From Micro to Macro Genetics

What we know…

- **Physical characteristics** (what you look like) are determined by genes that are **inherited from parents**
- There are **two forms of genes (alleles) for every characteristic** (one from mom, one from dad)
- **Mutations** can create favorable, unfavorable or no change at all. **Everyone has them!**
  - More on mutations next unit

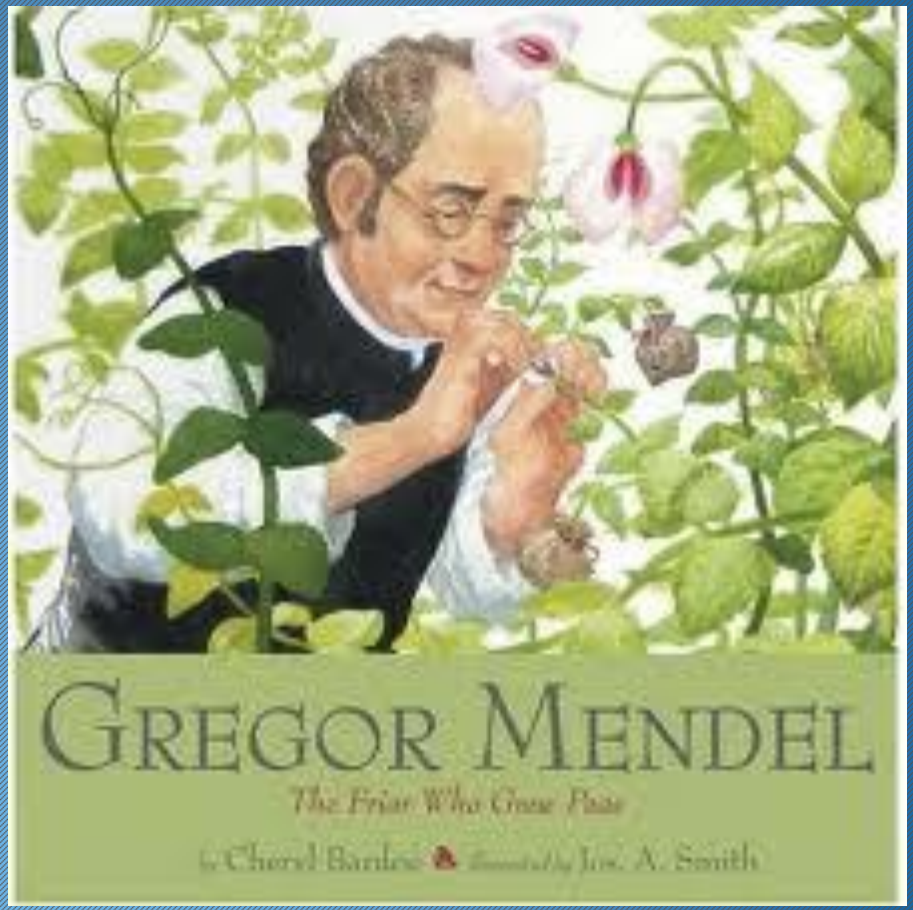
How do we know this?

…How do we know that genetic information is passed through our chromosomes/ genes?

Gregor Mendel

Gregor Mendel

- Father of "Mendelian Genetics"
- Made discoveries in the 3-step experiment (which you may have learned about last year)



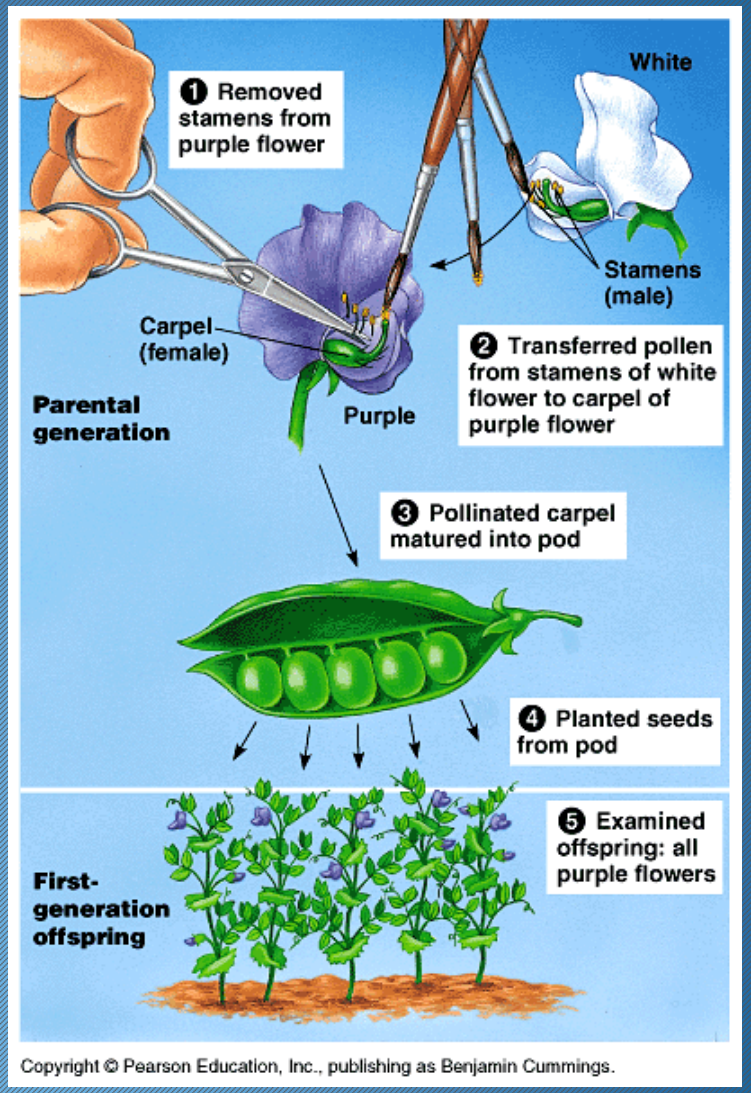
Quick Question #1

What do you think "purebred" plants are? What kind of offspring do you think they will always produce?

Step 1: Purebred Pea Plants

- Lets start by thinking of only one trait

- He started with:
  - pure-bred pea plants (P1- parental generation)
  - These will reproduce and always have offspring that are identical to the original



Quick Question #2

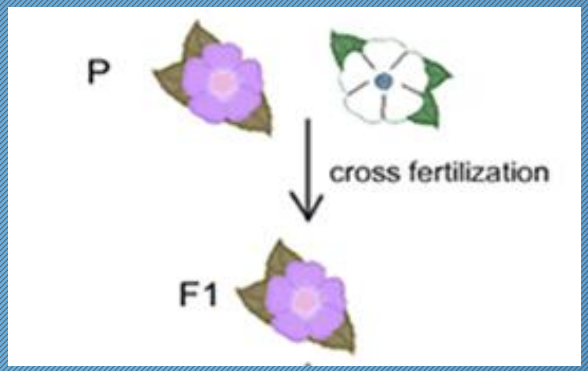
What color flower do you think the offspring will be F_1 generation will be? (F1 is created by breeding purebred purple with purebred white) Why?

Step 2: Cross Fertilization

(think about bag labeled F1)

Cross-fertilized two different Pea varieties (F1 generation)

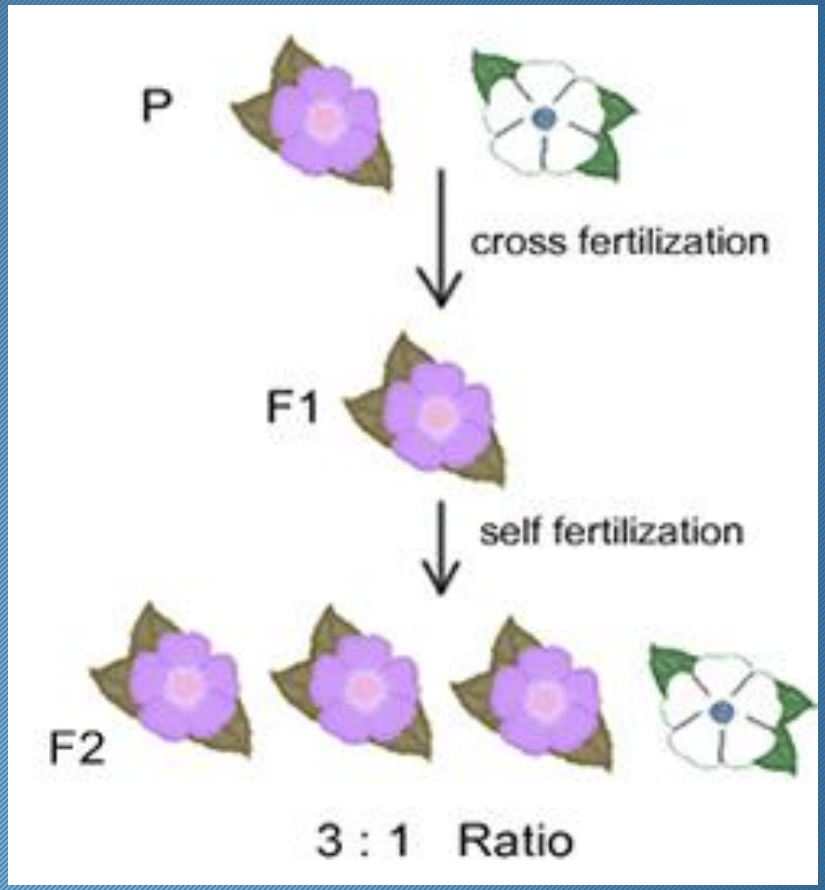
- **All offspring (Hybrids) look like one parent. There is no mixing of colors.**
  - **Ex: green pea crossed with a yellow pea: results in all yellow peas**
  - **Ex: purple flowers with white flowers: results in all purple flowers**



Step 3: Hybrid Self Fertilization

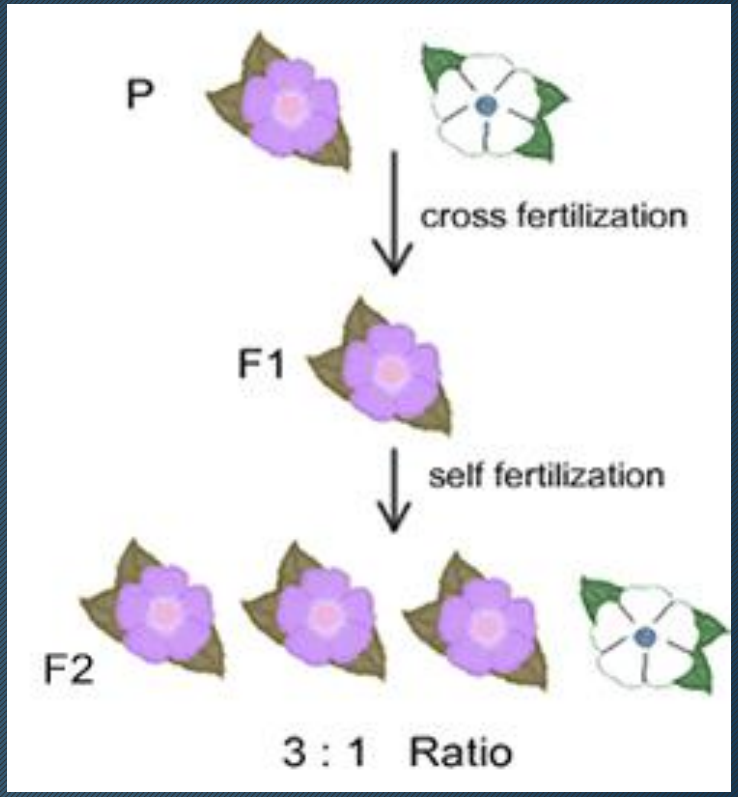
Mendel Self-fertilized the F1 plants to create the F2 generation

- **3:1 ratio of each parent**



Quick Question #3

How can you explain the re-occurrence of the parental color when it had "disappeared" before?



What Does The outcome of 3:1 Mean for inheritance?

- Mendel thought: "There must be some factor that controls the genes"…genes
  - **Alleles:** different forms of genes (ex: flower color can be purple or white)
- Mendel's idea:
  - **The Principle of Dominance:** some factors are *dominant* while others are *recessive*

Quick Question #4

Summarize the Principle of Dominance

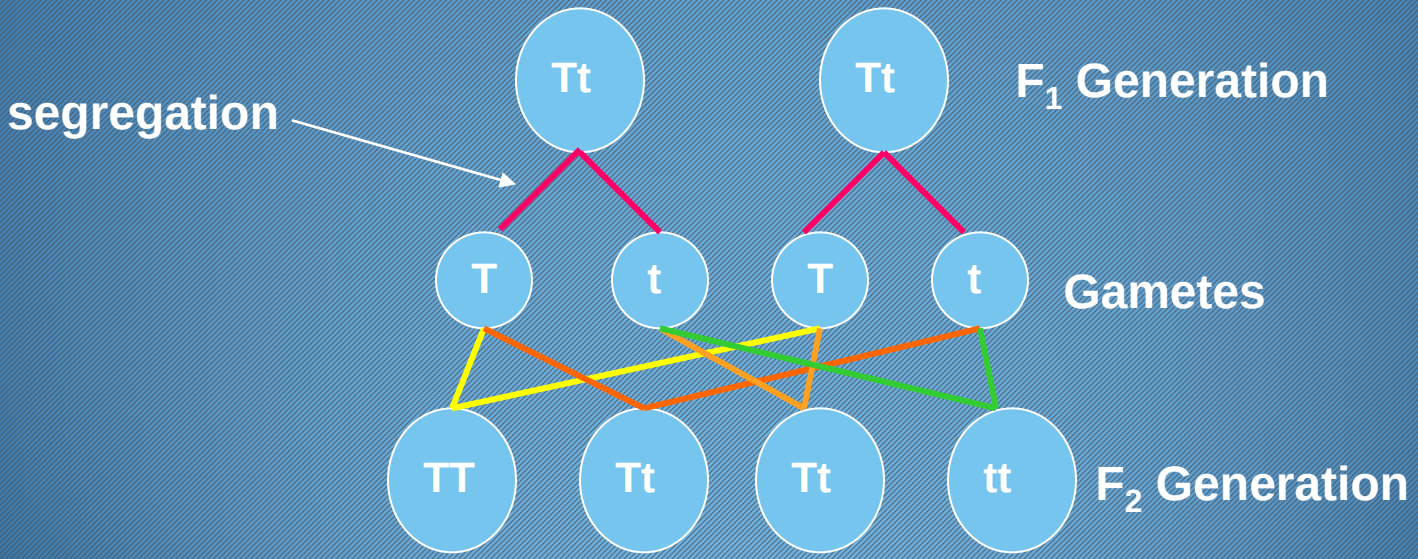
Quick Question #5

We all have 2 alleles for each gene/trait. One dominant and one recessive gene.

Where do they come from?

So, what determines which allele you get from each parent?

The principle of segregation: for any particular trait, the pair of alleles of each parent separate and only one allele passes from each parent on to an offspring.



The Principle of Segregation

Each parent plant has 2 alleles for each trait (one from mom, one from dad)

Mendel proposed that the 2 alleles separate during gamete formation and are paired up again during fertilization

Can be explained
using the Punnett squares
you have used before

	A	a
a	Aa	aa
a	Aa	aa

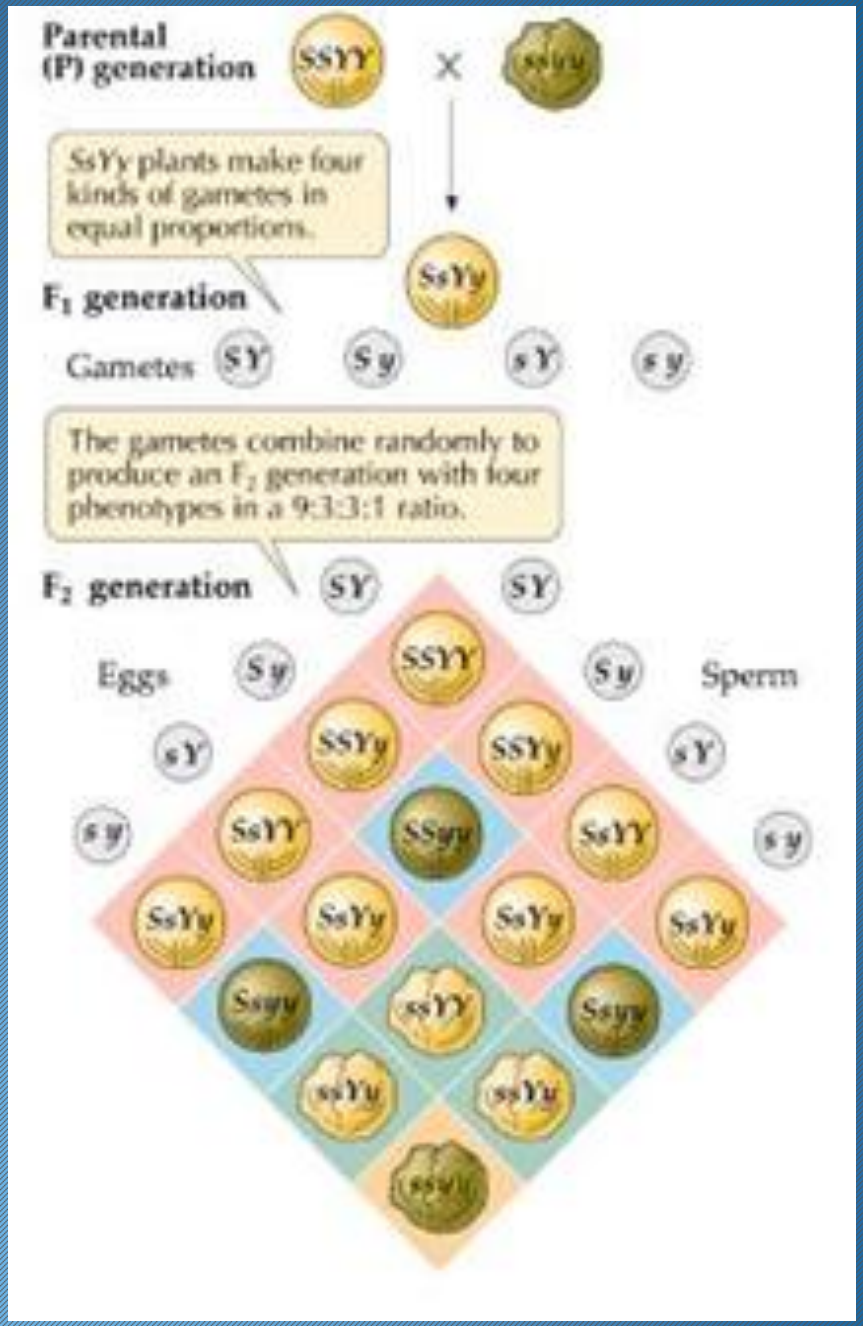
What if you look at more than one allele at a time?

For example, pea color AND pea shape.

If the parents are smooth and yellow (SSYY) and wrinkly and green (ssyy) create a Punnett square to determine all possible characteristics.

The Experiment…

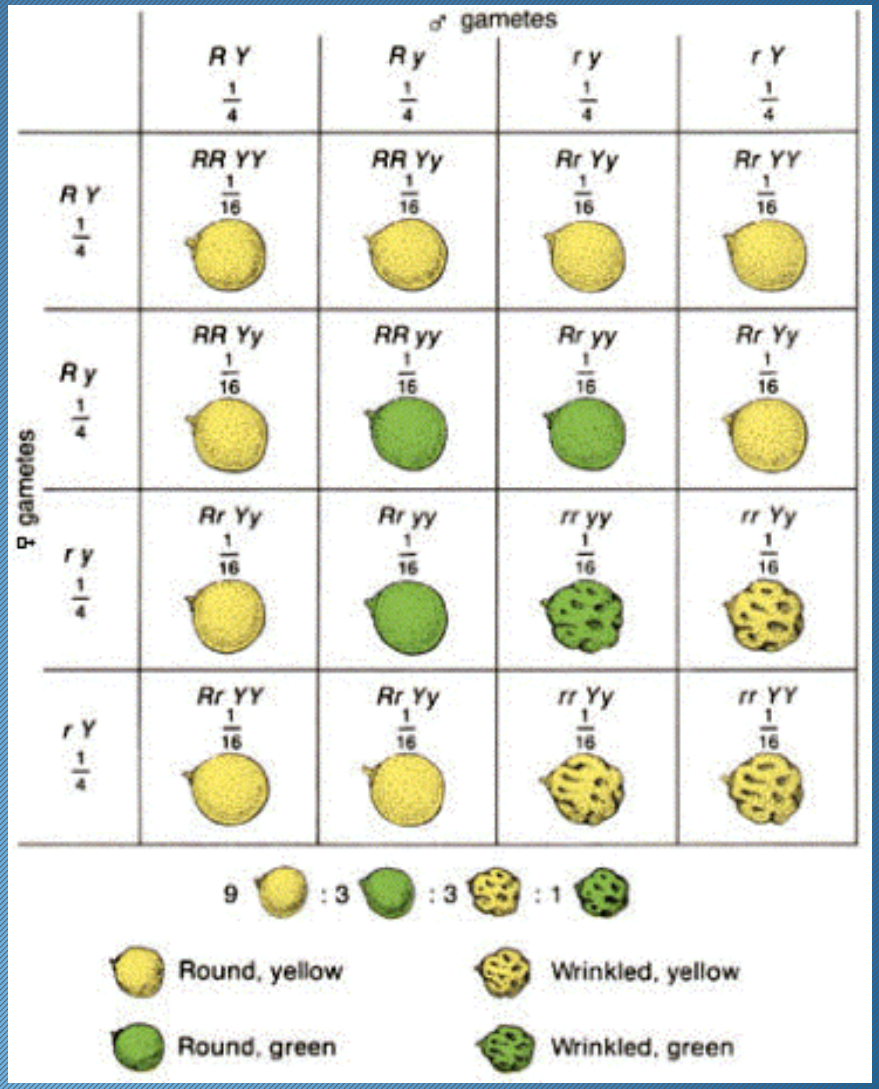
1. The **two-factor cross**: parental (P) generation has 2 traits
2. Gametes (F_1 generation) have segregated alleles
3. Gametes fuse to produce offspring with specific traits (F_2 generation)



The Results…

The 9:3:3:1 ratio made Mendel to propose the Law of Independent Assortment

In a *dihybrid cross*, the inheritance of one trait does not influence the inheritance of another trait

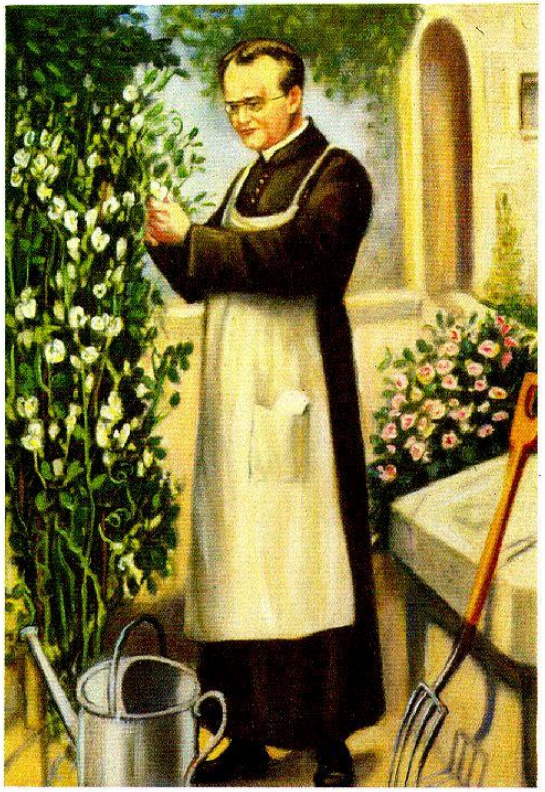


The Principle of Independent Assortment

During gamete formation different pairs of alleles (different traits) are passed to offspring independently of each other.

MEANING: that just because the pea is green does not mean the pea has to be smooth.

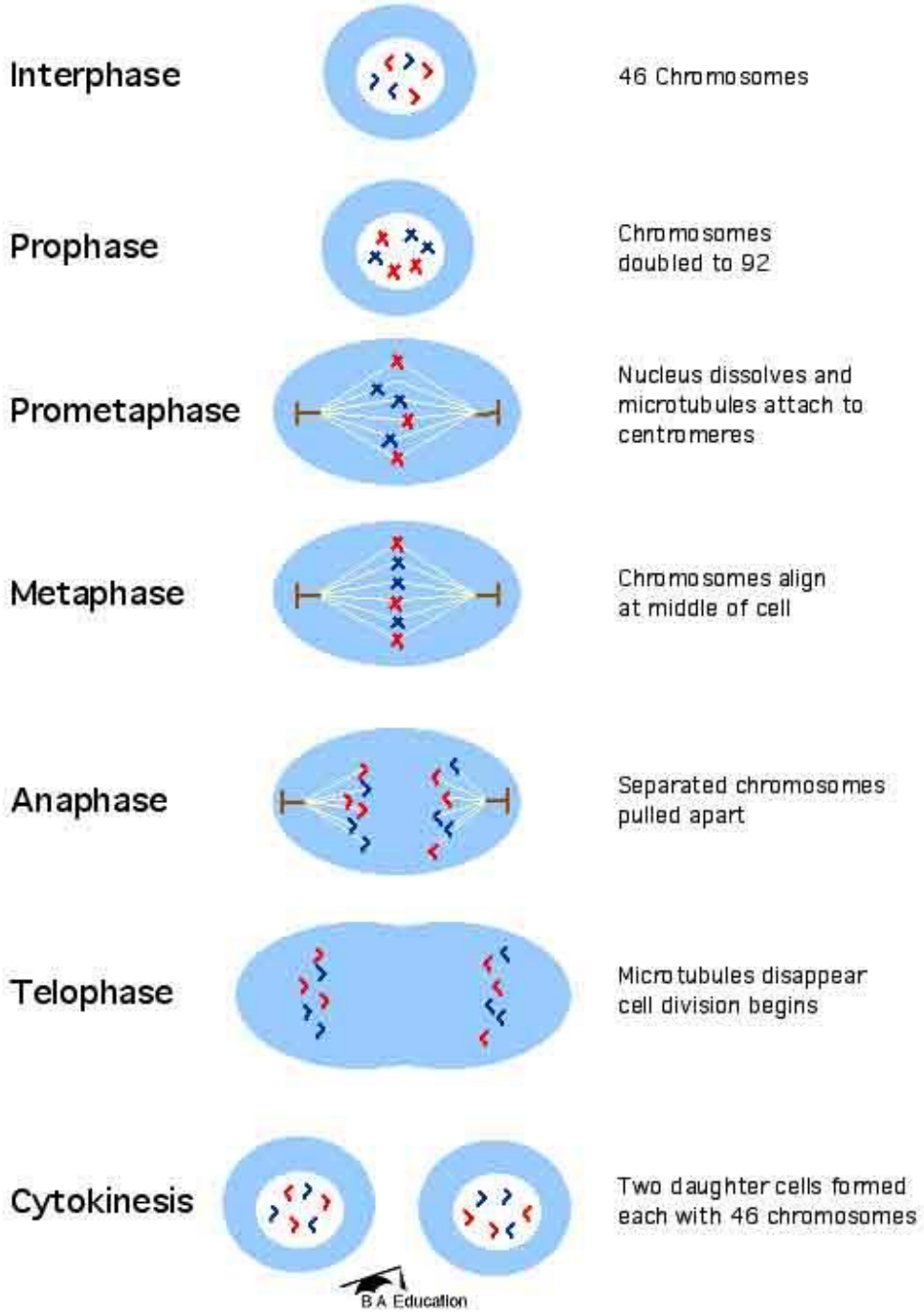
The result is that new combinations of genes present in neither parent are possible.



Gregor Mendel

Mendel discovered by looking at only PHENOTYPE, without knowing about genes…

We know more know because of mitosis and meiosis



Reviewing Mitosis

- This occurs in order to replicate all our body cells
- The process starts with one cell with 46 chromosomes
- The process results in two identical cells

In order to understand genetics and inheritance, you need to understand how gametes (sex cells-sperm and egg) are created

MEIOSIS!!!!!

Meiosis has **two** parts: Meiosis I and Meiosis II

Meiosis I:

DNA has been replicated. These homologous chromosomes line up in pairs

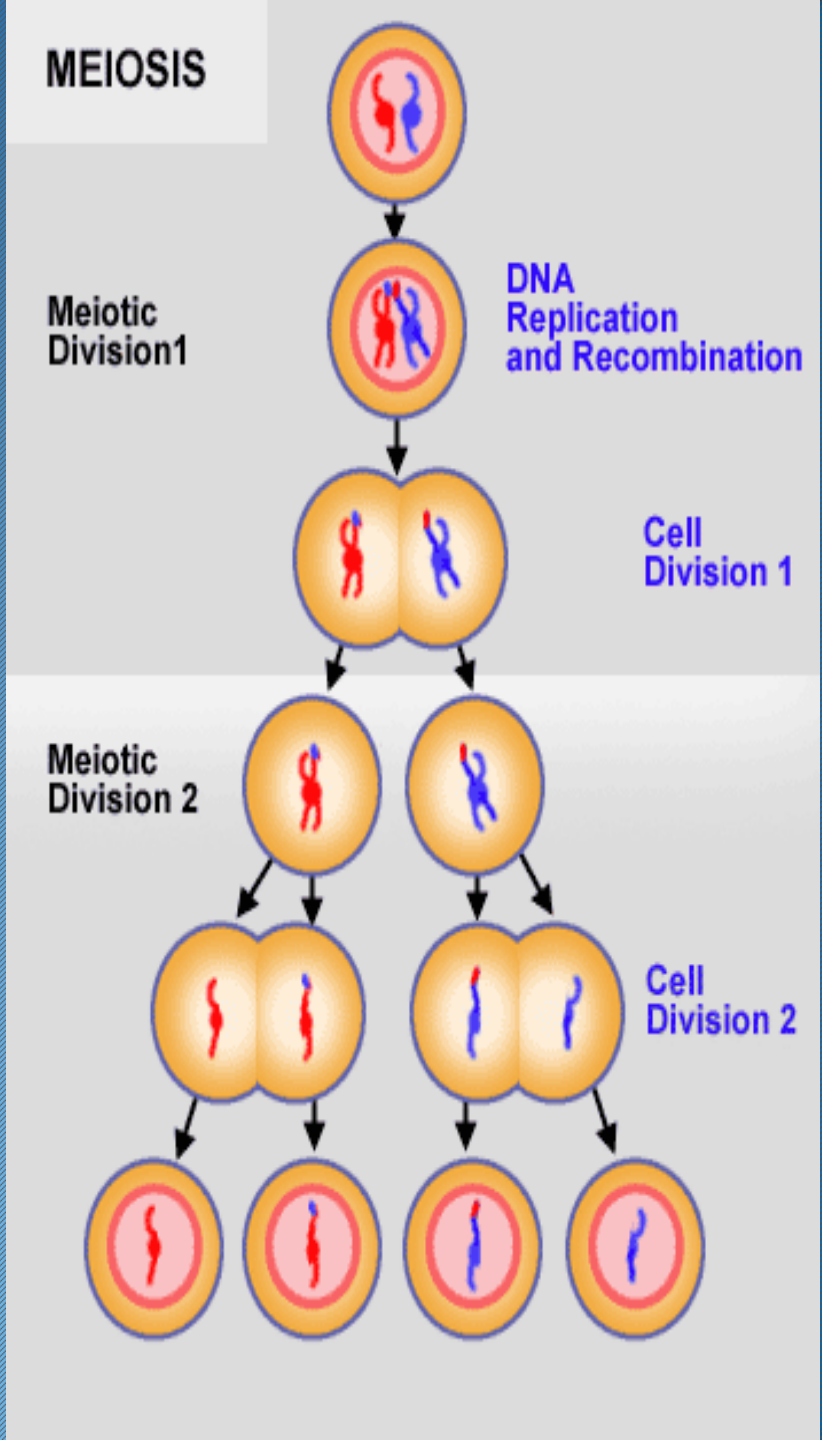
When the cell divides, each cell gets one chromosome set. Two cells with half the number of chromosomes as the original cell are created

Meiosis II:

There is NO DNA replication before this round of cell division

The chromosomes line up like they did in mitosis

The chromosomes are pulled apart and each of the 4 resulting haploid cells have half the number of chromosomes as the original cell



Purpose of Meiosis

- In order for reproduction to occur, each offspring must receive one set of alleles from mom and one from dad.
- Meiosis creates gametes which carry this information
- Meiosis is the process of reduction division where the diploid cell divides twice to create 4 haploid cells that carry half of the parents genetic information.
- Human cells start with 46 chromosomes and end up with 23

Summary of Mendel's Work

- The factors that control heredity are individual units known as genes. In organisms that reproduce sexually, genes are inherited from each parent
- In cases in which two or more forms of the gene for a single trait exist, some forms of the gene may be dominant and others may be recessive
- The two forms of each gene are segregated during the formation of reproductive cells
- The genes for different traits may assort independently of one another