

CA State Standard 3b - Students know the genetic basis for Mendel's laws of segregation and independent assortment.

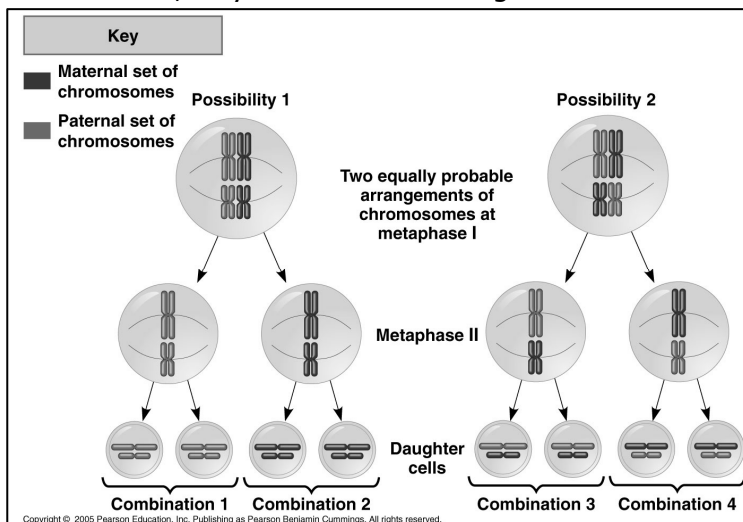
Mendel's two laws state that: (1) each individual has two units for a trait, and the individual inherits one unit from each parent: and (2) each trait is passed independently of other traits.

Law of Segregation

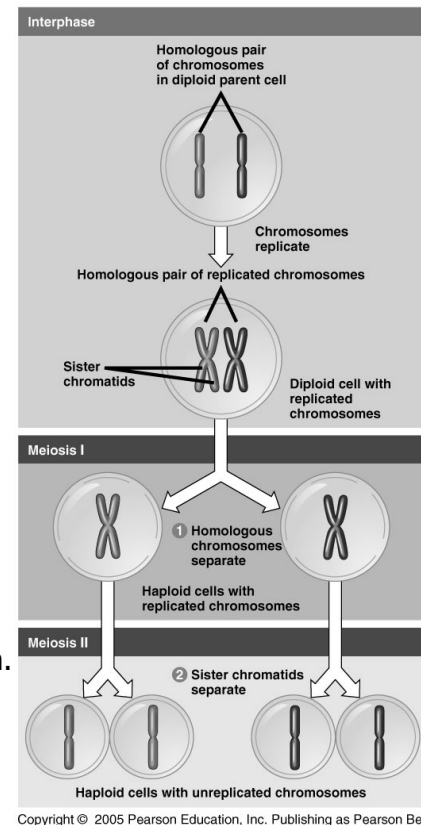
Gregor Mendel determined that traits in an individual exist as a pair of units – one inherited from each parent – and that these units separate during gamete formation so that each gamete carries only one version of the trait.

Today, we call Mendel's "units" **genes**, and we know that the patterns he observed were caused by the expression of the alternate **alleles**, a term used to describe different versions of the same gene. Because organisms have two copies of each chromosome, they have two alleles for every gene – one on each chromosome. When two different versions for the allele are present, the **dominant** allele is expressed as a trait, and the **recessive** allele remains hidden.

Although Mendel did not know it, this is due to **meiosis**. When an organism's germ cells go through meiosis, its chromosomes are randomly separated into two sets. The resulting gametes have only one copy of each chromosome and, as a result, only one allele of each gene.



Using letters, we can represent the genes or **genotype** of an organism. For example, "T" is tall (dominant) and "t" is short (recessive). When the letters are translated into the physical expression of the genotypes, we call this the **phenotype**. "TT" and "Tt" are tall organisms, but "tt" is a short organism.



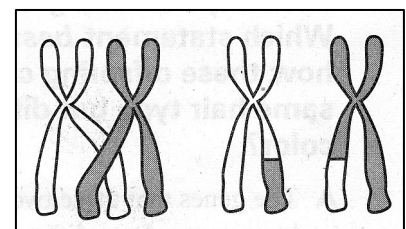
Law of Independent Assortment

Mendel also wanted to learn about how two

different traits are inherited. For example, in pea plants, traits could be inherited independently of other traits – yellow pods did not always inherit the wrinkled pea seeds, green pods did not always inherit with smooth pea seeds. This means that **traits are not inherited in pairs**, and the presence of two characteristics together in a parent plant does not mean that those two characteristics will always occur in combination together. This observation is called the **law of independent assortment**. See diagram above.

The law of independent assortment is not always true. If two genes are very close together on the same chromosome, they can be inherited together. This is called **genetic linkage**. Mendel was very wise or very lucky in choosing many traits that were not on the same chromosomes and could move independently. He picked a few traits that shared a chromosome, but the genes for these traits were not physically close to one another. Because the genes were far apart on the chromosomes, they were separated by crossing over.

Crossing over occurs when **homologous chromosomes**, those that are paired in a cell, line up by pairs and swap portions of their genetic material with each other.



Answer the following questions:

1. Explain the Law of Segregation (in your own words):
2. Explain the Law of Independent Assortment (in your own words):
3. Individuals have two genes for each trait. Each parent contributes only one gene for each trait to offspring. Which term best describes these statements?
a) crossing over b) law of segregation c) law of independent assortment d) genetic linkage
4. Suppose two dominant alleles (PP) are found in a pea plant that has smooth pods. This plant is crossed with a pea plant with wrinkled pods (pp). How many offspring will have more than one recessive allele (p)?
a) 0% b) 50% c) 25% d) 100%
5. Suppose two parents have two children. One child has curly hair and brown eyes. The second child has curly hair and green eyes. Which statement best explains how these offspring can have the same hair type but different eye color?
a) The genes that these two individuals have come from different parents.
b) The genes that codes for hair type and eye color are on sex alleles.
c) The genes that codes for hair type and eye color are on linked genes.
d) The genes that codes for chair type and eye color are on different chromosomes.
6. Which of the following best describes Mendel's conclusion about how multiple traits are passed to offspring?
a) Traits are always passed in pairs.
b) Traits get passed equally to offspring.
c) Traits are passed independently of one another.
d) Traits do not get passed to offspring.
7. Different gametes have different sets of chromosomes because homologous chromosomes are divided between gametes by
a) Genetic linkage b) Independent assortment c) Crossing over d) External fertilization
8. Flower color in a certain plant species is determined by one gene with two alleles. The allele for pink flowers (F) is dominant and the allele for white flowers (f) is recessive. According to the parent genotypes (Ff and ff) in a Punnett square, determine the probable genotypes and phenotypes of the offspring. [Draw your own Punnett square to help answer this question].