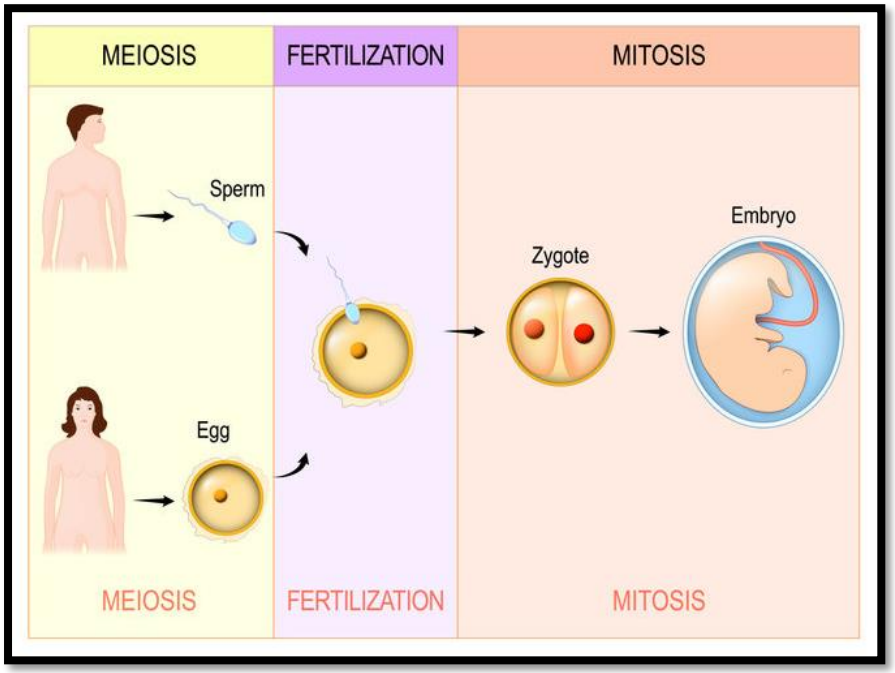
MENDELIAN GENETICS

Mendel's Laws and Dihybrid Crosses

Recap

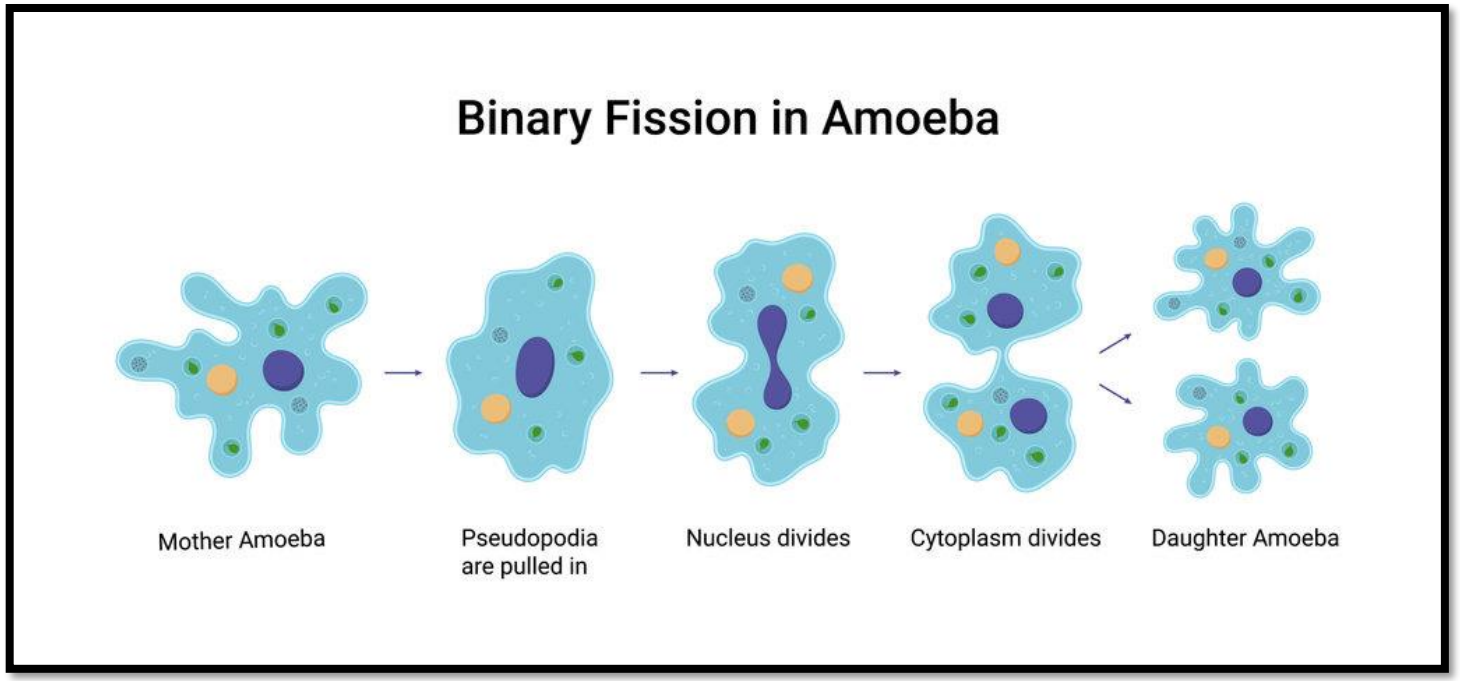
- Organisms can produce *sexually* or *asexually*.

- **sexual reproduction:**
  - requires 2 parents
  - produces genetic variation
  - uses gametes produced through meiosis



Recap

- **asexual reproduction:**
  - requires only 1 parent
  - no genetic variation
  - uses mitosis to create new

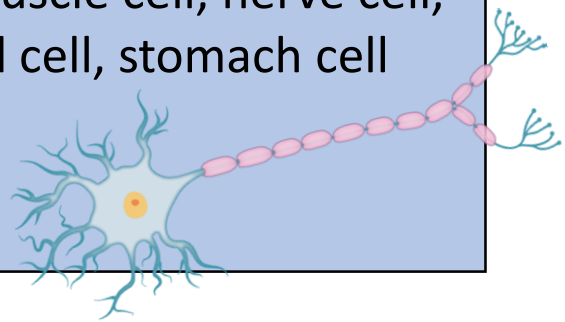


Recap

- Cells in the body of sexually producing organisms can be:
  - **Somatic Cells** (body cells)
  - **Gametes** (sex cells)

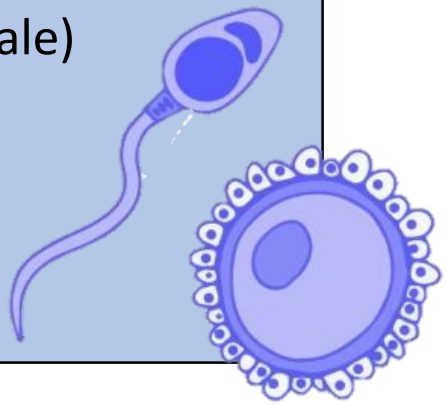
Somatic Cells

- contain the diploid (2n) chromosome number
- produced through mitosis
- 46 in humans (23 from mom, 23 from dad)
- ex. muscle cell, nerve cell, blood cell, stomach cell

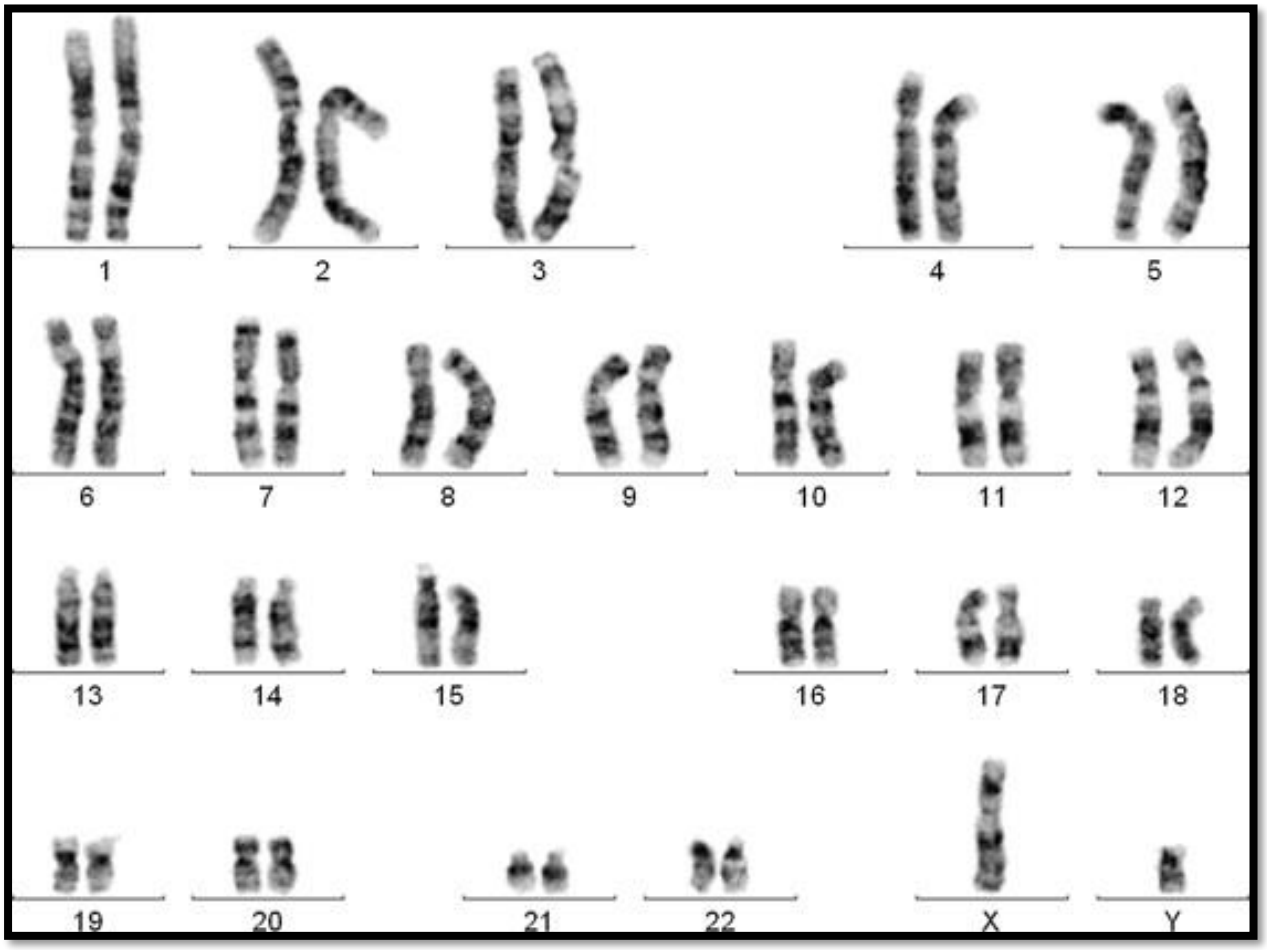


Gametes

- contain the haploid (n) chromosome number
- produced through meiosis
- ex. sperm cell (male) and egg cell (female)



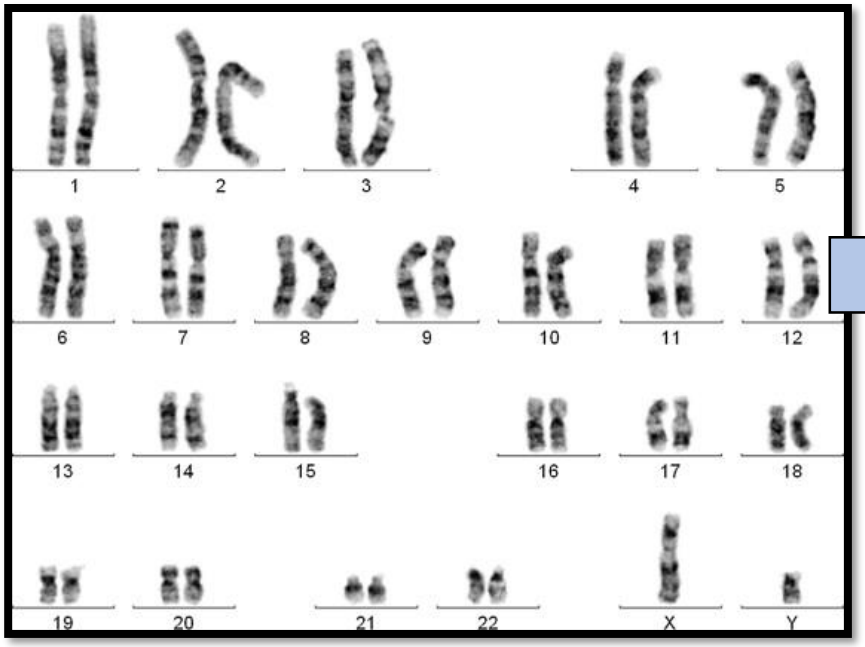
A **chromosome** is a thread-like structure made up of DNA. **Chromosomes** are found in the nucleus of each cell. A karyotype is used to show an individual's chromosomes.

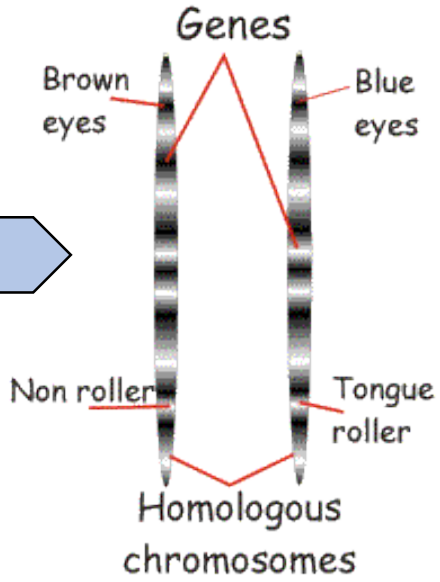


The typical **human karyotypes** contain 22 pairs of autosomal chromosomes and one pair of sex chromosomes.

Recap

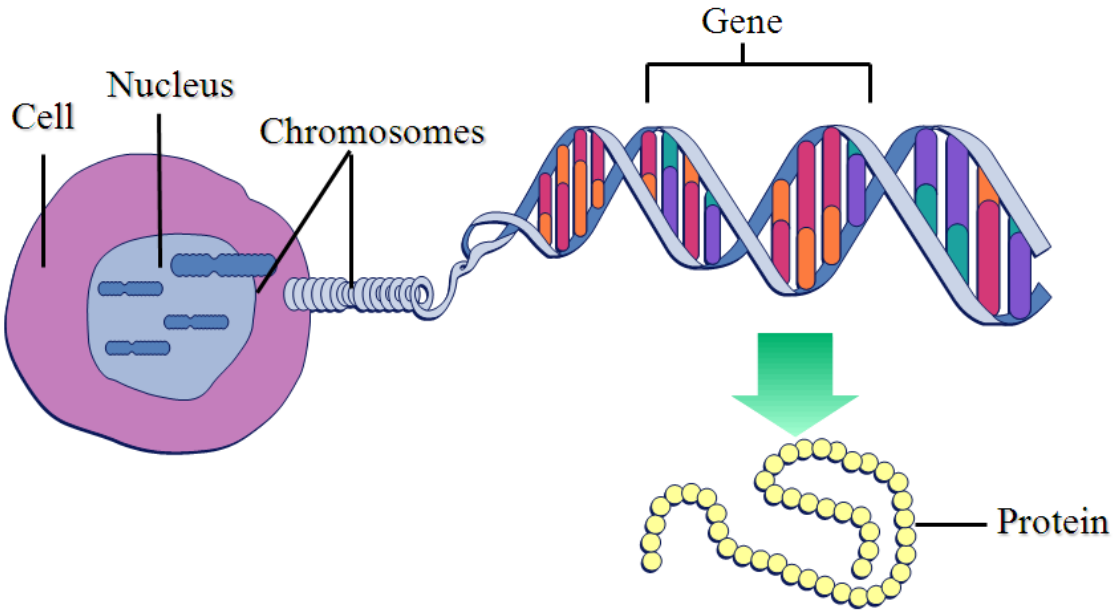
- **This karyotype shows homologous chromosomes**: the matching chromosomes from our mom and dad.
  - *They contain the same genes in the same locations but may contain different alleles (different versions of the same gene).*





Recap

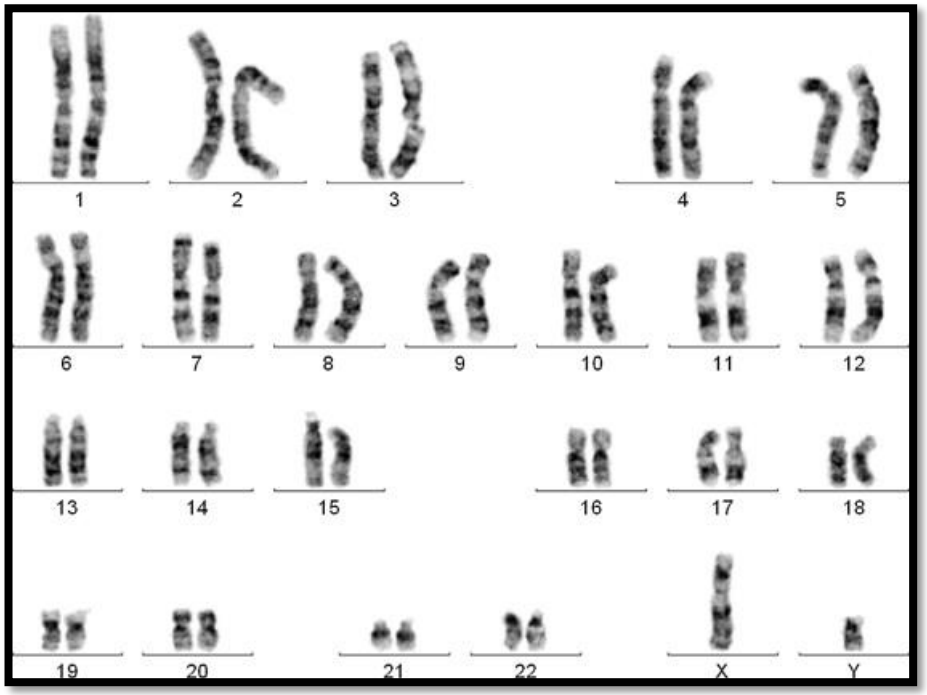
- **gene**: section of DNA that provides the instructions for making a protein



- Since a gene is a piece of a chromosome and we have two of every chromosome, we have **two copies of instructions to make every protein in our bodies**.

Recap

- **alleles**: different versions of the same gene
  - We inherited a full set of chromosomes (containing genes) from each of our parents, but we may not have inherited the same version of every gene.



•Ex. Mom gave you a gene for blue eyes, and dad gave you a gene for brown eyes.

Mendel's Laws

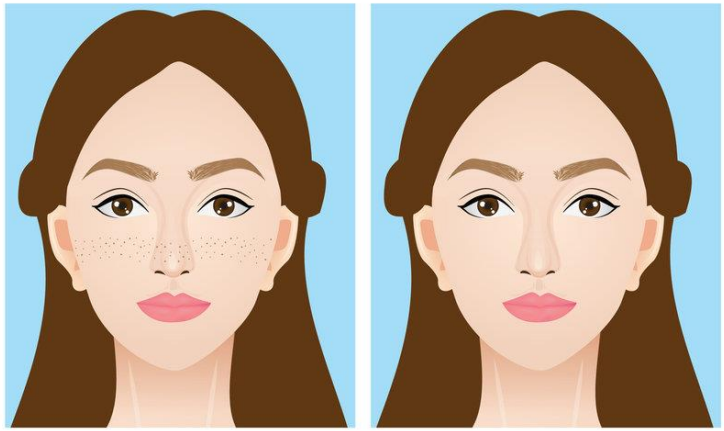
- In this unit, we are focusing on heredity (the passing of traits from parent to offspring).

- Gregor Mendel, in his experiments with pea plants, paved the way for what we know about inheritance today.

- He provided us with 3 laws of inheritance:
  - Law of Dominance
  - Law of Segregation
  - Law of Independent Assortment

Law of Dominance

A dominant allele will express itself over a recessive allele.

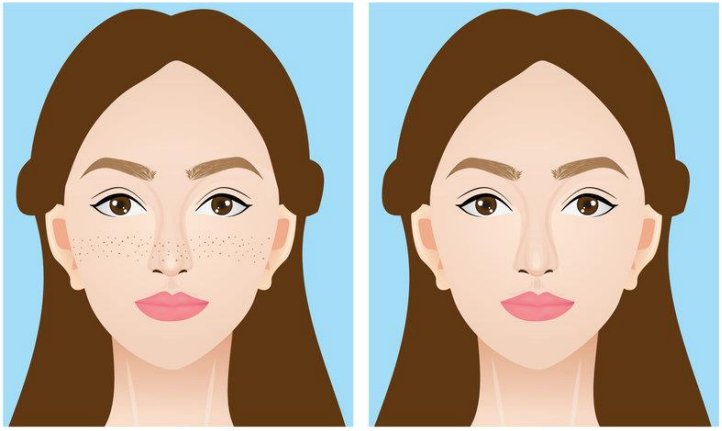


FRECKLES

- Freckles (F) are dominant over non-freckles (f).
- If a person inherits the F allele from one or both parents, they will have freckles.
- If a person inherits the recessive f allele from both parents, they will not have freckles.

Law of Dominance

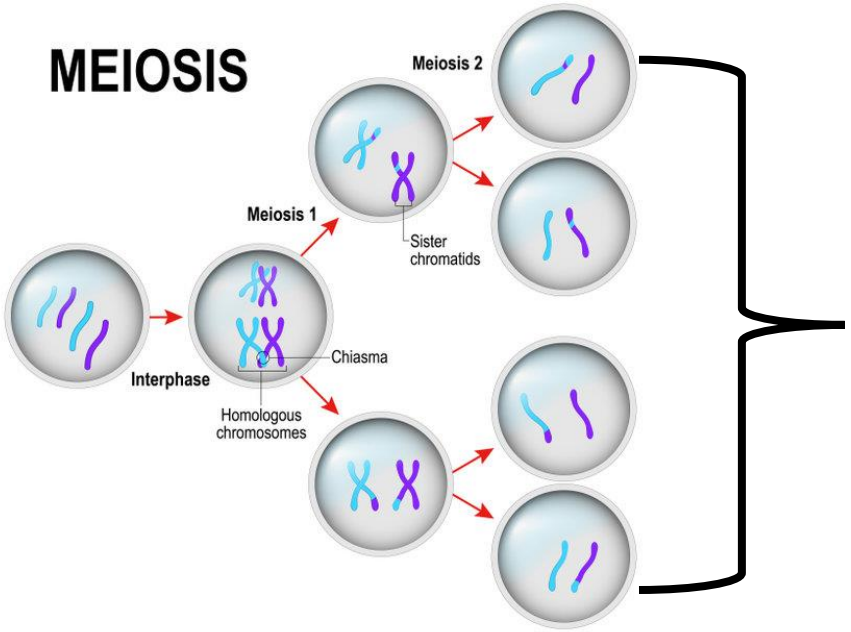
- **Remember:**
  - **genotype – the actual alleles inherited**
  - **ex: genes that code for freckles such as FF, Ff, or ff**
  - **phenotype – the physical traits/characteristics seen in an organism**
  - **ex: freckles**



FRECKLES

Law of Segregation

When chromosomes separate in meiosis, each gamete (egg or sperm) will receive only one chromosome from each pair.



The chromosomes **segregate** (or separate) during meiosis.

If a man has alleles for brown eyes and blue eyes, he is heterozygous (Bb) for eye color. His sperm cells can contain the allele for brown eyes (B) **OR** the allele for blue eyes (b).

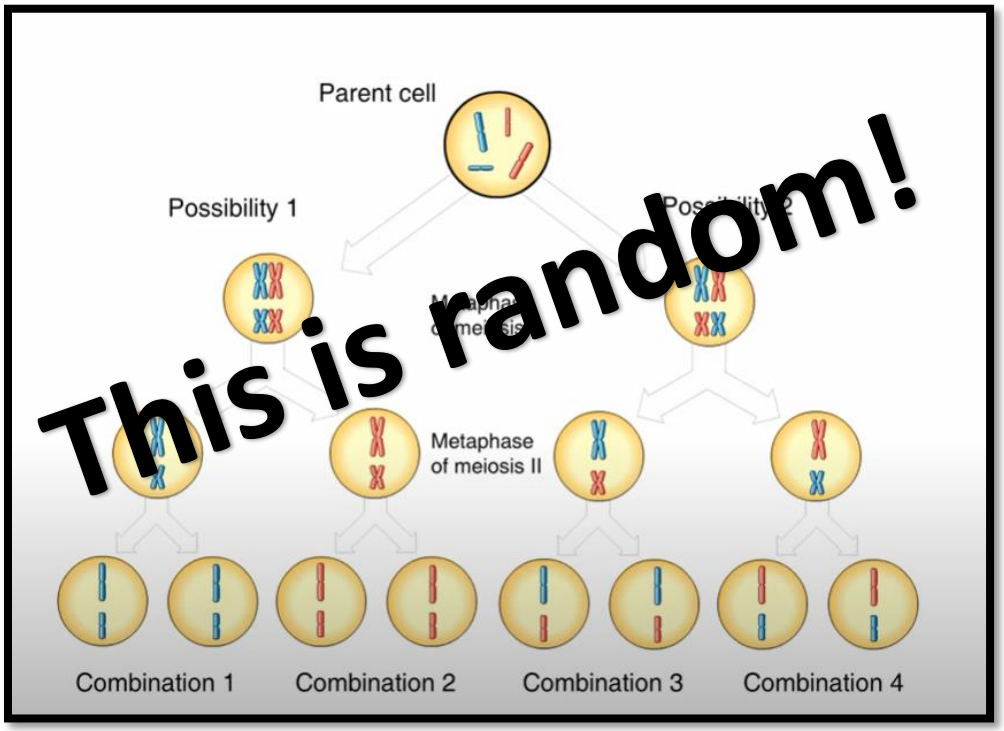
Each sperm only gets **ONE** of the alleles.

Video Explanation

Video Link: https://youtu.be/wQltEeAPtIk

Law of Independent Assortment

The inheritance of one trait does not affect the inheritance of another.



-Each pair of homologous chromosomes consists of one chromosome inherited from the father and one from the mother.

-Each pair of chromosomes line up independently of one another in meiosis I.

-There are two different ways that chromosome pairs can line up.

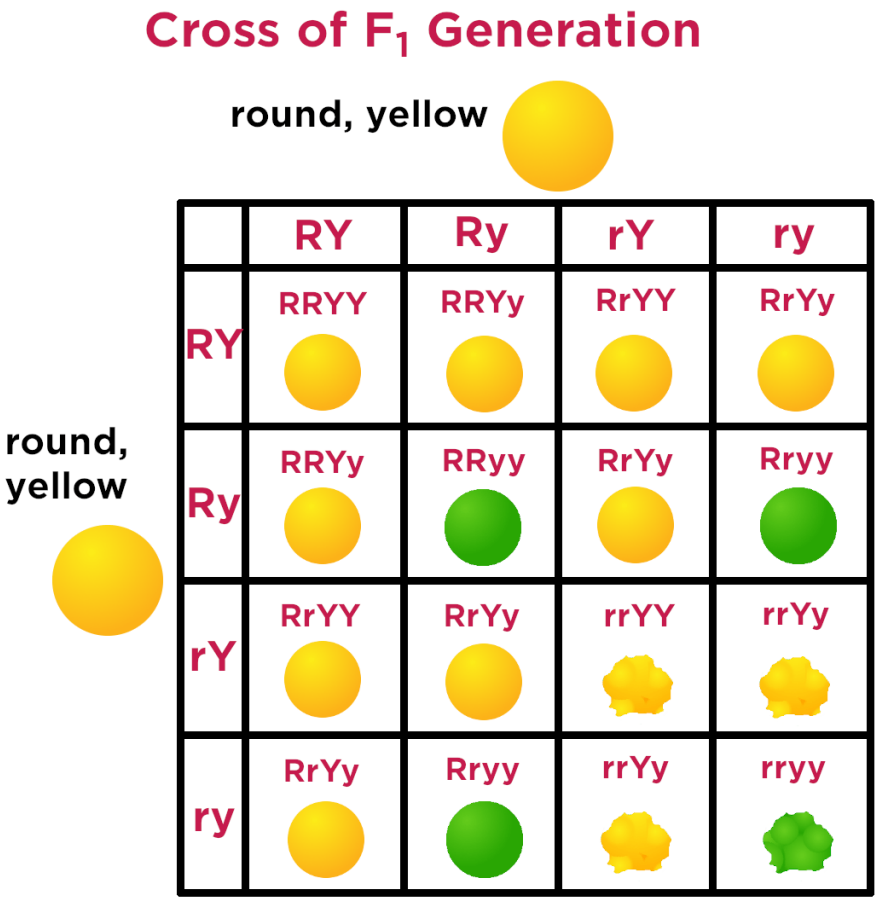
-In humans, this creates about 8 million combinations.

Video Explanation

Video Link: https://youtu.be/VAUE9YX1KOA

Dihybrid Crosses

- Dihybrid crosses are used when finding the possible genotypes for offspring when considering two traits at the same time.
- 16 squares



Dihybrid Crosses

Example #1:

Cross two parent pea plants that are heterozygous for pea color and flower color.

Notes:

Yellow peas (Y) are dominant to green peas (y).

Purple flowers (P) are dominant to white flowers (p).

Step 1

Write out the parent's genotypes.

Parent 1: YyPp

Parent 2: YyPp

Dihybrid Crosses

Example #1:

Cross two parent pea plants that are heterozygous for pea color and flower color.

Notes:

Yellow peas (Y) are dominant to green peas (y).

Purple flowers (P) are dominant to white flowers (p).

Step 2

Write out the possible allele combinations that each parent could contribute to the offspring.

Place these on the outside of the dihybrid Punnett square.

Dihybrid Crosses

Step 2

F- first

O- outer

I- inner

L- last

Parent 1:

YP

Yp

yP

yp

Dihybrid Crosses

Step 2

F- first

O- outer

I- inner

L- last

Parent 2:

YP

Yp

yP

yp

Dihybrid Crosses

Step 2

Write parent 1's alleles across the top (X axis) of the square.

Write parent 2's alleles down the side (Y axis) of the square.

Notes:

-Place all the alleles for pea color first, then pea shape.

-Place the dominant allele before the recessive allele (for the same trait).

Dihybrid Crosses

Parent 1:

YP

Yp

yP

yp

Parent 2:

YP

Yp

yP

yp

	YP	Yp	yP	yp
YP				
Yp				
yP				
yp				

Dihybrid Crosses

yellow pea/purple flower: **9**

yellow pea/white flower: **3**

green pea/purple flower: **3**

green pea/white flower: **1**

Step 3

Combine the alleles from the top and left to fill in the square.

Determine the phenotypic ratio.

Notes:

-Place all the alleles for pea color first, then pea shape.

-Place the dominant allele before the recessive allele (for the same trait).

	YP	**Yp**	**yP**	**yp**
YP	YYPP	YYPp	YyPP	YyPp
Yp	YYPp	YYpp	YyPp	Yypp
yP	YyPP	YyPp	yyPP	yyPp
yp	YyPp	Yypp	yyPp	yypp

Let’s do another!

Dihybrid Crosses

Example #2:

Tall plants (D) are dominant over dwarf plants (d). Purple flowers (W) are dominant over white flowers (w). Cross a homozygous dominant parent with a homozygous recessive parent.

Step 1

Write out the parent's genotypes.

Parent 1: DDWW

Parent 2: ddww

Dihybrid Crosses

Example #2:

Tall plants (D) are dominant over dwarf plants (d). Purple flowers (W) are dominant over white flowers (w). Cross a homozygous dominant parent with a homozygous recessive parent.

Step 2

Write out the possible allele combinations that each parent could contribute to the offspring.

Place these on the outside of the dihybrid Punnett square.

Dihybrid Crosses

Step 2

F- first

O- outer

I- inner

L- last

Parent 1:

DW

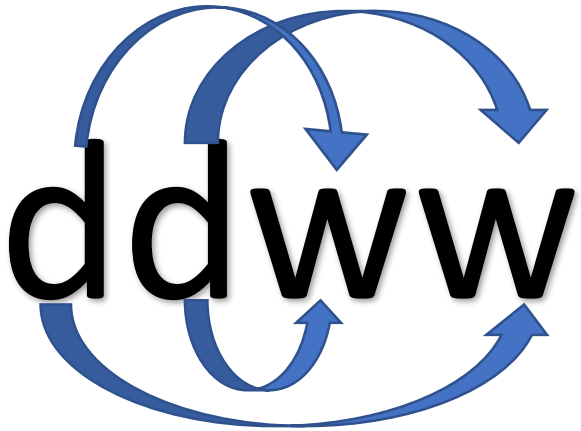
DW

DW

DW

Dihybrid Crosses

Step 2



F- first

O- outer

I- inner

L- last

Parent 2:

dw

dw

dw

dw

Dihybrid Crosses

Parent 1:

DW
DW
DW
DW

Parent 2:

dw
dw
dw
dw

	DW	DW	DW	DW
dw				
dw				
dw				
dw				

Dihybrid Crosses

tall plant/ purple flowers: **16**

tall plant/ white flowers: **0**

dwarf plant/ purple flowers: **0**

dwarf plant/ white flowers: **0**

Step 3

Combine the alleles from the top and left to fill in the square.

Determine the phenotypic ratio.

Notes:

-Place all the alleles for plant height first, then plant color.

-Place the dominant allele before the recessive allele (for the same trait).

	DW	DW	DW	DW
dw	DdWw	DdWw	DdWw	DdWw
dw	DdWw	DdWw	DdWw	DdWw
dw	DdWw	DdWw	DdWw	DdWw
dw	DdWw	DdWw	DdWw	DdWw