

The Story of Gregor Mendel and his Peas

This is the story of Gregor Mendel and how his pea experiments were used to study heredity. People had noticed for thousands of years that family resemblances were inherited from generation to generation, but no one knew how or why this pattern of heredity occurred. The study of genetics was soon created to help explain this idea of heredity. Mendel was the first person to succeed in predicting how traits would be transferred from one generation to the next. BUT, how was he able to solve this problem of heredity you ask?

Mendel loved his garden at the monastery and was extremely curious why certain plants had certain traits and others did not. He began his experiments using pea plants because they reproduced sexually (have two distinct sex cells – male and female) and both of these gametes are located in the same flower. The male gamete is in the form of pollen grains and the female gamete is in the ovule, which is located on the pistil. When pollination occurs a seed is formed. This type of fertilization occurs naturally. The gametes are tightly enclosed within the petals, preventing the pollen of other flowers to enter. The peas therefore self-pollinate. Mendel used this method of pollination but also cross pollinated. By using these two forms of pollinating, Mendel could be sure of the parents in his crosses.

Mendel studied seven traits that are specific to garden peas. Seed shape, seed color, flower color, flower position, pod color, pod shape and plant height. Although he studied seven traits, he only studied one trait at a time to control variables and analyze his data mathematically.

Mendel's first crosses were called monohybrid crosses. He started with a set of tall pea plants, from generations that had produced tall plants. He crossed this plant with a set of short pea plants, from generations that had produced short plants. The tall and short plants were a part of the *P generation*. The cross resulted in a *F₁ generation* that Mendel called the hybrid. Every one of the offspring in the *F₁ generation* were tall. Next he created another monohybrid cross with two of the hybrids from the *F₁ generation*. The cross resulted in a *F₂ generation* that consisted of 3 tall plants and 1 short plant.

From this experiment Mendel was able to conclude that there are at least two factors that control each trait. We now know these factors are genes and that they are located on chromosomes. Genes exist in alternate forms called alleles. Each of Mendel's pea plants had two alleles of the gene that determined height. A plant could have two alleles for tallness, two alleles for shortness or one allele for tallness and one for shortness. One allele is inherited from the female parent and one from the male parent.

Mendel also observed that certain traits showed up and others seemed to disappear. He deemed one of the alleles dominant and the other recessive. In the first monohybrid cross of the *P generation*, he crossed a tall and short plant. In the *F₁ generation*, all the plants were tall. Although they were all tall they had a hybrid genotype. Each offspring received one allele from the tall and one from the short. The allele for tallness masks the alleles for shortness in the pea plants. The tall allele is therefore dominant over the short allele. To show this we use the same letter for different alleles of the same gene. An uppercase letter is used for the dominant allele and a lowercase letter for the recessive. The dominant allele is always written first.

Mendel's Law of Segregation explains why hybrid offspring can occur. Two organisms can look alike, have the same phenotype, but have different genotypes. The genotypes for tall plants can be *TT* or *Tt*. The genotype of short is only *tt*. If the genotype is *TT* or *tt* then it is said to be homozygous or pure breed. If the genotype is *Tt*, it is said to be heterozygous or hybrid. The only way to get a phenotype of short is to have the alleles be *tt*.

In 1905, Reginald Punnett devised a short handed way of finding the expected proportion of possible genotypes in the offspring of a cross. This method is called a punnett square. It takes account of the fact that fertilization occurs randomly as Mendel's law of segregation states. If you know the genotypes of the parents you can use a punnett square to predict the possible genotypes of their offspring. Knowing the genotypes, you can also know the phenotype.

Gregor Mendel and His Peas Questions

1. Mendel was the first person to succeed in doing what? _____
2. Where was his garden? _____
3. Why did he work on pea plants? _____
4. How many traits did he study? _____
5. Why did he only study one trait at a time? _____
6. What were the characteristics of the two pea plants he crossed first?
7. What generation were they called? _____
8. After the cross, what were they called? _____
9. What were the characteristics of the plants in the first cross? (tall or short) _____
10. What happened when he crossed the "hybrid" generation plants?
11. Genes exist in alternate forms called what? _____
12. Each plant has how many alleles for each trait? _____
13. What kind of letter is used for a dominant trait? _____ Recessive trait? _____
14. Which allele is *always* written first? _____
15. If a genotype has two of the same alleles (letters), TT or tt, it is said to be what? _____
16. Can two organisms look alike but have different genotypes? _____
17. If a genotype has two different alleles (letters), Tt, it is said to be what? _____
18. Who came up with a short handed way of finding expected genotypes? _____
19. If you know the genotypes of the parents, what can you use to determine the possible genotypes of the offspring? _____
20. If you know the genotype, you will also know the what? _____

Based on your reading, fill in the blanks

21. Genotype is the _____ of an organism.
22. Phenotype is the _____ of an organism.