**Chapter 11: Mendel & Heredity**

Why its Important: **Knowledge of heredity explains why you inherit certain genes that affect your…**

**\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_,** \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_,** **and \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

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| Objectives | Vocabulary |
| * **Identify** the investigator whose studies formed the basis of modern genetics.
* **List** characteristics that make the garden pea a good subject for genetic study.
* **Summarize** the three major steps of Gregor Mendel’s garden pea experiments.
* **Relate** the ratios that Mendel observed in his crosses to his data.
* **Describe** the four major hypotheses Mendel developed.
* **Define** the terms homozygous, heterozygous, genotype, and phenotype.
* **Compare** Mendel’s two laws of heredity.
 | 11.1 Vocabulary* Heredity
* Genetics
* Monohybrid cross
* True-breeding
* P generation
* F1 generation
* F2 generation

11.2 Vocabulary* Allele
* Dominant
 | * Recessive Homozygous
* Heterozygous
* Genotype
* Phenotype
* Law of Segregation
* Law of Independent Assortment
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**Mendel’s Studies of Traits**

* Many of your \_\_\_\_\_\_\_\_\_\_\_\_\_, including the color and shape of your eyes, the texture of your hair, and even your height and weight, \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ those of your parents.
* The passing of traits from parents to offspring is called **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.**
* Long before the discovery of \_\_\_\_\_\_\_ and \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_, humans began experimenting with heredity
* From the beginning of recorded history, humans have attempted to alter \_\_\_\_\_\_\_\_\_\_ plants and \_\_\_\_\_\_\_\_\_\_\_\_\_\_ animals to give them traits that are more useful to us.

**Mendel’s Breeding Experiments**

* The scientific study of heredity began more than a century ago with the work of an Austrian monk named Gregor Johann \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.
* The hereditary patterns that Mendel discovered form the basis of **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_,** the branch of biology that focuses on heredity.
* Mendel repeated experiments carried out earlier by a British farmer named T. A. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_, who crossed purple and white pea plants
* The term cross refers to the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ or \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ of two individuals
* Mendel’s experiments differed from Knight’s because Mendel \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ the number of each kind of offspring and \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ the data
* To control breeding, Mendel cut out the male reproductive organs, the \_\_\_\_\_\_\_\_



* from one flower in the cross
* Only the female reproductive organ, the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_, remained
* Mendel then used a brush to transfer the male gamete, commonly called

\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_ to the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ of another flower

**Useful Features in Peas**

* The garden pea was a good subject for studying heredity for several reasons:

1. Several traits of the garden pea exist in \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ clearly different forms.

2. The male and female reproductive parts of garden peas are enclosed within the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ flower. This allows cross pollination or \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ pollination

 3. The garden pea is \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_, grows easily, matures quickly, and produces \_\_\_\_\_\_\_\_\_\_\_\_\_ offspring.

**Traits Expressed as Simple Ratios**

* Mendel’s initial experiments were \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ crosses.
* A **monohybrid cross** is a cross that involves \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ pair of contrasting traits.
* For example, crossing a plant with purple flowers and a plant with white flowers is a monohybrid cross.
	+ The single trait studied is flower \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
	+ What were the two contrasting forms? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Mendel carried out his experiments in three steps**

**Step 1** : Mendel allowed each variety of garden pea to \_\_\_\_\_\_\_\_\_\_\_-pollinate for several generations to ensure that each variety was **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_-breeding** for a particular trait “True breeding” means that all of a plant’s offspring display only \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ form of a trait. These true-breeding plants are considered \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ and served as the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ or \_\_\_\_\_\_\_\_\_\_\_\_ generation in Mendel’s experiments.

**Step 2** : Mendel then \_\_\_\_\_\_\_\_\_ -pollinated two P generation plants that had \_\_\_\_\_\_\_\_\_\_\_\_\_ forms of a trait, such as purple flowers and white flowers. Mendel called the offspring of the P generation the first \_\_\_\_\_\_\_\_\_\_\_\_\_ generation, or **\_\_\_\_ generation.** **filial = son or daughter in latin**

* **What color flowers did all of the F1 offspring have? Are the F1 offspring still purebreds?**

**Step 3**: Mendel allowed the F1 generation to \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ -pollinate.

He called the offspring of the F1 generation plants the second filial generation, or **\_\_\_\_\_\_\_\_\_\_ generation.**

What two colors showed up in the F2 offspring?

**How many total F2 offspring did Mendel analyze?**

**What color ratio did they exhibit?**

**In Summary Results**

* Each of Mendel’s F1 plants showed only \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ form of the trait.
	+ What color were they?
* But when the F1 generation was allowed to self-pollinate, the missing trait \_\_\_\_\_\_\_\_\_\_\_\_\_ in some of the plants in the F2 generation.
	+ What was the missing color?
* For each of the seven traits Mendel studied, he found a \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ ratio of contrasting traits in the F2 generation.

**A Theory of Heredity**

* Mendel correctly concluded from his experiments that each pea has \_\_\_\_\_\_\_\_\_\_\_\_ separate “heritable factors” for each trait—one from each parent.
* When gametes (sperm and egg cells) form, each receives only \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ of the organism’s two factors for each trait.
* But when gametes \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ during fertilization, the offspring has two factors for each trait, one from each parent. Today these factors are called \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

**Mendel’s Hypotheses**

* The four hypotheses Mendel developed as a result of his experiments now make up the Mendelian theory of heredity—the foundation of genetics.

 **1.** *For each inherited trait, an individual has \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ copies of the gene—one from each parent.*

**2.** *There are \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ versions of genes.* Today the different versions of a gene are called its \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**.**

**3.** *When two different alleles occur together, one of them may be completely \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_, while the other may have no \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ effect on the organism’s appearance.*

 Mendel described the expressed form of the trait as **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.**

The trait that was not expressed when the dominant form of the trait was present was described as \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**.**

**4.** *When gametes are formed, the alleles for each gene in an individual \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ independently of one another. Thus, gametes carry only \_\_\_\_\_\_\_\_\_\_\_\_\_ allele for each inherited trait. When gametes unite during \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_, they combine to create an individual that has \_\_\_\_\_ alleles for each inherited trait.*

**Mendel’s Findings in Modern Terms**

* Dominant alleles are indicated by writing the first letter of the trait as a \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ letter.
* Recessive alleles are also indicated by writing the first letter of the dominant trait, but the letter is \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.
	+ Example: Purple is the dominant trait for the flower color of pea plants…
		- The dominant allele is written as \_\_\_\_\_\_
		- The recessive allele is written as \_\_\_\_\_\_
* If the two alleles of a particular gene present in an individual are the \_\_\_\_\_\_\_\_\_\_, the individual is said to be **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**
	+ **The prefix *homo-* means the same**. **An individual may be…**
		- **Homozygous dominant = \_\_\_\_\_\_\_\_\_**
		- **Homozygous recessive = \_\_\_\_\_\_\_\_\_**
* If the alleles of a particular gene present in an individual are \_\_\_\_\_\_\_\_\_\_\_\_\_\_, the individual is **\_\_\_\_\_\_\_\_\_\_\_\_.**
	+ **The prefix *hetero-* means other or different**
	+ **A heterozygous individual is written as \_\_\_\_\_\_**
* In heterozygous individuals, only the \_\_\_\_\_\_\_\_\_\_\_\_\_ allele is expressed; the recessive allele is present but \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.
* What color flowers will the following pea plant have…Pp?
* The set of alleles that an individual has is called its **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.**
* The physical appearance of a trait is called a **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.**
* Phenotype is determined by which \_\_\_\_\_\_\_\_\_\_\_\_ are present. So if a plant has the genotype \_\_\_\_\_\_\_, what phenotype will it have?

**The Laws of Heredity**

* Mendel’s findings allowed him to write two laws that accurately describe the behavior of chromosomes during \_\_\_\_\_\_\_\_\_\_\_\_\_
* **These laws are called…**

**The Law of Segregation**

* + This law states that the two alleles for a trait segregate or \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ when gametes are formed
	+ The alleles segregate because they are found on \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ which separate as they are passed on to \_\_\_\_\_\_\_\_\_\_\_\_\_

**The Law of Independent Assortment**

* + This law states that the alleles of different genes separate \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ of one another during gamete formation.
	+ Mendel based this law on the fact that for the traits he studied, the inheritance of one trait did not \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ the inheritance of any other trait.
	+ So for example, the inheritance of one trait, such as plant \_\_\_\_\_\_\_\_\_\_\_\_\_, did not affect the inheritance of another trait such as flower \_\_\_\_\_\_\_\_\_\_\_
	+ When Mendel wrote his laws, chromosomes had \_\_\_\_\_\_\_ yet been discovered…he also did not know that genes are \_\_\_\_\_\_\_\_ on chromosomes
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