BAL BHARATI PUBLIC SCHOOL PITAMPURA

CLASS XII (SESSION 2020-21)

BIOLOGY

CHAPTER - GENETICS (PART 1)

INSTRUCTIONS-

STEP 1- READ THE **CHAPTER- PRINCIPLES OF INHERITANCE (PART 1)**
VERY BASIC CONCEPTS OF CELL AND RELATED ASPECTS ARE INCLUDED HERE SO THAT A THOROUGH UNDERSTANDING OF CELL AND ITS COMPONENTS AND ITS BEHAVIOUR IS BUILT UP AND USED FOR FORTHCOMING CHAPTERS
UNDERLINE THE DIFFICULT TERMS

STEP 2- READ THE NOTES CAREFULLY. FOLLOW THE YOUTUBE LINKS MENTIONED AFTER EVERY TOPIC

TOPIS COVERED :

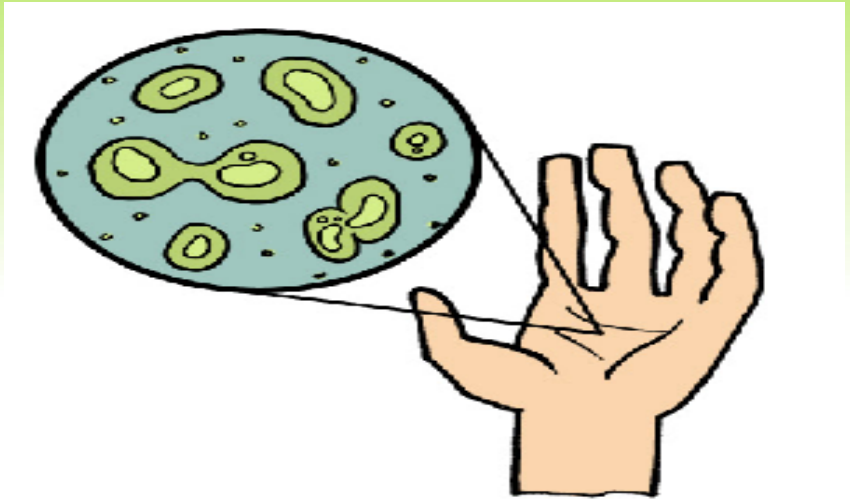
A MENDELISM
B MENDEL'S EXPERIMENT
C DEVIATIONS OF MENDEL'S LAWS
D CHROMOSOMAL THEORY
E LINKAGE

STEP 3- ATTEMPT THE GIVEN ASSIGNMENT

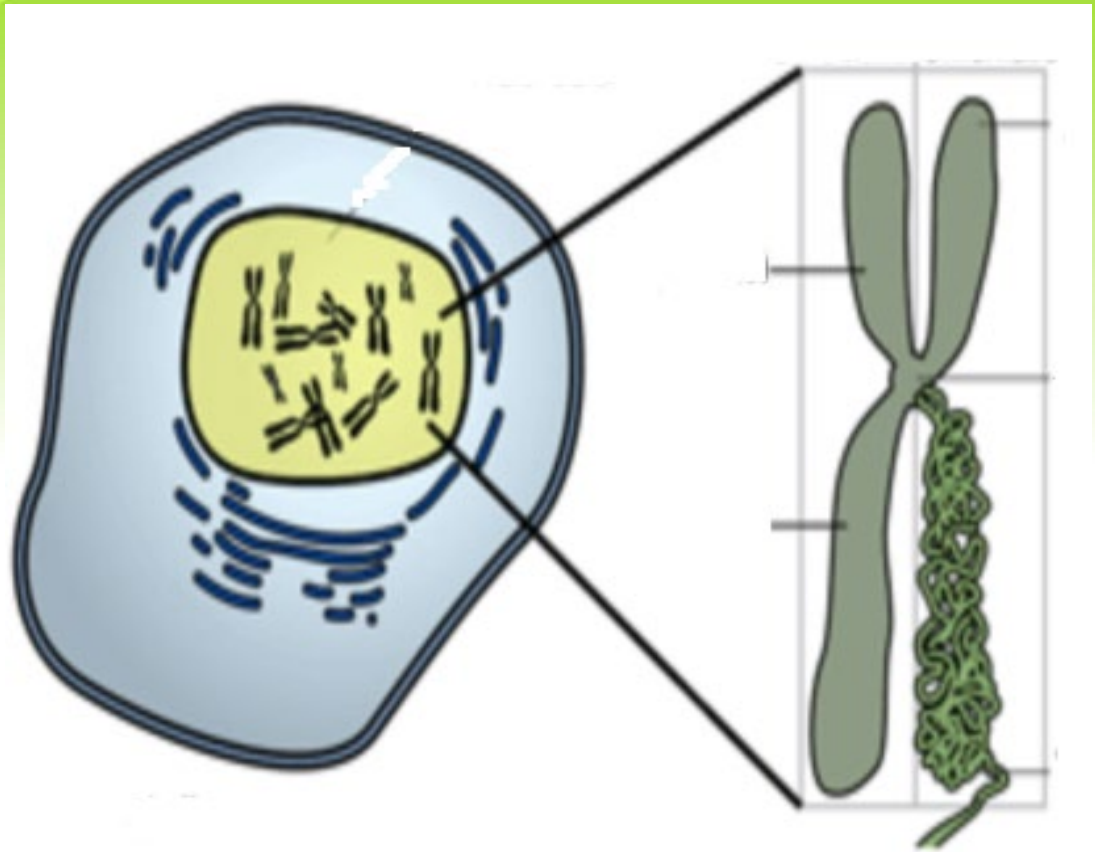
How Do Genes Work?

Your body is made up of trillions of tiny cells. Almost every cell in your body has a nucleus, a sort of headquarters that contain your genes. Your mix of genes is unique to you—even your full brothers or sisters have a slightly different mix. Genes are instructions for building the parts of your body and doing the work that keeps you alive, from carrying oxygen to digesting the food and everything else we do. The genes are grouped into collections called chromosomes. Humans have 23 pairs of chromosomes.

https://www.youtube.com/watch?time_continue=215&v=eOvMNOMRRm8&feature=emb_logo



WORD MATCH ACTIVITY



- Match the genetic terms to their corresponding parts of the illustration.

- cell
- chromosome
- DNA(Deoxyribonucleic Acid)
- centromere
- genes
- telomere
- chromatid
- arm

- **Do all living things have the same types of chromosomes?**
- Chromosomes vary in number and shape among living things. Most bacteria have one or two circular chromosomes. Humans, along with other animals and plants, have linear chromosomes that are arranged in pairs within the nucleus of the cell.

- The only human cells that do not contain pairs of chromosomes are reproductive cells, or gametes, which carry just one copy of each chromosome. When two reproductive cells unite, they become a single cell that contains two copies of each chromosome. This cell then divides and its successors divide numerous times, eventually producing a mature individual with a full set of paired chromosomes in virtually all of its cells.
- **How are chromosomes inherited?**
- In humans and most other complex organisms, one copy of each chromosome is inherited from the female parent and the other from the male parent. This explains why children inherit some of their traits from their mother and others from their father.

- The pattern of inheritance is different for the small circular chromosome found in mitochondria. Only egg cells - and not sperm cells - keep their mitochondria during fertilization. So, mitochondrial DNA is always inherited from the female parent.

https://www.youtube.com/watch?time_continue=16&v=-Yg89GY61DE&feature=emb_logo

SOME BASIC CONCEPTS

G1 phase. The cell grows.

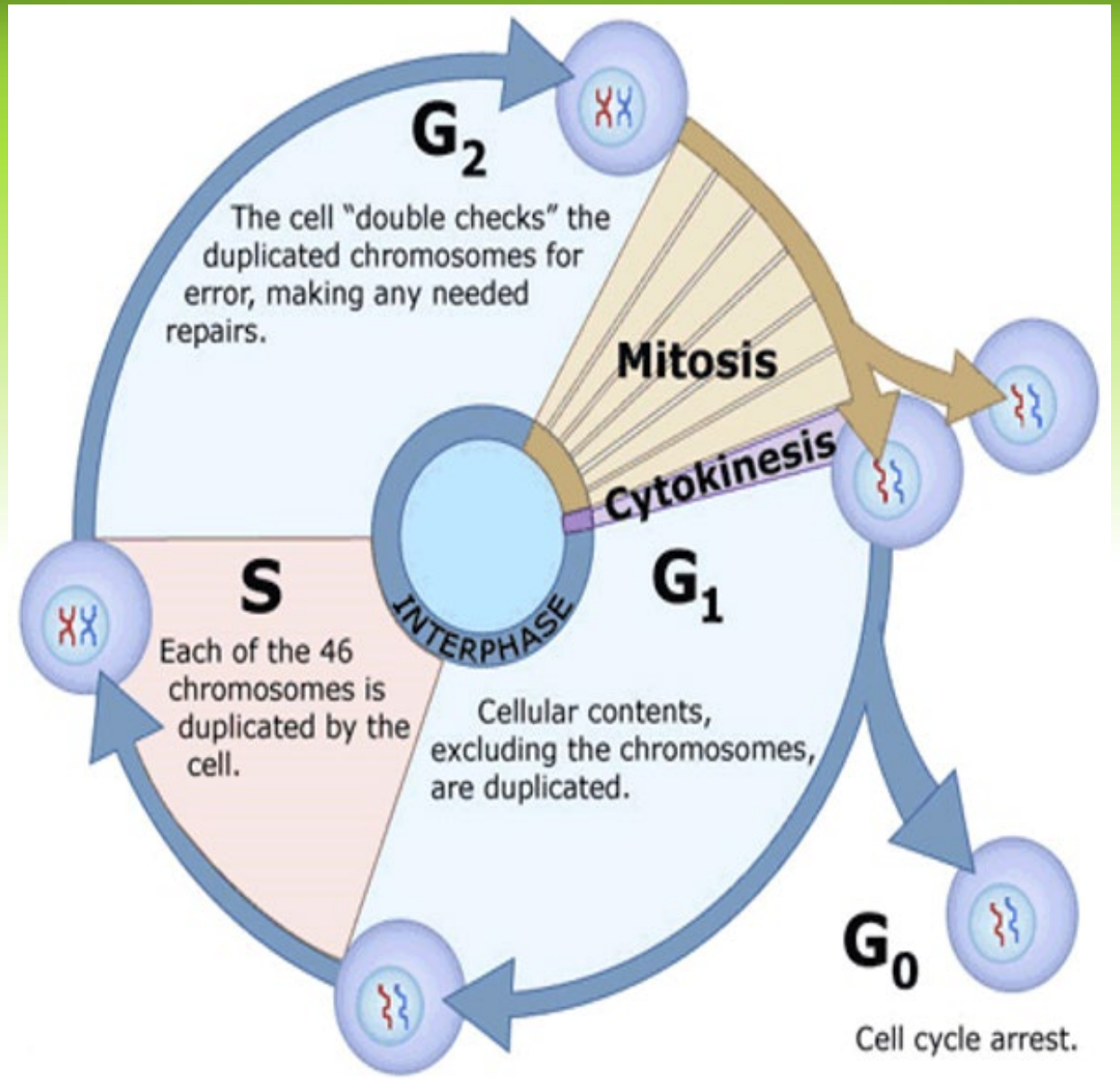
S phase. The cell makes copies of its chromosomes. Each chromosome now consists of two sister chromatids.

G2 phase. The cell checks the duplicated chromosomes and gets ready to divide.

M phase. The cell separates the copied chromosomes to form two full sets (mitosis) and the cell divides into two new cells (cytokinesis).

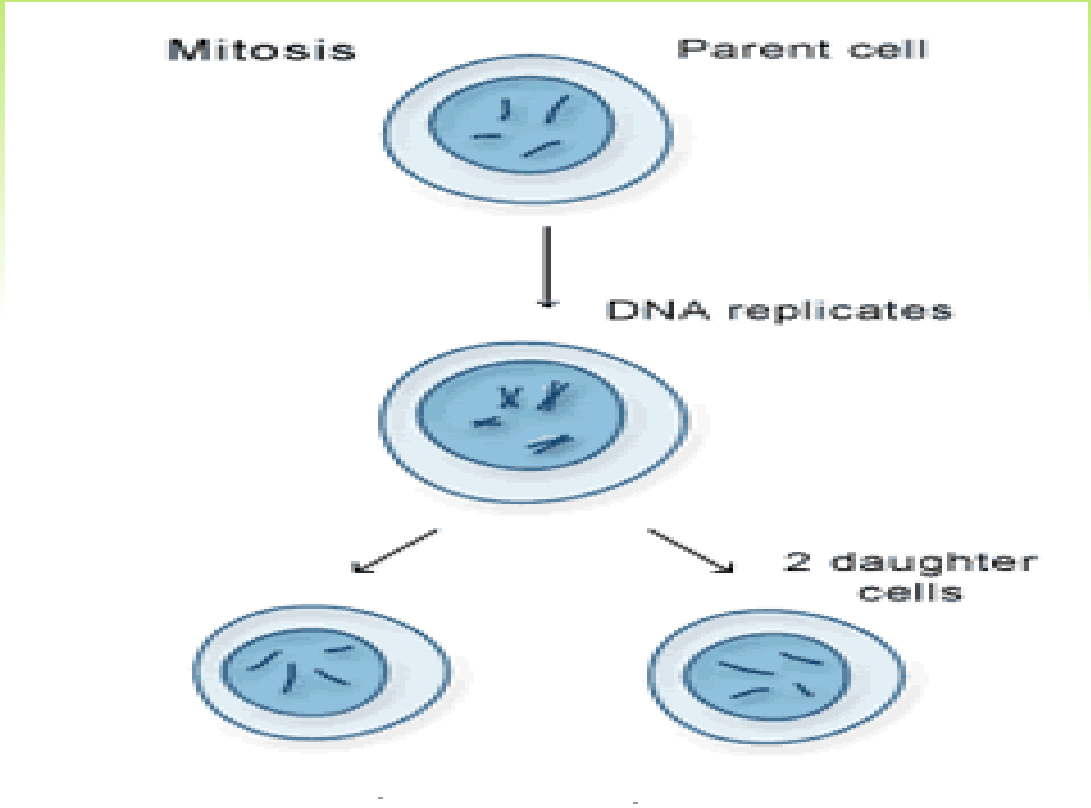
The period between cell divisions is known as 'interphase'.

Cells that are not dividing leave the cell cycle and stay in G0.

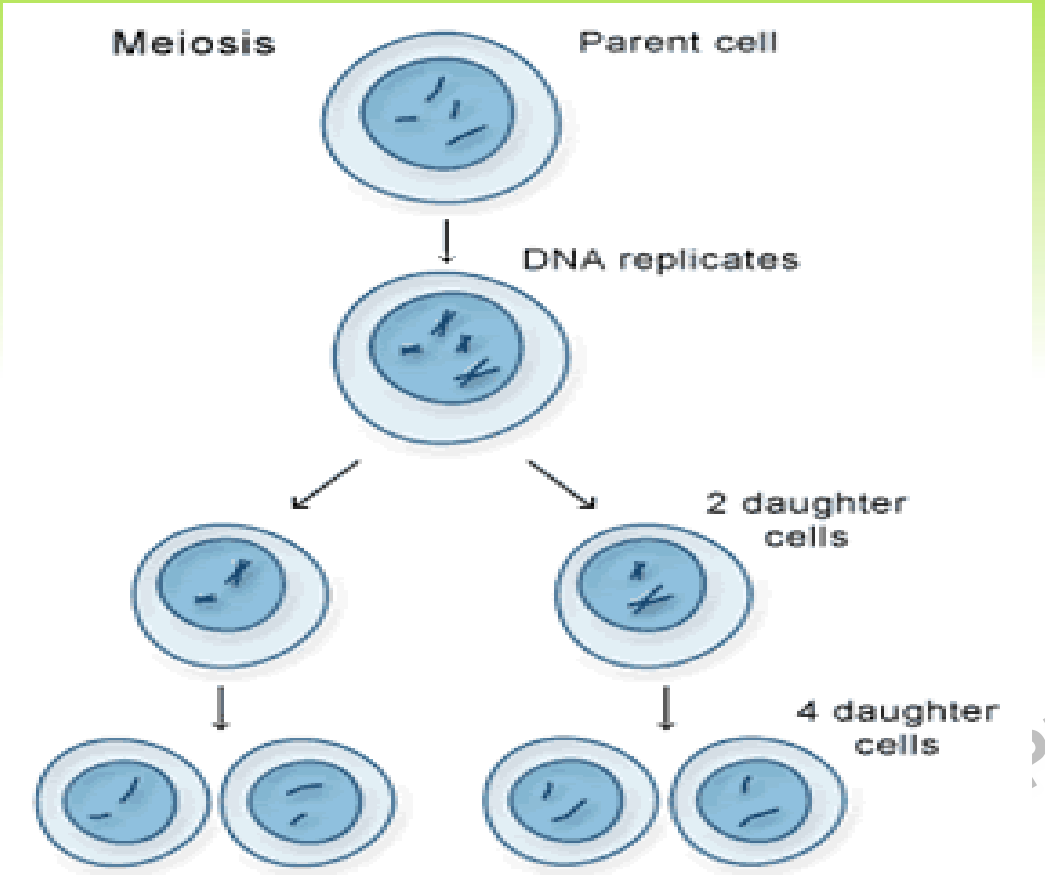


Cells divide into two different ways to make new cells.

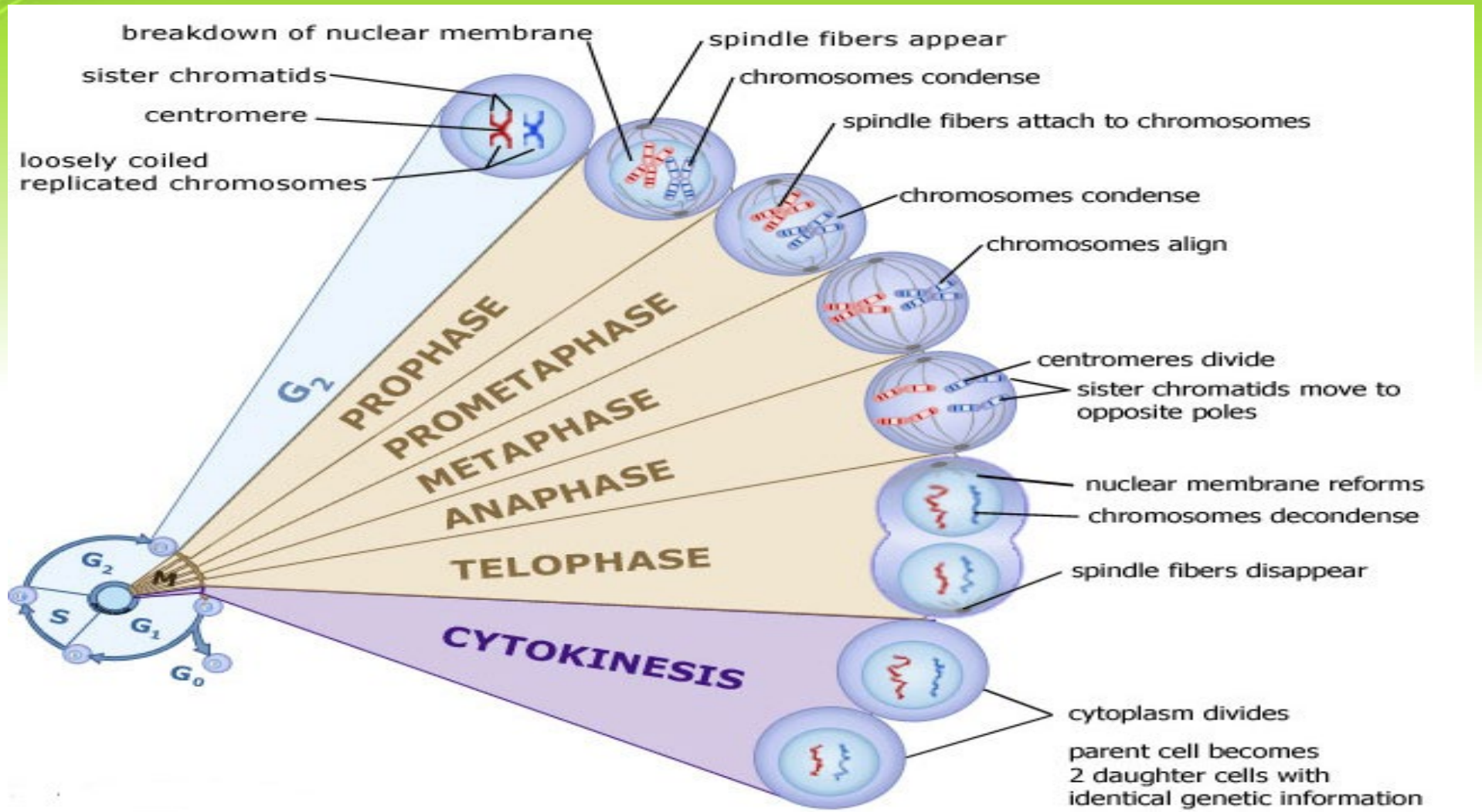
MITOSIS



MEIOSIS



The process of mitosis involves a number of different stages. The following diagram sets out the stages, and the main events that occur in each stage.



Gregor Mendel’s Courage and Persistence

- Our modern understanding of how traits may be inherited through generations comes from the principles proposed by Gregor Mendel in 1865. However, Mendel didn't discover these foundational principles of inheritance by studying human beings, but rather by studying Pisum sativum, or the common pea plant by his own admission—"some courage" to persist with them, Mendel proposed three foundational principles of inheritance.
- Mendel's work showed:

- Each parent contributes one factor of each trait shown in offspring.
- The two members of each pair of factors segregate from each other during gamete formation.
- The blending theory of inheritance was discounted.
- Males and females contribute equally to the traits in their offspring.
- Acquired traits are not inherited.

- **Johann Gregor Mendel** (1822-1884)
- Father of Genetics
- Mendel's Laws of Heredity are usually stated as:

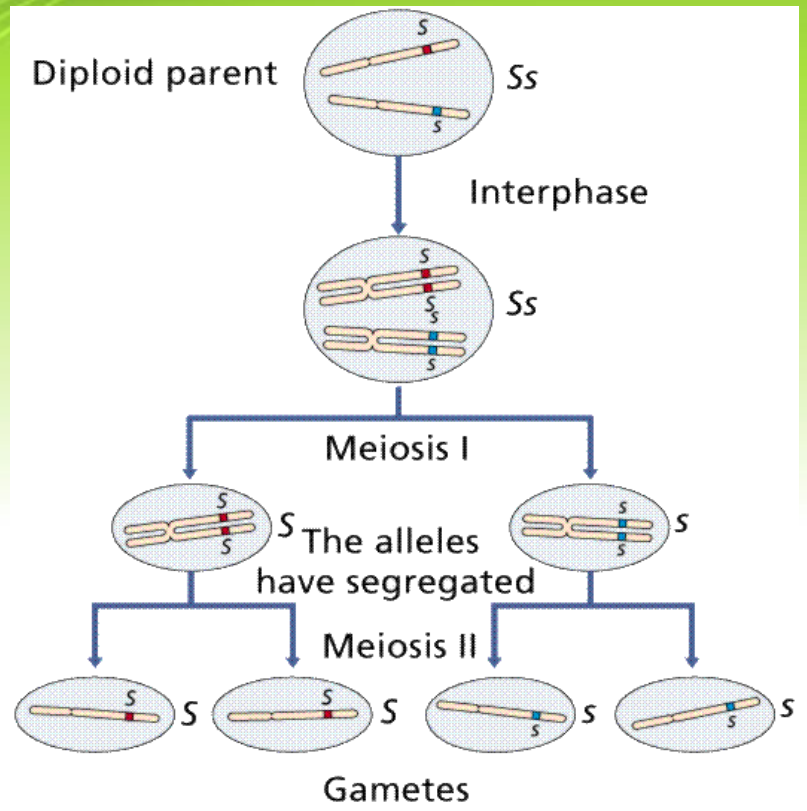
- 1) **The Law of Segregation:** Each inherited trait is defined by a gene pair. Parental genes are randomly separated to the sex cells so that sex cells contain only one gene of the pair. Offspring therefore inherit one genetic allele from each parent when sex cells unite in fertilization.
- 2) **The Law of Independent Assortment**: Genes for different traits are sorted separately from one another so that the inheritance of one trait is not dependent on the inheritance of another.
- 3) **The Law of Dominance:** An organism with alternate forms of a gene will express the form that is dominant.
- The genetic experiments Mendel did with pea plants took him eight years (1856-1863) and he published his results in 1865. During this time, Mendel grew over 10,000 pea plants, keeping track of progeny number and type. Mendel's work and his Laws of Inheritance were not appreciated in his time. It wasn't until 1900, after the rediscovery of his Laws, that his experimental results were understood.
- **https://www.youtube.com/watch?v=ni5jyO0g1_w : genetics Mendels work**

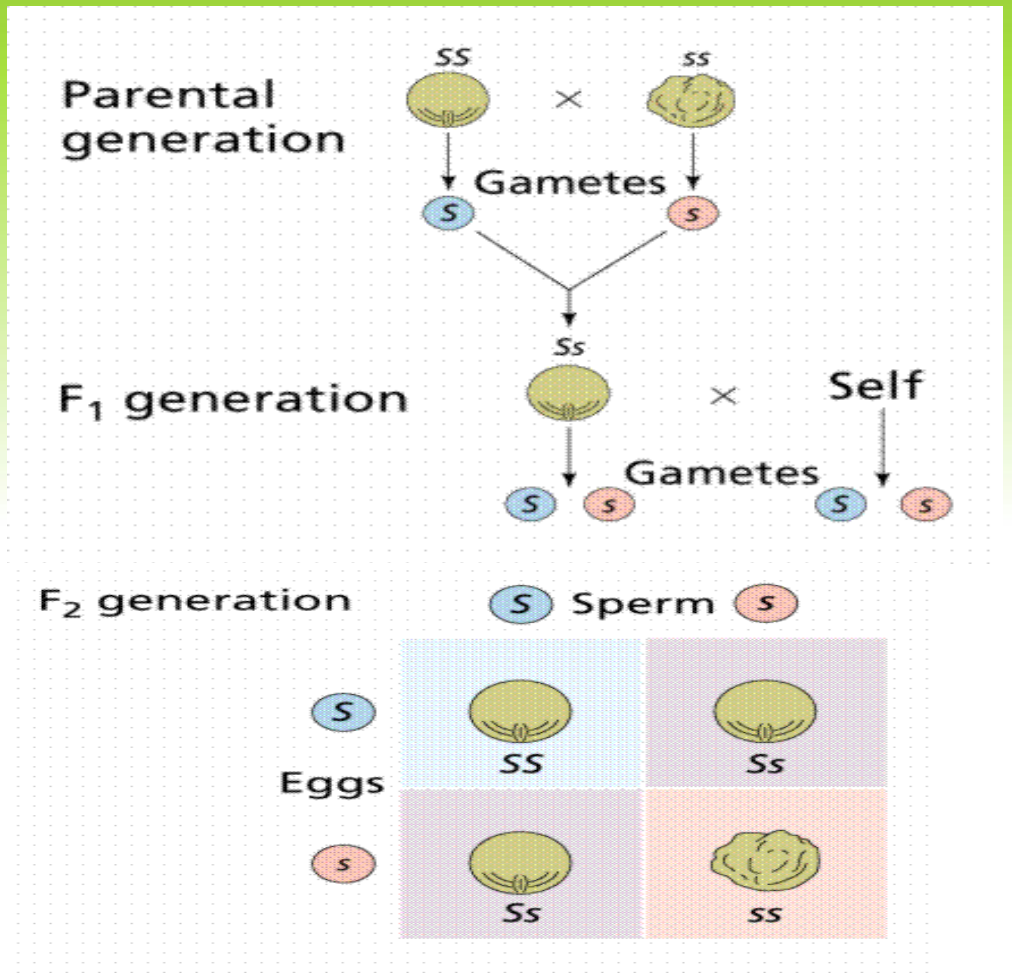
Difference Between Monohybrid And Dihybrid

- Monohybrid
- Mono refers to single and hybrid means mixed breed
- is used to study the inheritance of a single pair of alleles Used to study the dominance of genes
- Genotype ratio 1:2:1
- Phenotype ratio 3:1

- Dihybrid
- Di refers to two or double and hybrid means breed
- Dihybrid cross is used to study the inheritance of 2 different alleles
- Used to study Offspring assortment
- Genotype ratio 1:2:1:2:4:2:1:2:1
- Phenotype ratio 9:3:3:1

MONOHYBRID CROSS





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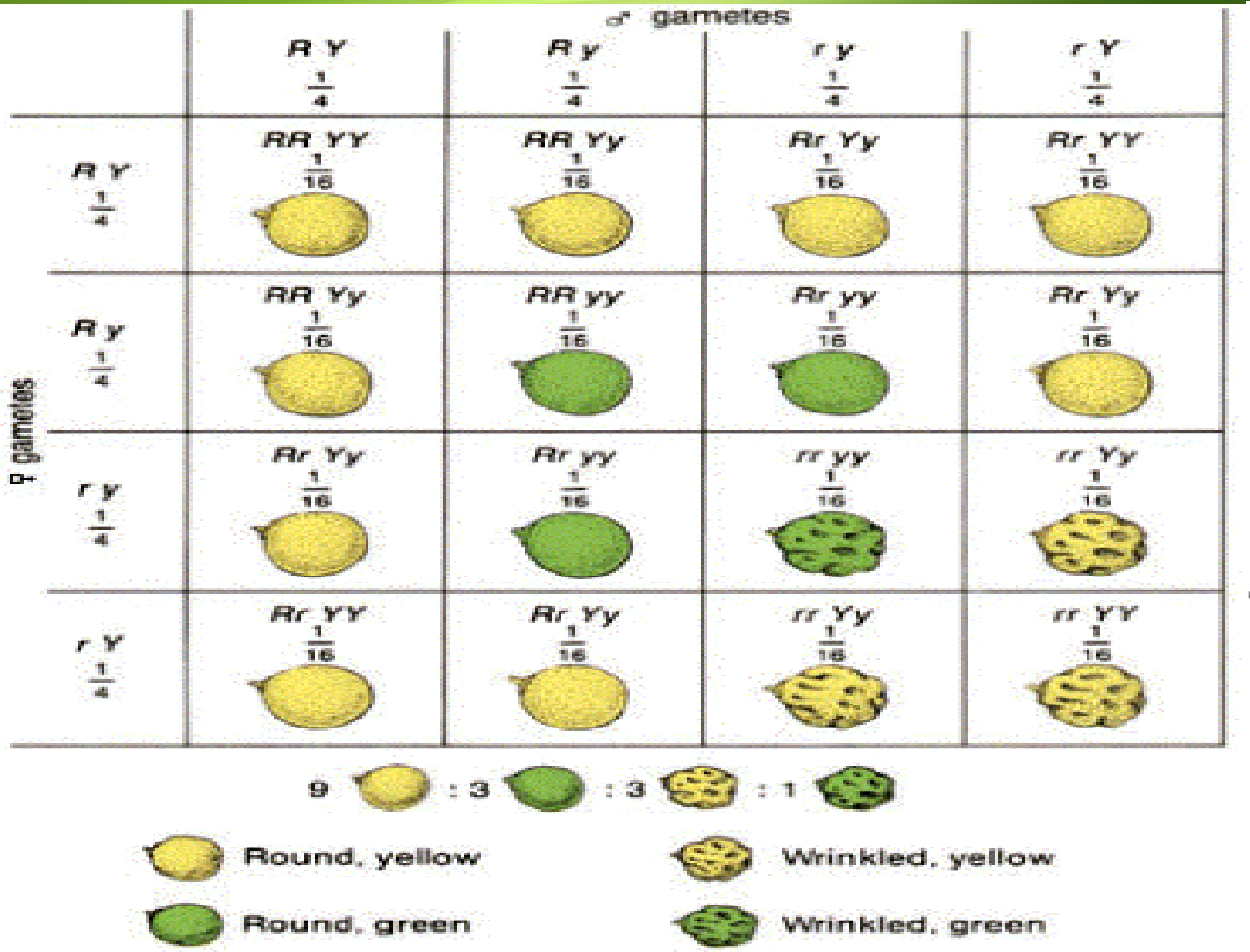
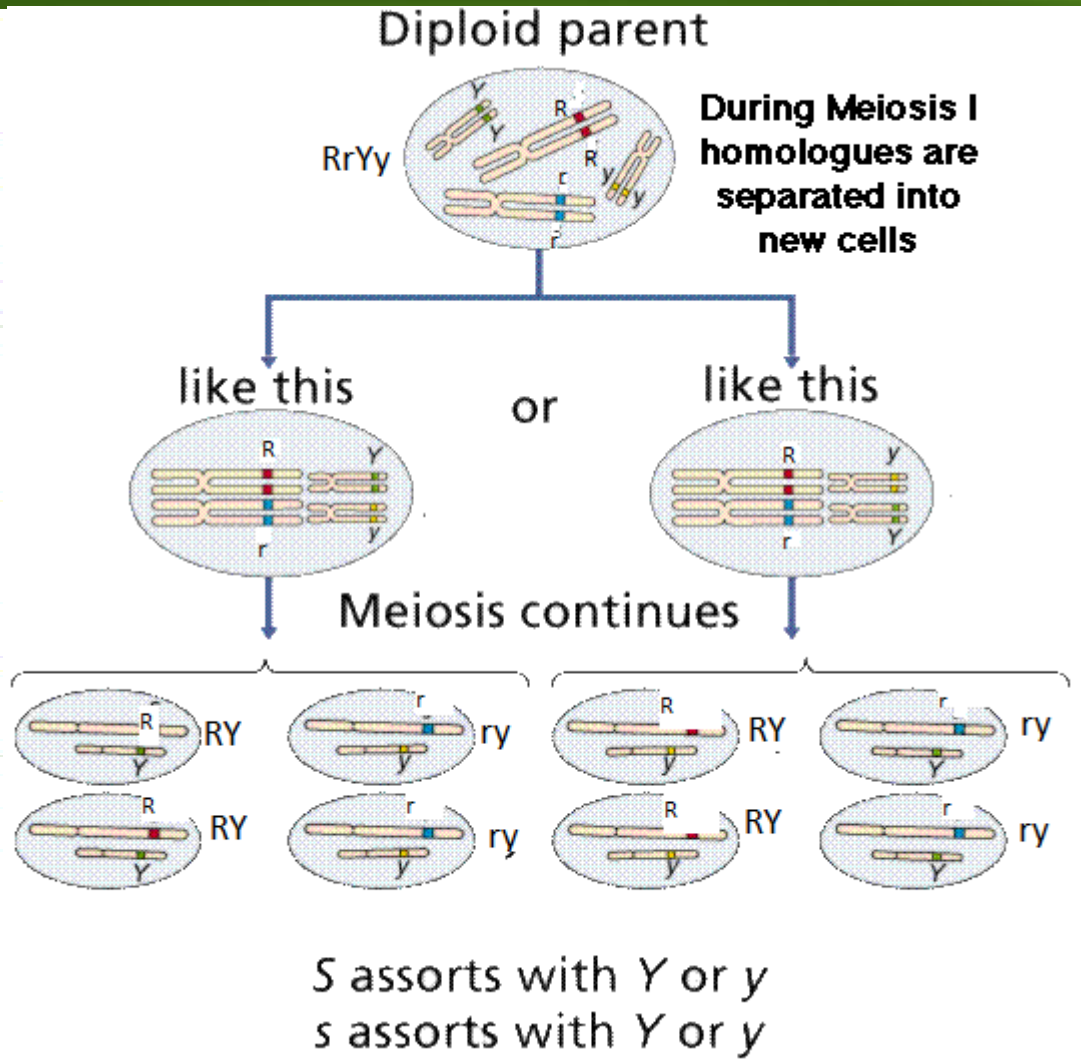


Inheritance of two traits simultaneously, a **dihybrid cross**



S assorts with *Y* or *y*
s assorts with *Y* or *y*

INCOMPLETE DOMINANCE

- **https://www.youtube.com/watch?v=o4_Mg4_QPkg**
- Incomplete dominance is a form of intermediate inheritance in which one allele for a specific trait is not completely expressed over its paired allele. This results in a third phenotype in which the expressed physical trait is a combination of the phenotypes of both alleles. Unlike complete dominance inheritance, one allele does not dominate or mask the other.
- As an example, incomplete dominance is seen in cross-pollination experiments between red and white snapdragon plants. In this monohybrid cross, the allele that produces the red color (R) is not completely expressed over the allele that produces the white color (r). The resulting offspring are all pink.

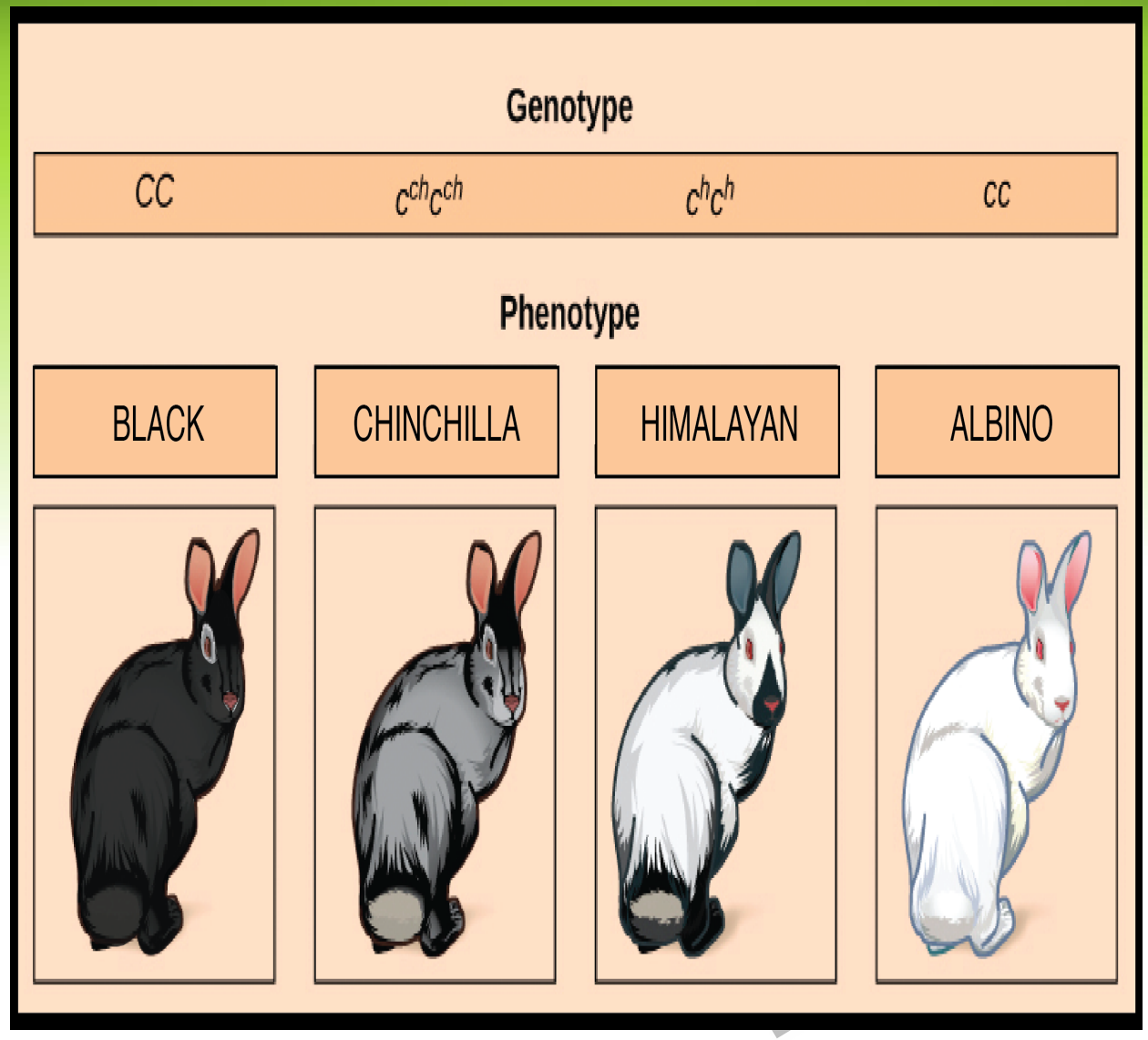
- The genotypes are: Red (RR) X White (rr) = Pink (Rr).

CO-DOMINANCE

- **https://www.youtube.com/watch?v=_sWbQadFCso**
- Co-dominance is a type of non-Mendelian inheritance pattern that finds the traits expressed by the alleles to be equal in the phenotype. There is neither a complete dominance or incomplete dominance of one trait over the other for that given characteristic.
- the heterozygous individual expresses both alleles equally. There is no mixing or blending involved and each is distinct and equally shown in the phenotype of the individual. Neither trait masks the other like in simple or complete dominance, either.
- One example of co-dominance in humans is the AB blood type. Red blood cells have antigens on them that are designed to fight off other foreign blood types, which is why only certain types of blood can be used for blood transfusions based on the recipient's own blood type. A type blood cells have one kind of antigen, while the B type blood cells have a different type. Normally, these antigens would signal that they are a foreign blood type to the body and would be attacked by the immune system. People with AB blood types have both antigens naturally in their systems, so their immune system will not attack those blood cells.

MULTIPLE ALLELISM

- **https://www.youtube.com/watch?v=arRjl4W9iGA**
- Mendel's work suggested that just two alleles existed for each gene. Today, we know that's not always, or even usually, the case! Although individual humans (and all diploid organisms) can only have two alleles for a given gene, multiple alleles may exist in a population level, and different individuals in the population may have different pairs of these alleles.
- As an example, let’s consider a gene that specifies coat color in rabbits, called the CCC gene. The CCC gene comes in four common alleles.



PLEIOTROPISM

- **https://www.youtube.com/watch?v=-wLRBwCk2NA**
- From Mendel's experiments, you might imagine that all genes control a single characteristic and affect some harmless aspect of an organism's appearance (such as color, height, or shape). Those predictions are true for some genes, but definitely not all of them! For example:
- A human genetic disorder called Marfan syndrome is caused by a mutation in one gene, yet it affects many aspects of growth and development, including height, vision, and heart function. These symptoms don't seem directly related, but as it turns out, they can all be traced back to the mutation of a single gene. This gene encodes a protein that assembles into chains, making elastic fibrils that give strength and flexibility to the body's connective tissues.Mutations that cause Marfan syndrome reduce the amount of functional protein made by the body, resulting in fewer fibrils.This is an example of pleiotropy, or one gene affecting multiple characteristics.
- Importantly, alleles of pleiotropic genes are transmitted in the same way as alleles of genes that affect single traits.

POLYGENIC INHERITANCE

- Polygenic traits, such as height, weight, eye color, and skin color, are determined by more than one gene and by interactions among several alleles. The genes contributing to these traits equally influence the phenotype and the alleles for these genes are found on different chromosomes.

- The alleles have an additive effect on the phenotype resulting in varying degrees of phenotypic expression. Individuals may express varying degrees of a dominant phenotype, recessive phenotype, or intermediate phenotype.

- Those that inherit more dominant alleles will have a greater expression of the dominant phenotype.
- Those that inherit more recessive alleles will have a greater expression of the recessive phenotype.
- Those that inherit various combinations of dominant and recessive alleles will express the intermediate phenotype to varying degrees.

CHROMOSOME THEORY OF INHERTANCE-
https://www.youtube.com/watch?v=huDDaj0PjLU&pbjreload=10

Walter Sutton and Theodor Boveri are credited with developing the Chromosomal Theory of Inheritance, which states that chromosomes carry the unit of heredity (genes).

The Chromosomal Theory of Inheritance was consistent with Mendel's laws and was supported by the following observations:

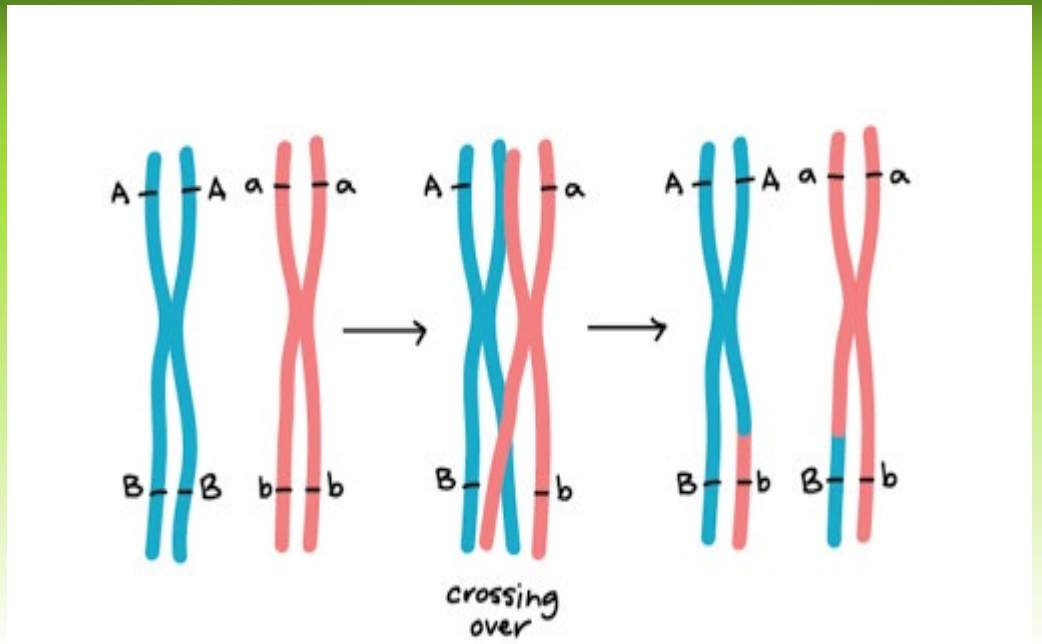
- During meiosis, homologous chromosome pairs migrate as discrete structures that are independent of other chromosome pairs.
- The sorting of chromosomes from each homologous pair into pre-gametes appears to be random.
- Each parent synthesizes gametes that contain only half of their chromosomal complement.
- Even though male and female gametes (sperm and egg) differ in size and morphology, they have the same number of chromosomes, suggesting equal genetic contributions from each parent.
- The gametic chromosomes combine during fertilization to produce offspring with the same chromosome number as their parents.
- This also demonstrated that linked genes disrupt Mendel's predicted outcomes. The fact that each chromosome can carry many linked genes explains how individuals can have many more traits than they have chromosomes.

CHROMOSOMAL THEORY OF LINKAGE

What is genetic linkage?

When genes are on separate chromosomes, or very far apart on the same chromosomes, they assort independently. That is, when the genes go into gametes, the allele received for one gene doesn't affect the allele received for the other. In a double heterozygous organism (AaBb), this results in the formation of all 4 possible types of gametes with equal, or 25% frequency.

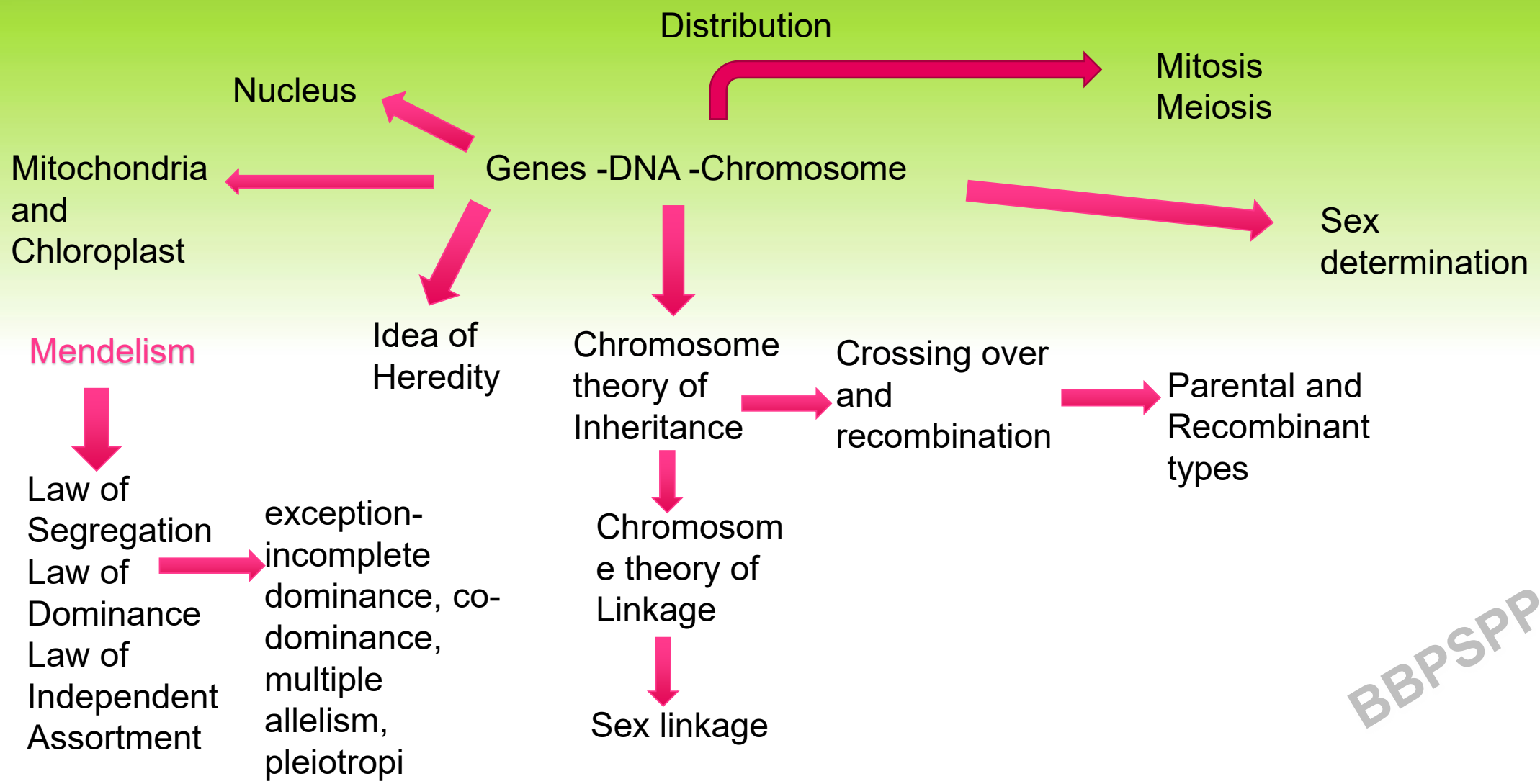
Why is this the case? Genes on separate chromosomes assort independently because of the random orientation of homologous chromosome pairs during meiosis. Homologous chromosomes are paired chromosomes that carry the same genes, but may have different alleles of those genes. One member of each homologous pair comes from an organism's mom, the other from its dad.



LINKAGE

- **When genes are on the same chromosome** but very far apart, they assort independently due to crossing over (homologous recombination). This is a process that happens at the very beginning of meiosis, in which homologous chromosomes randomly exchange matching fragments. Crossing over can put new alleles together in combination on the same chromosome, causing them to go into the same gamete. When genes are far apart, crossing over happens often enough that all types of gametes are produced with 25% frequency.

- **When genes are very close together** on the same chromosome, crossing over still occurs, but the outcome (in terms of gamete types produced) is different. Instead of assorting independently, the genes tend to "stick together" during meiosis. That is, the alleles of the genes that are already together on a chromosome will tend to be passed as a unit to gametes. In this case, the genes are linked.


Distribution
Mitosis
Meiosis
Nucleus
Mitochondria and Chloroplast
Genes -DNA -Chromosome
Sex determination
Idea of Heredity
Mendelism
Chromosome theory of Inheritance
Crossing over and recombination
Parental and Recombinant types
Law of Segregation
Law of Dominance
Law of Independent Assortment
exception-incomplete dominance, co-dominance, multiple allelism, pleiotropi
Chromosom e theory of Linkage
Sex linkage

ASSIGNMENT

1. Practice Quiz for Mendel's Genetics- Follow the link to attempt the quiz

https://www2.palomar.edu/anthro/practice/mendqui1.htm

2. H_____describes how some traits are passed from parents to their children.

• The traits are expressed by g_____ , which are small sections of DNA that are coded for specific traits.

• Genes are found on ch_____.

• Humans have two sets of _____chromosomes—one set from each parent.

3. Use textbook/e- resources to define the following words and write their definitions using your own words.

allele, genes,dominant, recessive,homozygous,heterozygous, genotype, phenotype,Mendelian Inheritance: