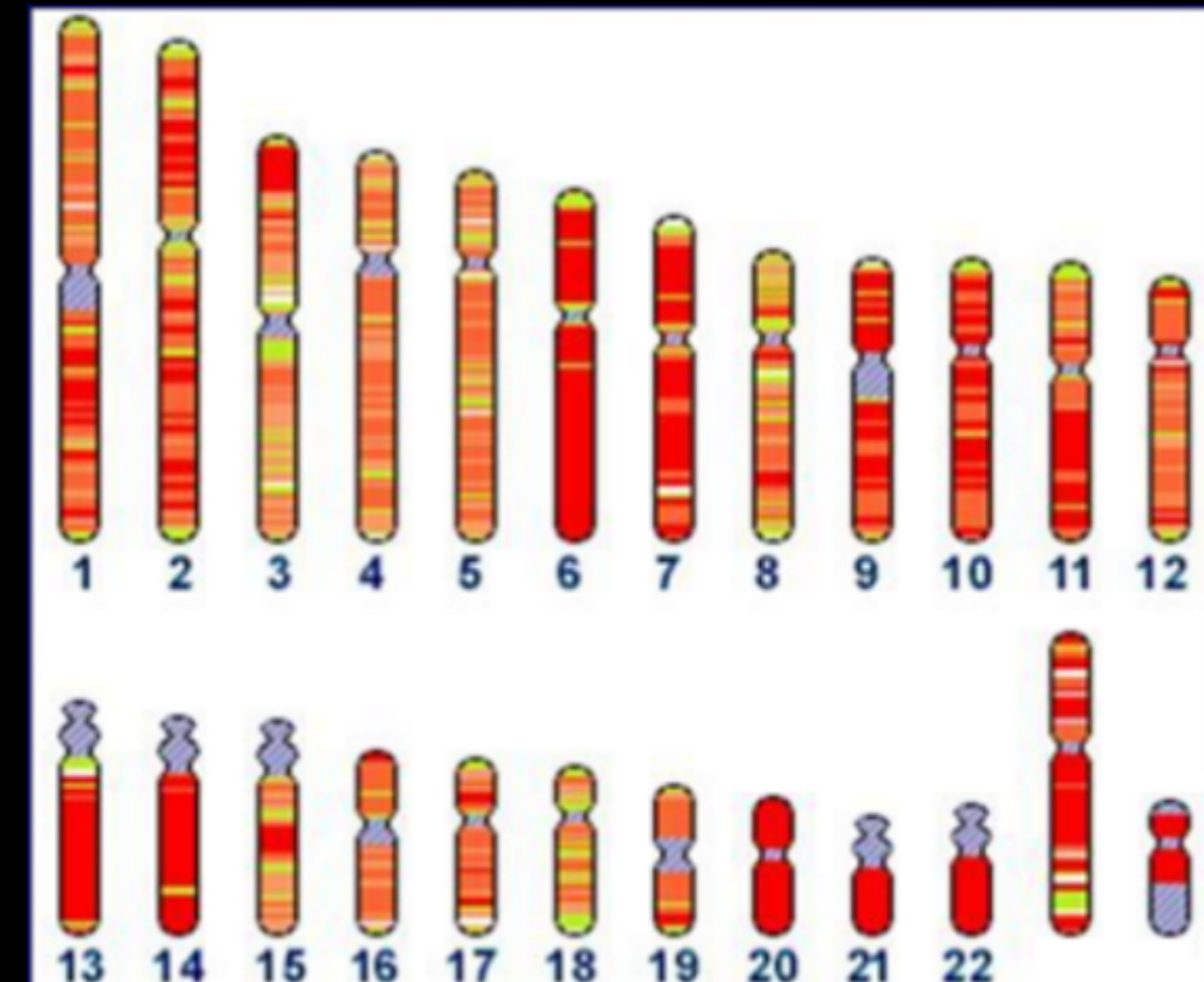
# SEX CHROMOSOMES

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Males (XY)




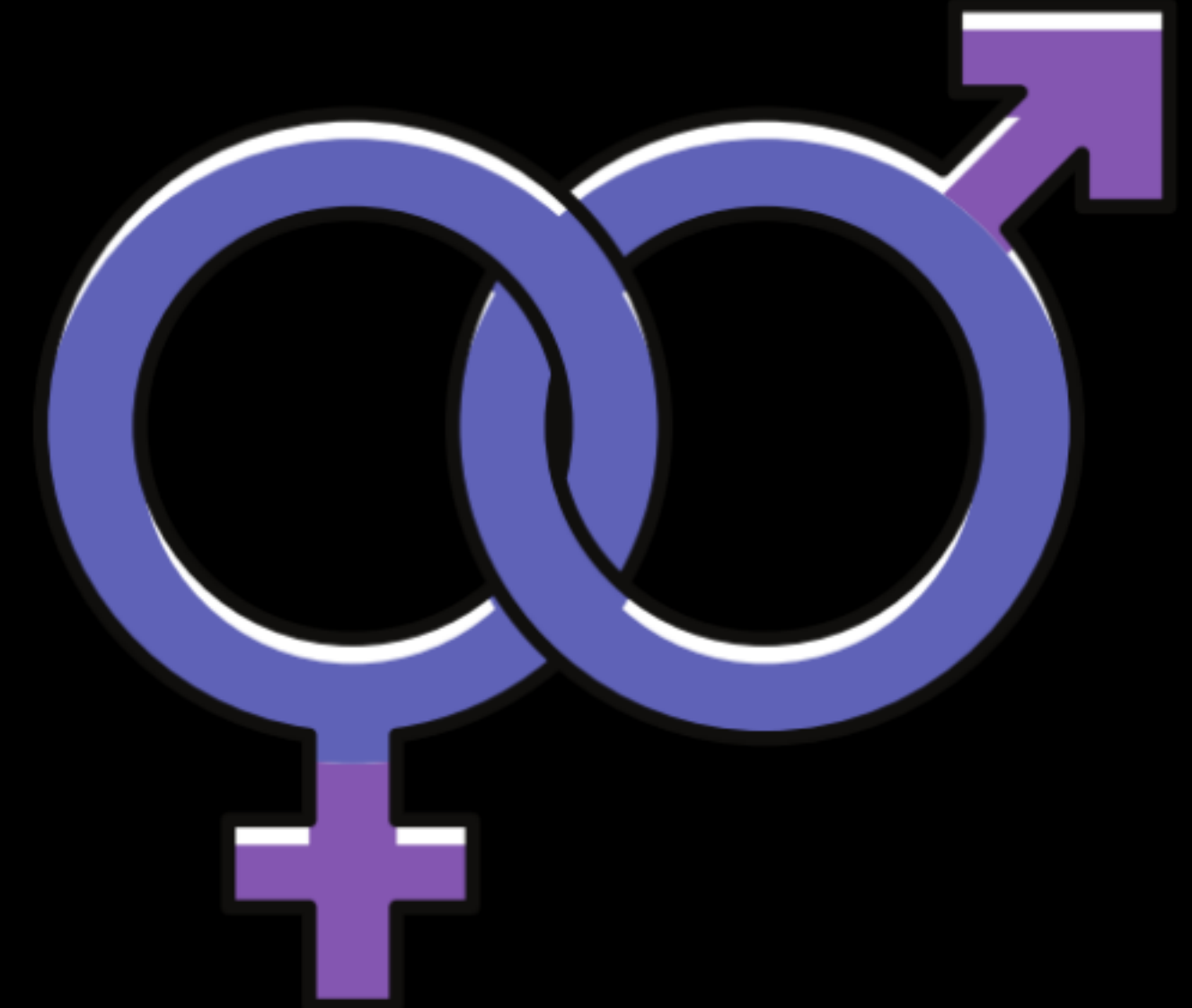
Females (XX)



# SEX DETERMINATION IN HUMANS

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- Most human chromosomes have a maternal and a paternal copy, and we have 22 such pairs. These **22 pairs** are called **autosomes**.
- Women have a perfect pair of sex chromosomes, **both called X (homogametic)**.  

- But men have a mismatched pair in which one is a normal-sized X while the other is a short one called Y (**heterogametic**).
- The one mismatched pair is called **Allosomes or sex chromosomes**.





# SEX DETERMINATION IN HUMANS

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23 pairs  $\rightarrow$  22

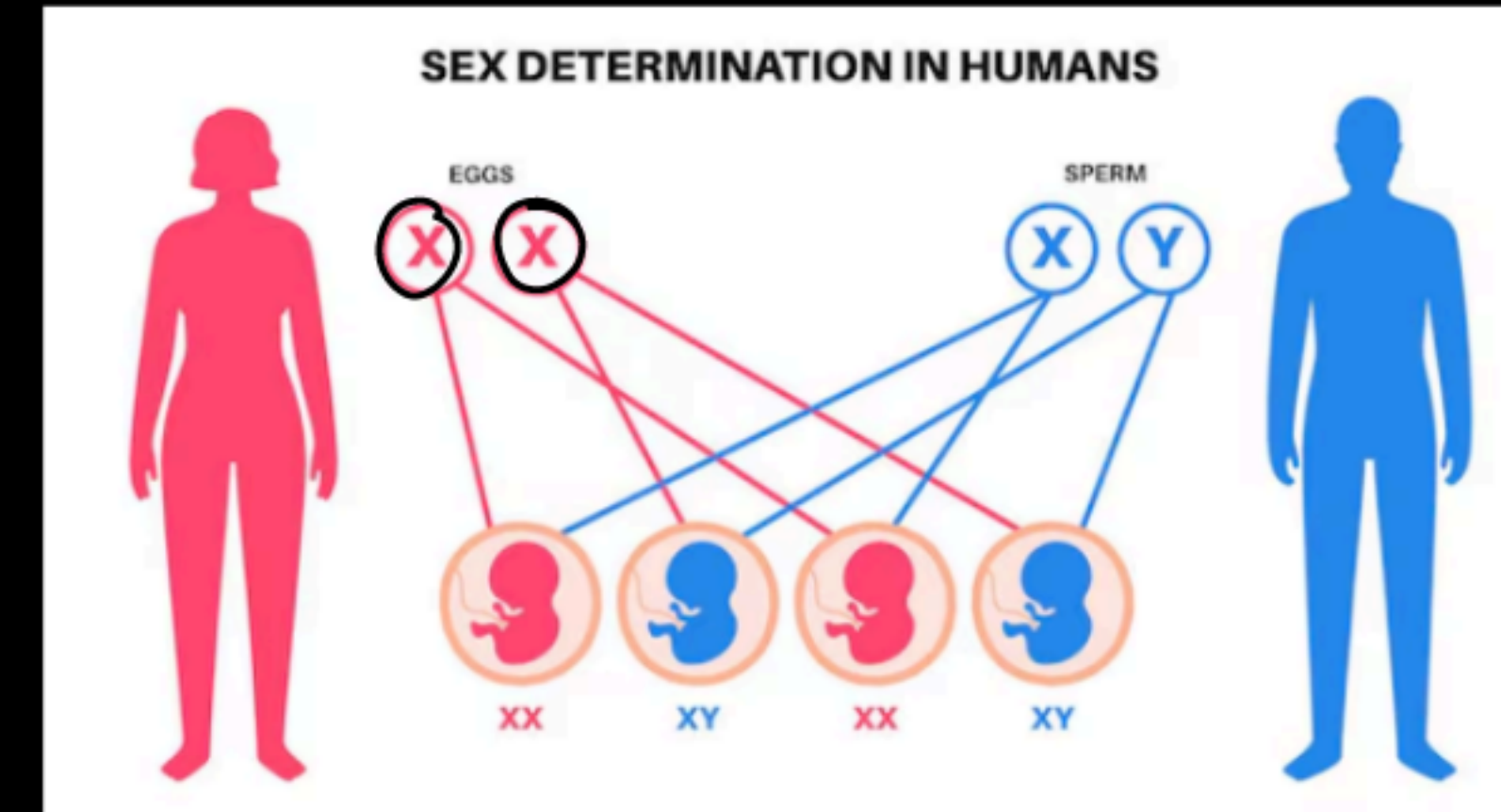
Autosomes	Allosomes (Sex chromosomes)
Chromosomes which are not connected with sex determination.	Chromosomes which are connected with determination.
Similar in males and females.	Dissimilar in males (XY) and female (XX)
Generally 44 or 22 pairs in human beings.	Generally 2 or one pair in human beings.

$\rightarrow$  22 pairs

# SEX DETERMINATION IN HUMANS

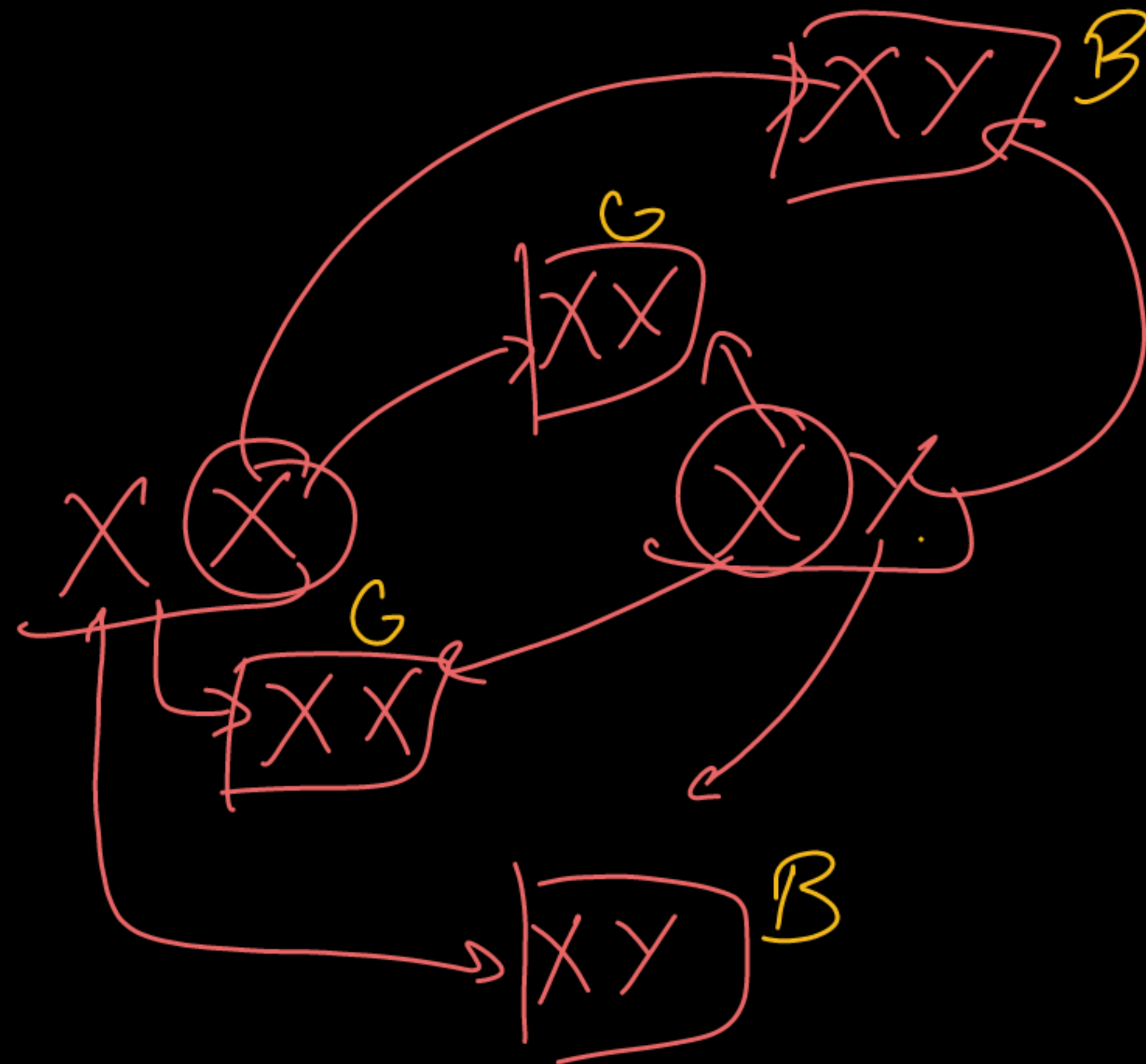
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- If a sperm with X chromosome fertilises the egg then the zygote will have XX chromosome in the 23rd pair.
- A **zygote with XX chromosome will develop into a girl child.**
- If a sperm with Y chromosome fertilises the egg then the zygote will have XY chromosome in the 23rd pair.



- A **zygote with XY chromosome will develop into a male child**
- This shows that half the children will be boys and half will be girls.
- All children will inherit an X chromosome from their mother regardless whether they are boys or girls.
- **“Thus, sex of children will be determined by what they inherit from their father, and not from their mother.”**





$$\boxed{1^b 0^1} = \underline{50\%}$$

$G : B$

## Abhay Premier League



XX

Q. A zygote that has an X-chromosome inherited from the father will develop into a (2024)

- (a) girl
- (b) boy
- (c) either boy or girl
- (d) X-chromosome does not influence the sex of a child.



## Abhay Premier League



**Q. Which chromosomes determine sex in humans?**

- ~~a) 22 pairs of autosomes~~
- ~~b) 22 autosomes and 1 pair of sex chromosomes~~
- ~~c) X and Y chromosomes~~
- d) All 23 pairs of chromosomes

## Abhay Premier League



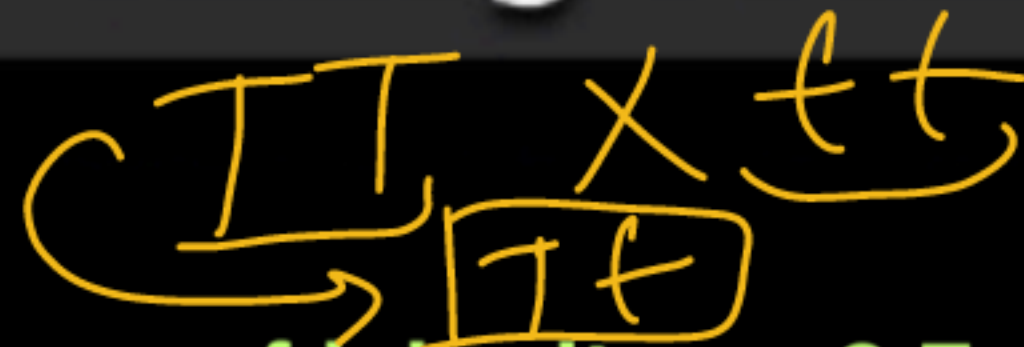
**Q. In Mendel's dihybrid cross, which law is illustrated?**

- a) Law of Segregation
- b) Law of Dominance
- ☒ c) Law of Independent Assortment
- d) Law of Recombination

RRYY / rryy



## Abhay Premier League



**Q. What are Mendel's laws of inheritance? Explain with an example. (2015, 2018, 2020)**

**Answer:**

- **Law of Dominance:** In a heterozygous organism, one allele (dominant) expresses itself over the other (recessive).
- **Example:** In pea plants, the tall (T) allele dominates over dwarf (t).
- **Law of Segregation:** The two alleles for a trait segregate during gamete formation and randomly recombine during fertilization.
- **Law of Independent Assortment:** Different pairs of alleles are inherited independently of each other.

## Abhay Premier League



Q. Differentiate between dominant and recessive traits. Give one example of each.

Year Asked: 2016, 2019

Answer:

- **Dominant Trait:** A trait expressed even in heterozygous conditions (e.g., tallness in pea plants).
- Recessive Trait:** A trait expressed only in homozygous conditions (e.g., dwarfness in pea plants).



## Abhay Premier League



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**Answer:**

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## Abhay Premier League



Q. How is the sex of the child ~~fixed~~ decided during the fertilisation, step in human beings? Explain (2022).

Human beings have 23 pairs chromosomes (22 pairs of autosomes +1 pair of sex chromosome). A male has one X chromosome and one Y chromosome whereas a female has two X chromosomes. Sex of a child depends on the two conditions which takes place during fertilisation. The two conditions are given below:

If a sperm carrying X chromosome fertilises an ovum which carries X chromosome, then the child born will be girl.

If a sperm carrying Y chromosome fertilises an ovum which carries X chromosome, then the child born will be a boy.





x & y in the  
alphabet



x & y in  
mathematics



x & y in  
genetics

→ Point

↪

↪

↪

|||||

x x x x  
x x