

# How Are Features Passed Along?



# Mendel and The Idea of Gene



*Gregor Mendel*

# Mendel and The Idea of Gene

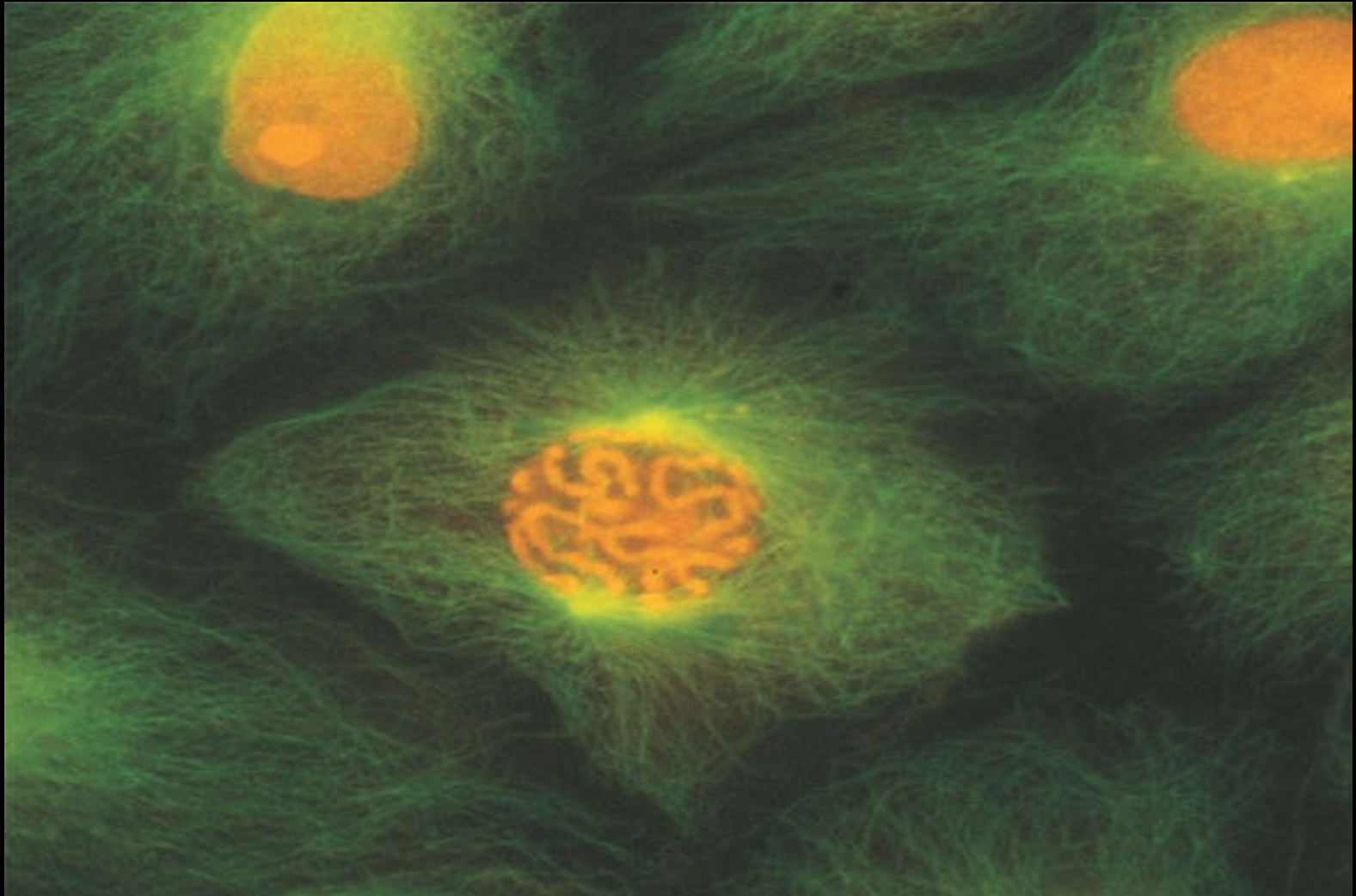
## Mendelian Genetics

- Mendelian Genetics Studies Mendelian Traits
- Many human traits follow a mendelian pattern of inheritance
- <http://www.ncbi.nih.gov> (Online Mendelian Inheritance in Man)

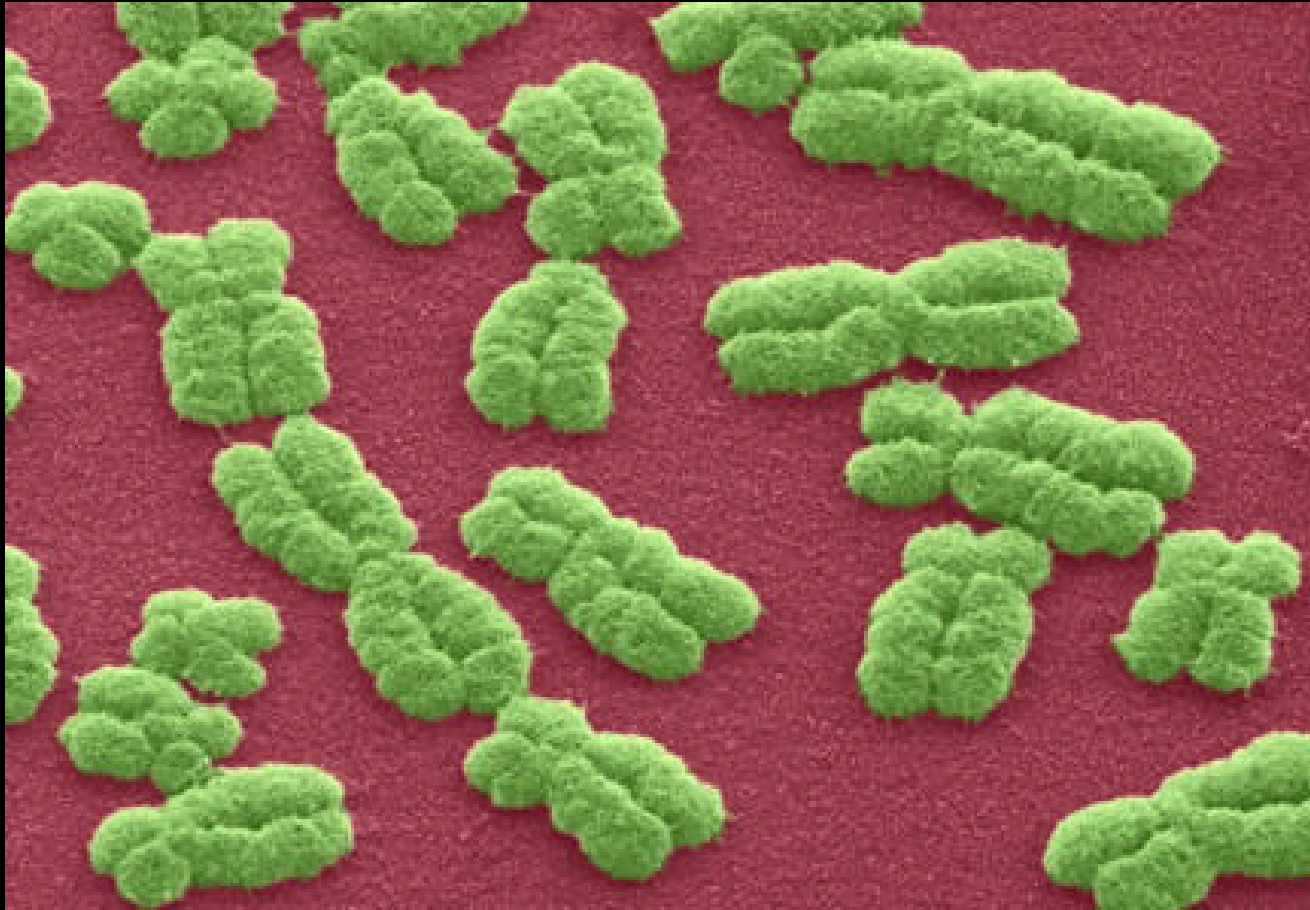


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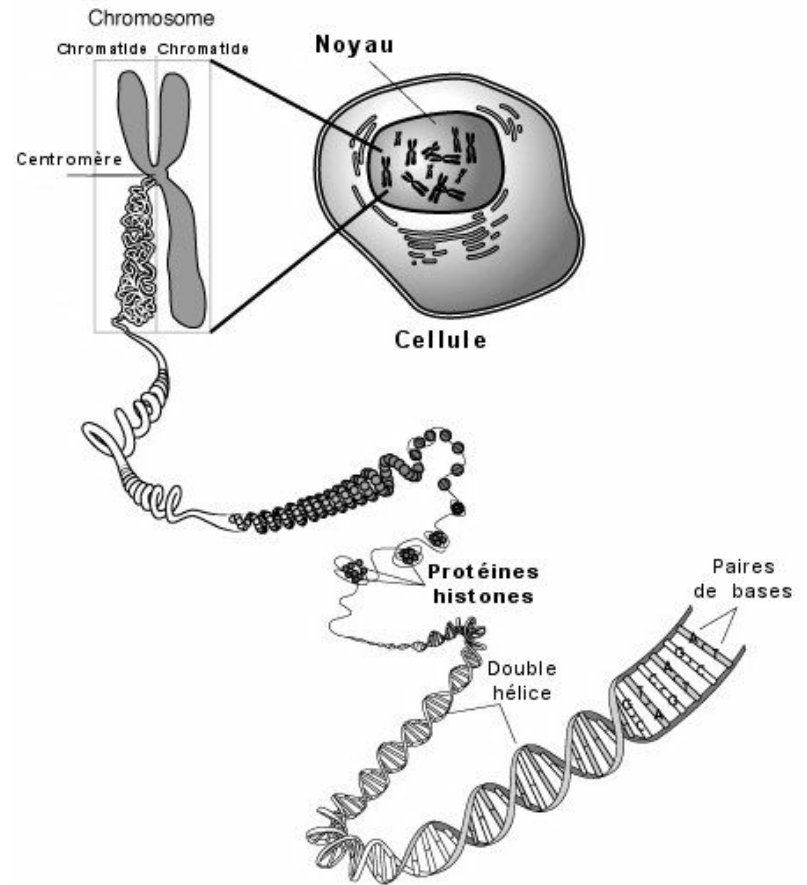
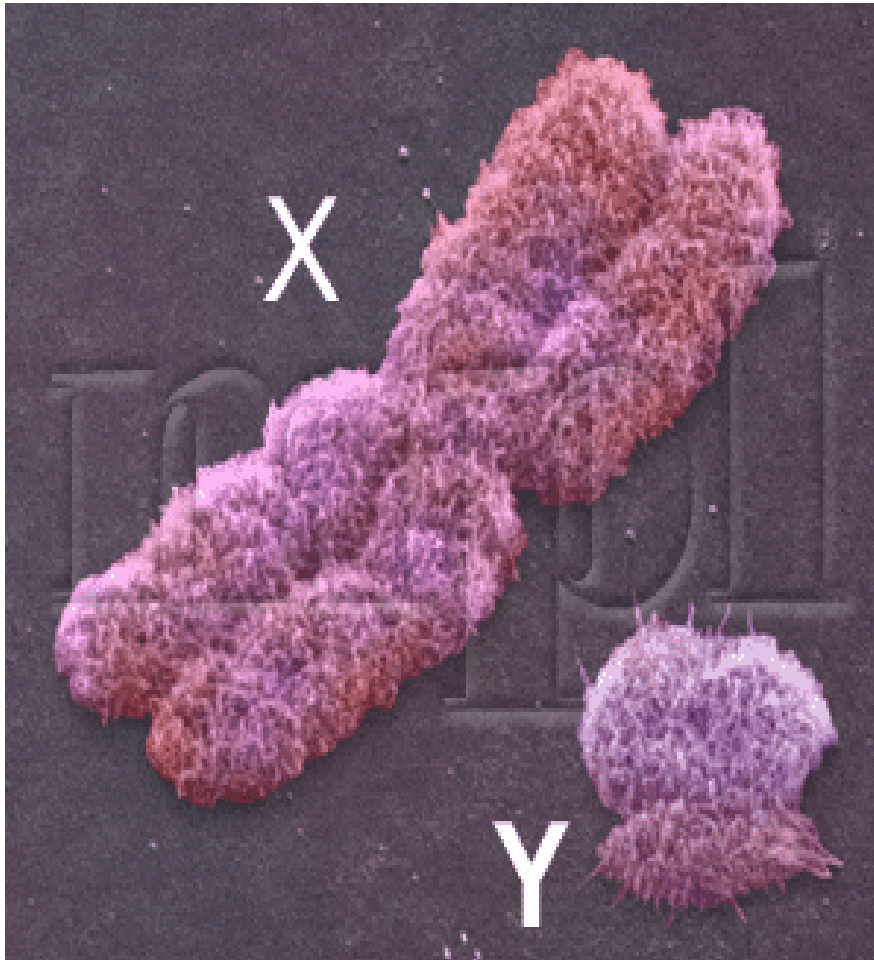
# Where Are Genes Located?



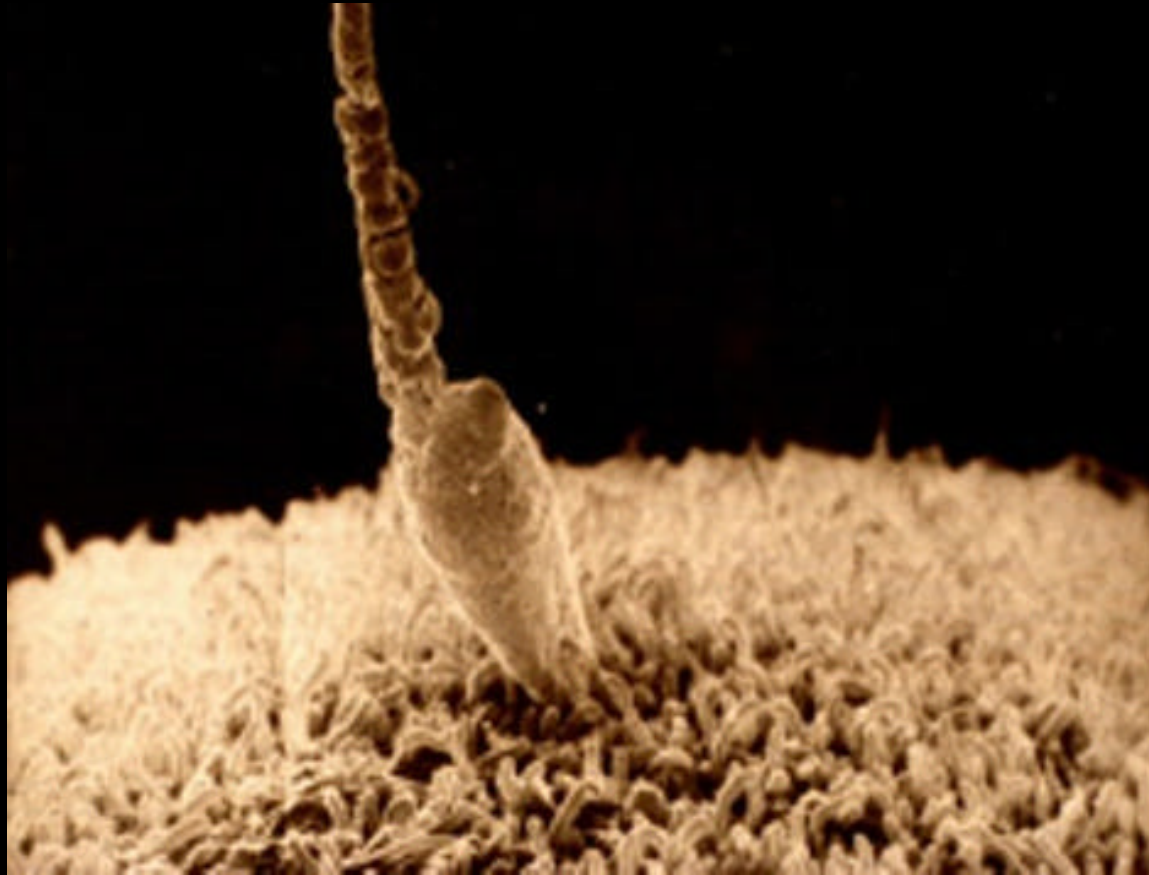
# What is a Chromosome?



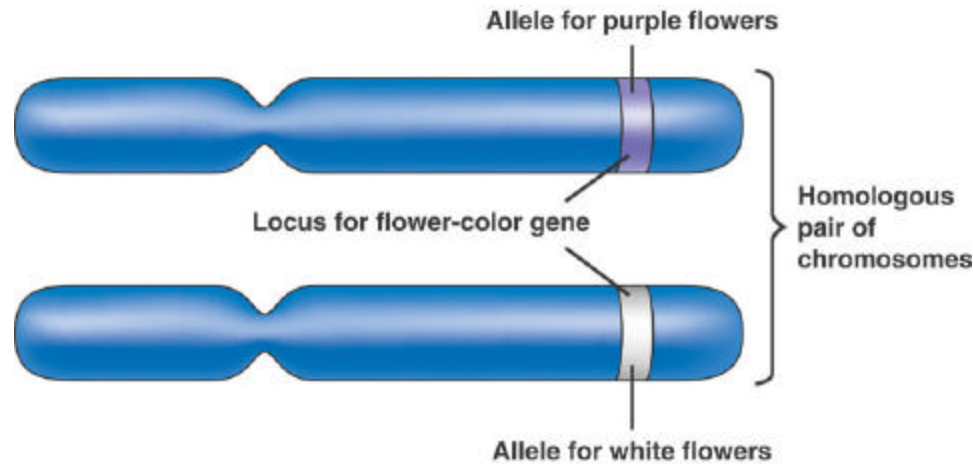
# What is a Chromosome?



# Sexual Reproduction and Fertilization: How We Inherit Genes



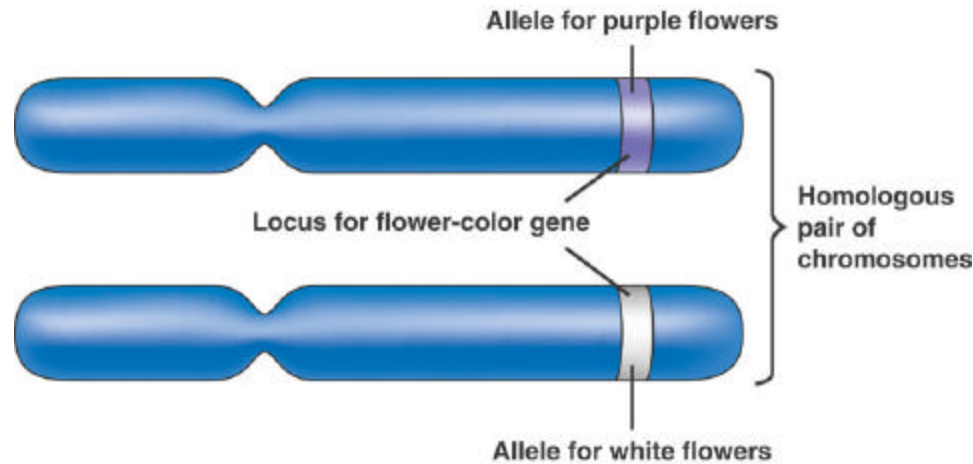
# Some Genetic Terms



- **Genes** are instructions for producing a trait
- **Locus** is the spot each genes has on a chromosome
- Diploid cells have **two genes (a gene pair)** for each trait, each on a homologous chromosome
- **Alleles** are various molecular forms of a gene encoding for the same trait (i.e. flower color)

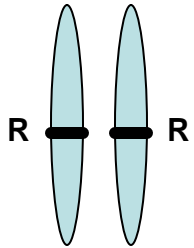


# Some Genetic Terms

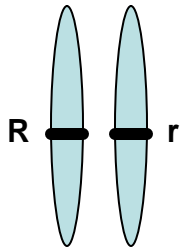


- In a **homozygous condition**, both alleles are the same
- In a **heterozygous condition**, the alleles differ
- For a given Mendelian trait, there is a dominant allele and a recessive allele
- In a heterozygous condition, a Mendelian trait would consist of a **dominant** allele (D) and a **recessive** allele (d)

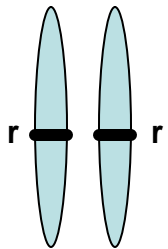
# Genotype and Phenotype



***RR*, homozygous dominant genotype**



***Rr*, heterozygous genotype**

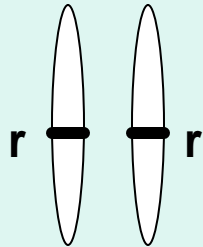


***rr*, homozygous recessive genotype**

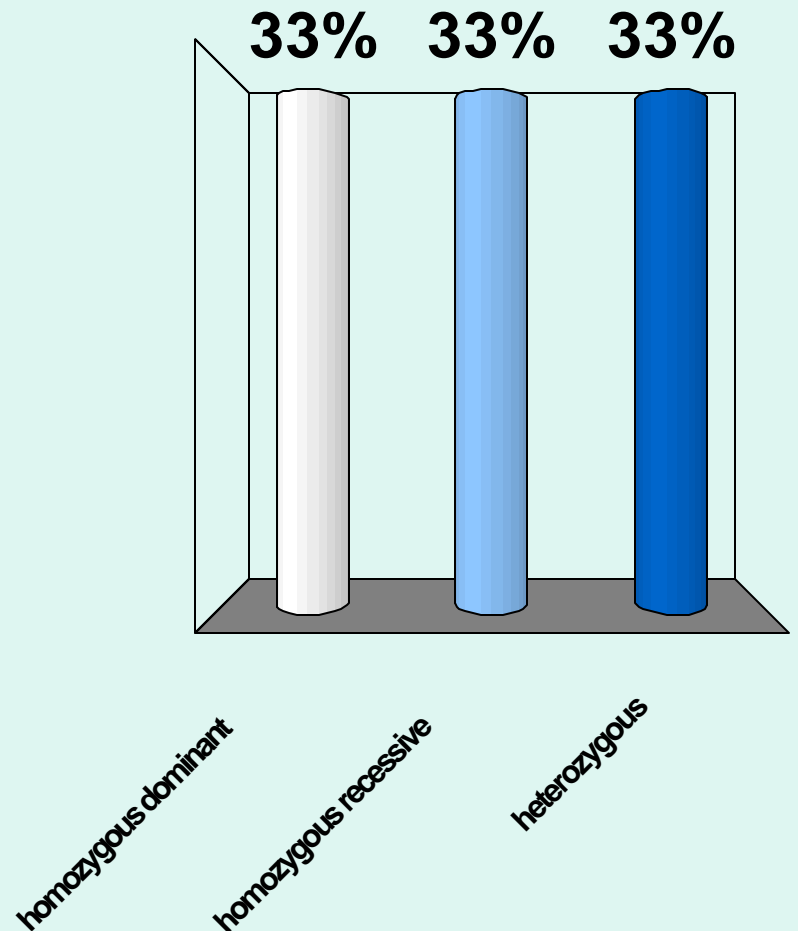


Benjamin  
Cummings

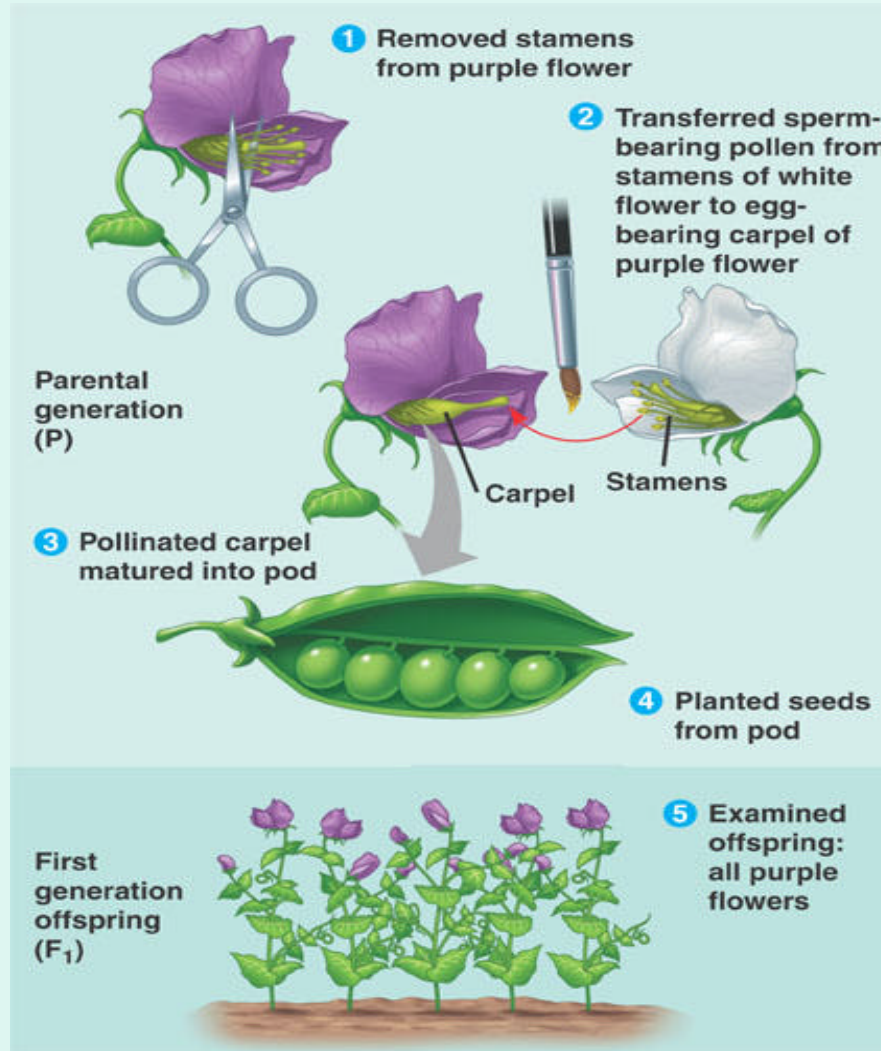
# This is a/an \_\_\_\_ genotype



1. homozygous dominant
2. homozygous recessive
3. heterozygous

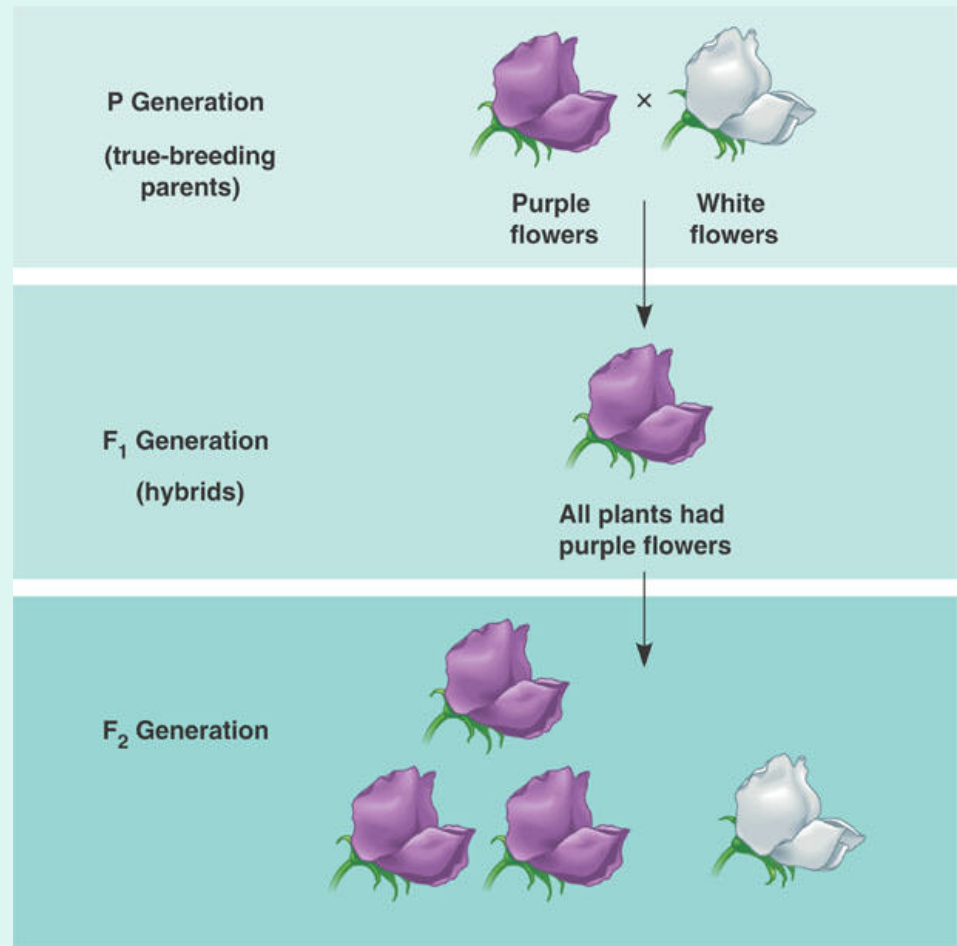


# Mendel's Experiments with Peas

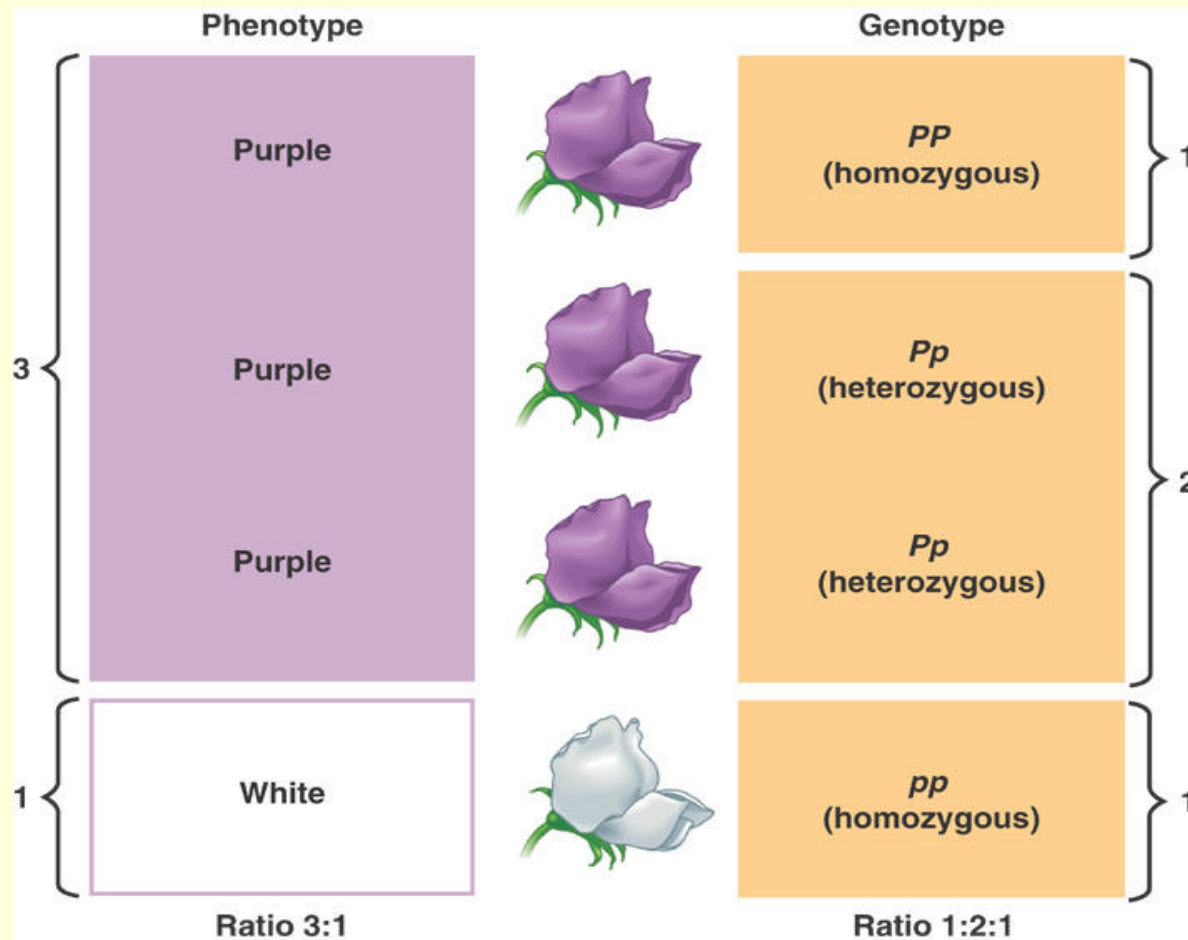


# Mendel's Theory of Inheritance of Traits. Monohybrid Cross

- Unless mutations occur, Mendelian traits are inherited in a predictable fashion
- $F_1$ : 100% purple, as they exhibit the dominant phenotype. The recessive trait is masked by the dominant gene
- $F_2$ : 75% purple, 25% white (phenotypic ratio = 3:1). The recessive phenotype appears in the  $F_2$



# Mendel's Experiments with Mendelian Traits



# Mendel's Theory of Inheritance of Traits. Monohybrid Cross

Each true-breeding plant of the parental generation has identical alleles,  $PP$  or  $pp$ .

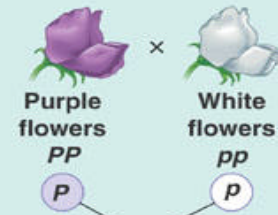
Gametes (circles) each contain only one allele for the flower-color gene. In this case, every gamete produced by one parent has the same allele.

## P Generation

Appearance:

Genetic makeup:

Gametes:



Union of the parental gametes produces  $F_1$  hybrids having a  $Pp$  combination. Because the purple-flower allele is dominant, all these hybrids have purple flowers.

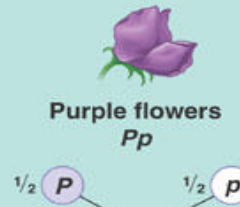
When the hybrid plants produce gametes, the two alleles segregate, half the gametes receiving the  $P$  allele and the other half the  $p$  allele.

## F<sub>1</sub> Generation

Appearance:

Genetic makeup:

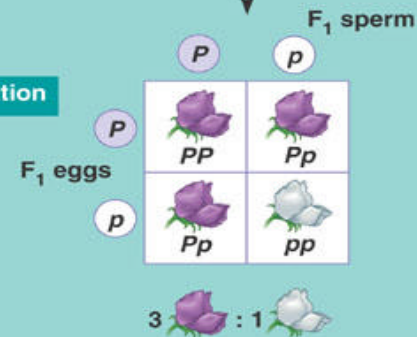
Gametes:



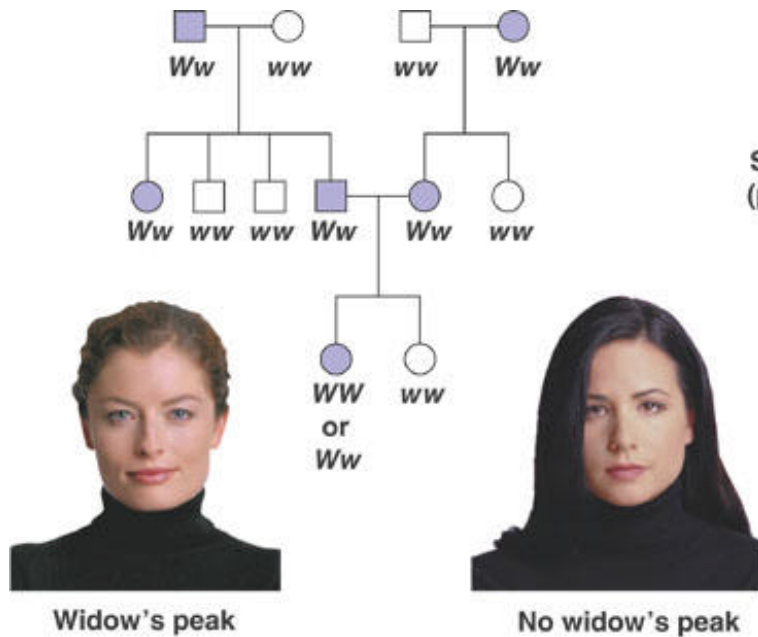
This box, a Punnett square, shows all possible combinations of alleles in offspring that result from an  $F_1 \times F_1$  ( $Pp \times Pp$ ) cross. Each square represents an equally probable product of fertilization. For example, the bottom left box shows the genetic combination resulting from a  $p$  egg fertilized by a  $P$  sperm.

Random combination of the gametes results in the 3:1 ratio that Mendel observed in the  $F_2$  generation.

## F<sub>2</sub> Generation

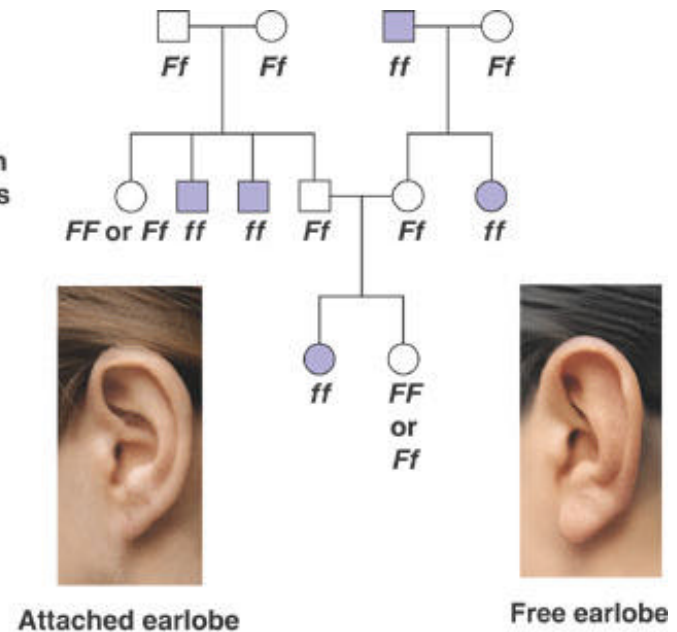


# Mendelian Traits. Pedigrees



(a) Dominant trait (widow's peak)

First generation  
 (grandparents)  
 Second generation  
 (parents plus aunts  
 and uncles)  
 Third  
 generation  
 (two sisters)



(b) Recessive trait (attached earlobe)



# Mendelian Traits in Humans

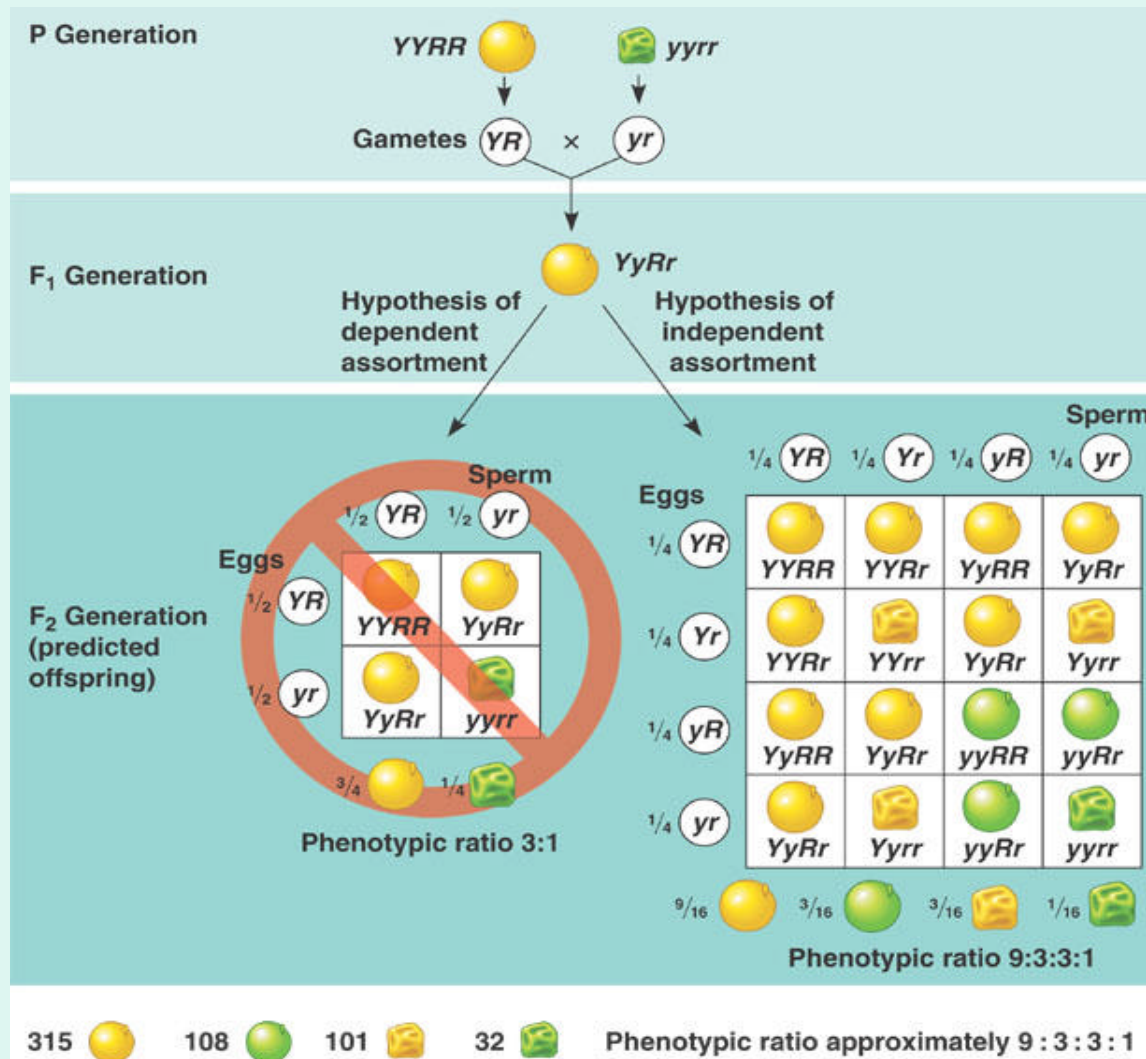


**Recessive phenotype: Albinism**



**Dominant phenotype: Achondroplasia**

# Mendel's Theory of Inheritance of Traits. Dihybrid Cross



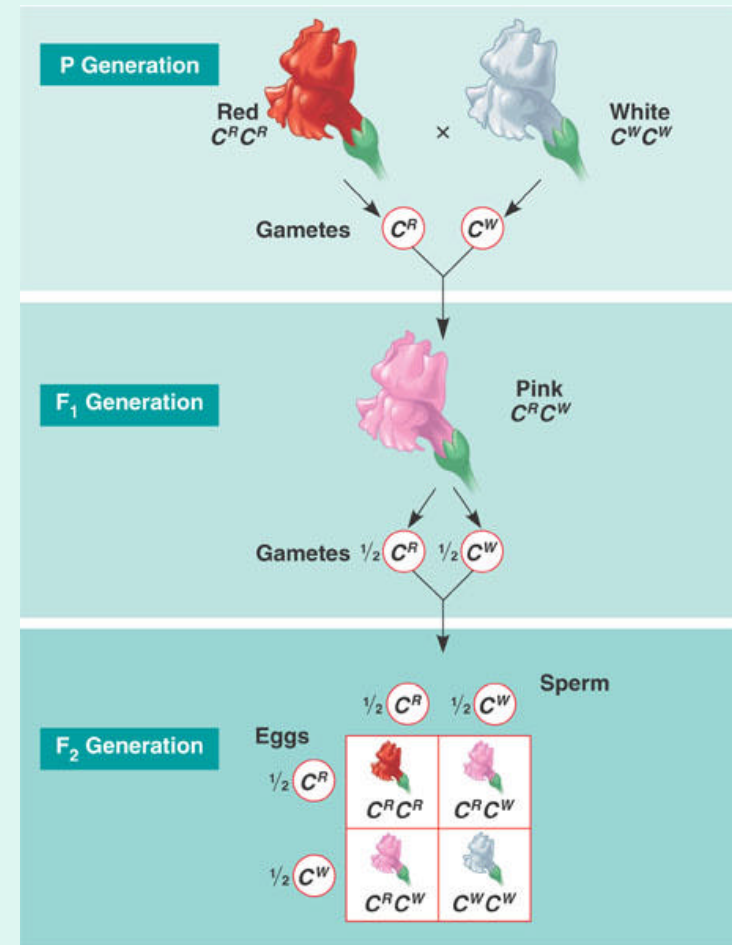
# Incomplete Dominance



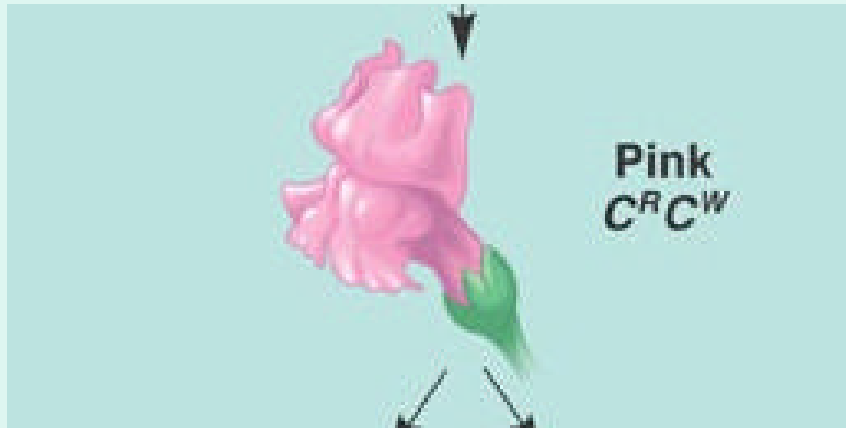
*Incomplete Dominance in Carnation Coloration*

# Incomplete Dominance

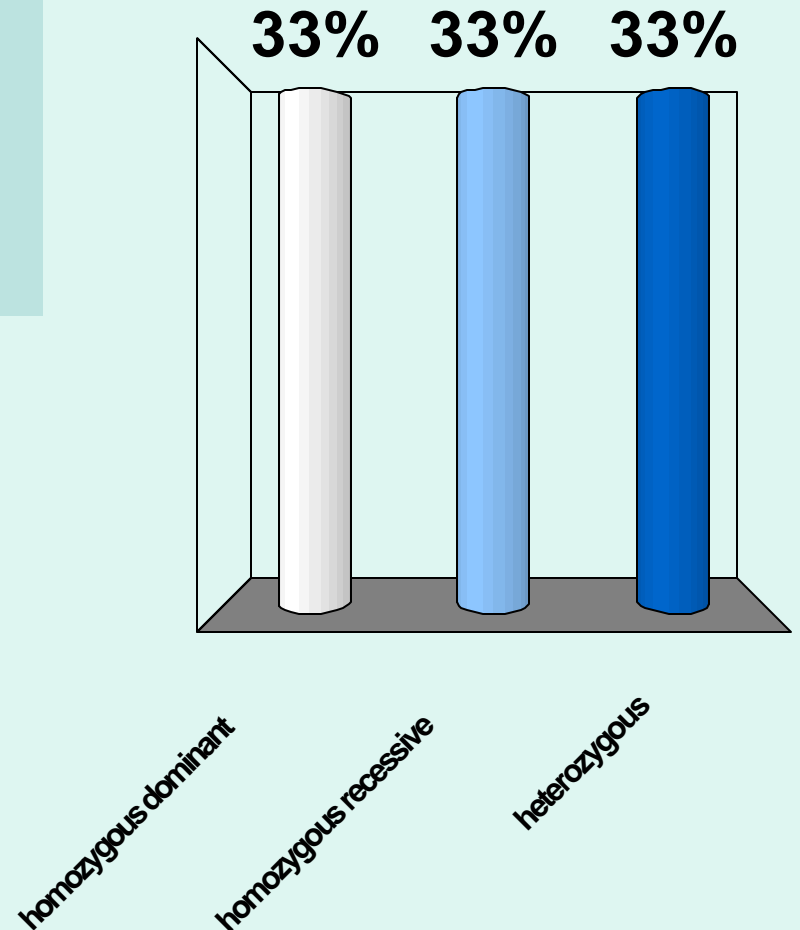
- $C^R C^R$ : Red Petals
- $C^R C^W$ : Pink Petals
- $C^W C^W$ : White Petals



# This is a/an \_\_\_\_ genotype



1. homozygous dominant
2. homozygous recessive
3. heterozygous







# Codominance. Human Blood Types

Codominance is a condition where two non-identical alleles of a pair specify two different phenotypes, yet one cannot mask the expression of the other (blood types in humans)

Blood types in humans are an example of a *multiple allele system*

**Table 14.2** Determination of ABO Blood Group by Multiple Alleles

Genotype	Phenotype (Blood Group)	Red Blood Cells
$I^A I^A$ or $I^A i$	A	
$I^B I^B$ or $I^B i$	B	
$I^A I^B$	AB	
$ii$	O	

# Codominance. Human Blood Types





“A” gives to A,  
receives from A and O

“B” gives to B,  
receives from B and O

“AB” gives to AB,  
receives from A, B,  
and O

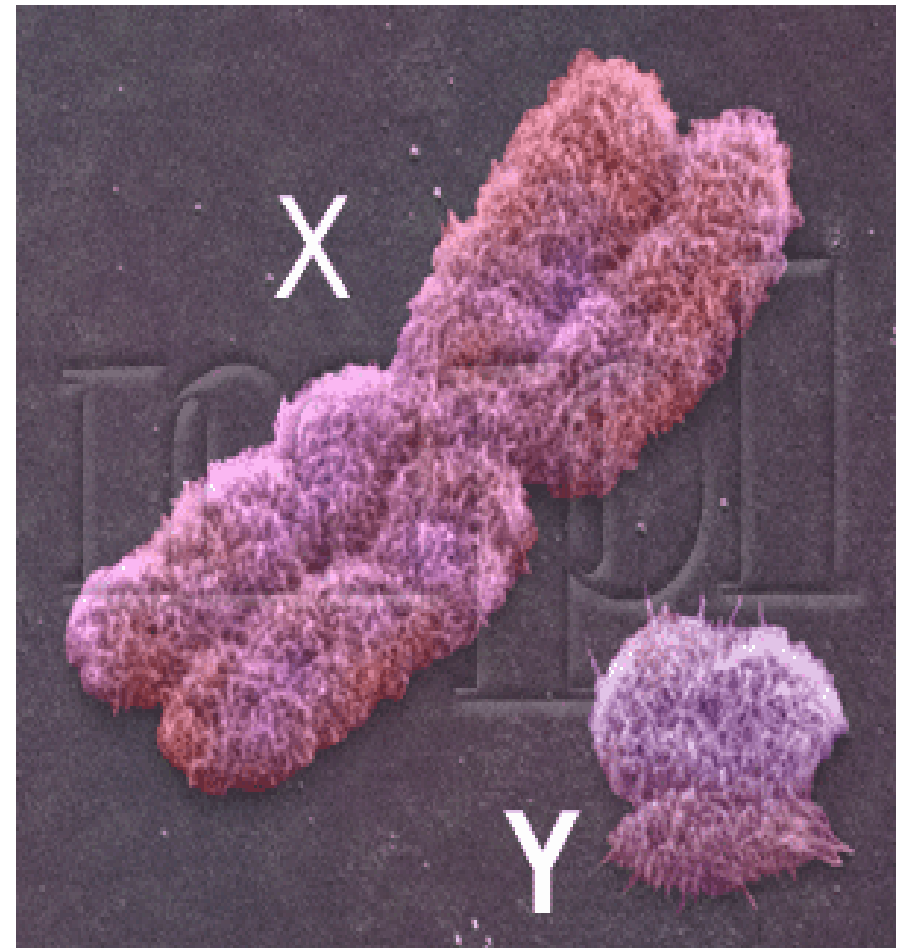
“O” gives to all blood  
types, receives only  
from O

**Table 14.2** Determination of ABO Blood Group by Multiple Alleles

Genotype	Phenotype (Blood Group)	Red Blood Cells
$I^A I^A$ or $I^A i$	A	
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# Sex Determination and Sex-Linked Traits

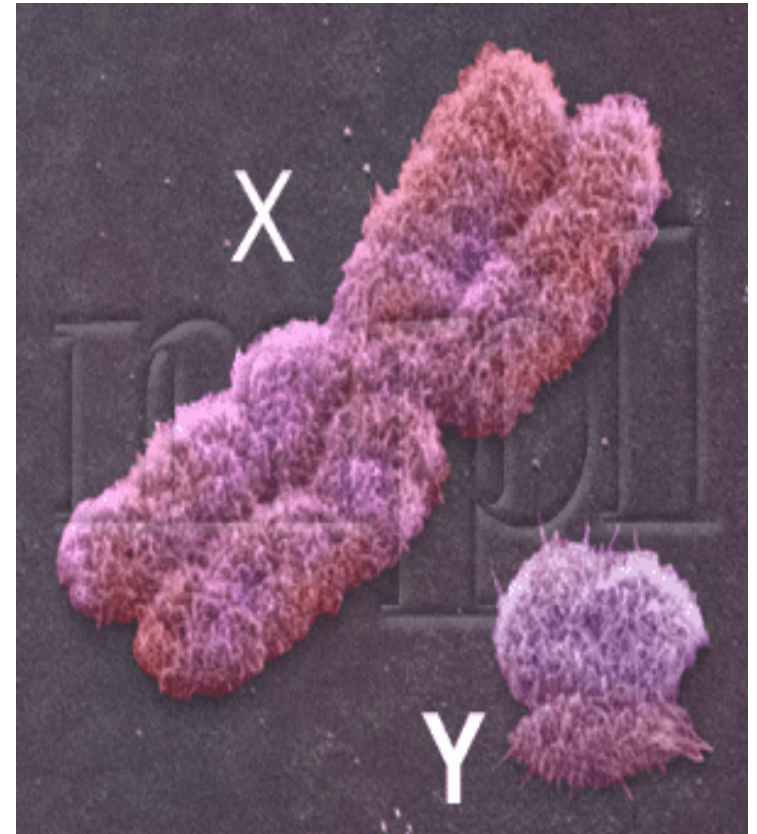
- Out of the 23 pairs of chromosomes, one pair contains the *sex chromosomes*. The non-sex chromosomes are referred to as *autosomes*
- Females are XX
- Males are XY





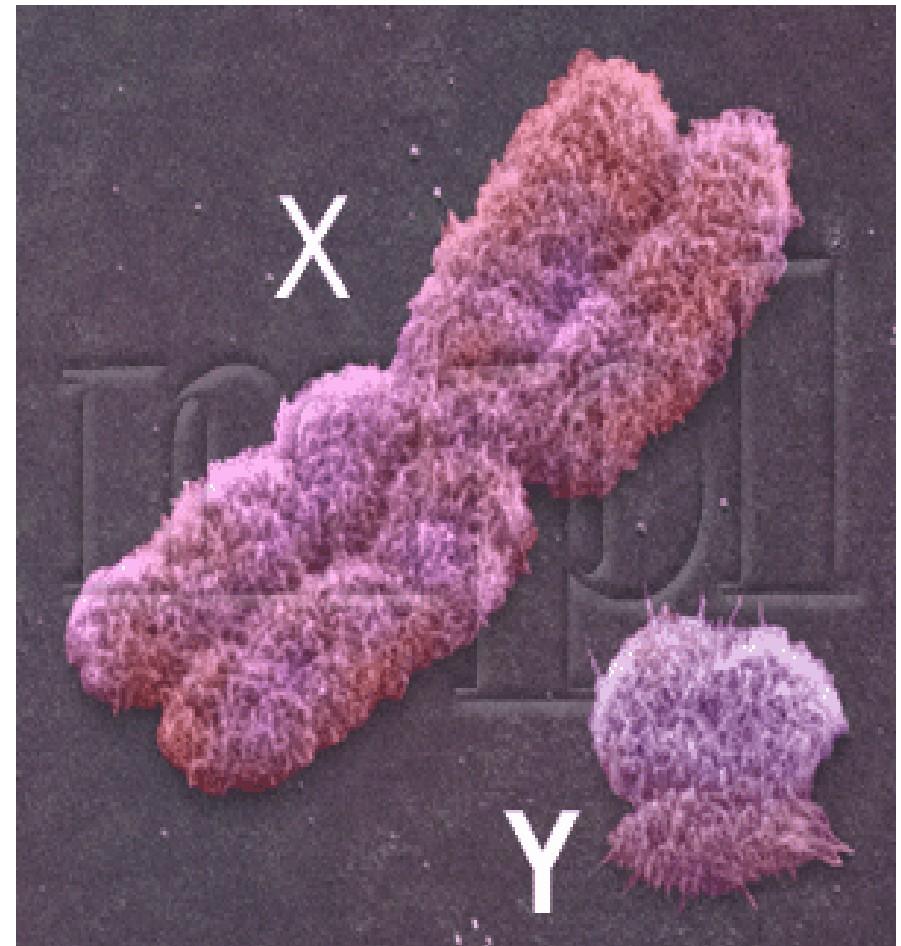
# Sex Determination and Sex-Linked Traits

- How is sex determined?

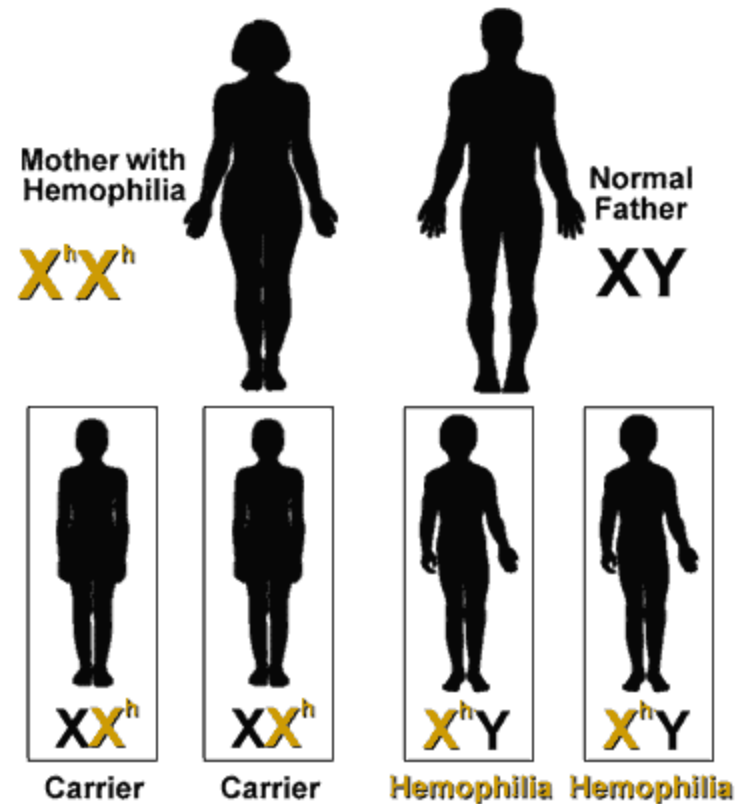
# Sex Determination and Sex-Linked Traits

- Besides sex information, there are almost 80,000 genes in the X chromosome, and about 90 in the Y chromosome
- Traits and genes linked to the X chromosome are referred to as “X-linked.”
- Traits and genes linked to the Y chromosome are referred to as “Y-linked.”



# X-Linked Traits

- Genes linked to the X chromosome that produce disease or certain conditions, are mostly recessive (colorblindness, haemophilia, baldness)



# X-Linked Traits: Haemophilia

**Inheritance of Hemophilia**  
**“Carrier” Mother and Father Without Hemophilia**

