

## AP BIO Lab 7: Genetics of *Drosophila*

In 1865, Gregor Mendel published a paper on the patterns of genetic inheritance in the common garden pea. This revolutionary work provided the basis for future study of genetics. Mendel hypothesized that heredity was passed on by discrete particles, rather than by the blending of parental traits, as was believed at the time, strongly affecting the argument over Darwin's theory of evolution.

Mendel proposed two very basic laws which serve as the cornerstones of modern genetics: Mendel's Law of Segregation and Law of Independent Assortment.

### Mendel's Laws of Genetic Inheritance

Mendel's Law of Segregation states that for each trait (gene), each organism carries two factors (alleles), and that each of the organism's gametes contains one and only one of these factors. In this way, the alleles segregate during meiosis, providing for genetic variability among the organism's offspring. This is apparent in monohybrid crosses—matings involving only one trait.

Mendel's Law of Independent Assortment, found in dihybrid crosses (crosses involving two Traits), states that the alleles for one trait will separate independently of the alleles in another trait. This means that with two genes (A and B), each with two possible alleles (A, a and B, b), there are four possible combinations gametes can receive (AB, Ab, aB, or ab). This helps to ensure genetic variability among offspring.

Although Mendel's laws have proven to be true, they have their limitations. It must be assumed that the genes involved are on different chromosomes. If they are on the same chromosome, the assortment of their alleles will be closely linked instead of being independent. It must also be assumed that the genes in question are not located on the X chromosome; this could cause the expression of the trait to be linked to the sex of the offspring. Color blindness in humans is a good example of this type of heredity. None of the traits Mendel selected in his pea plant investigations were sex linked, or located on the same chromosome.

Since Mendel's time, our knowledge of genetics, as well as the tools we use, have advanced drastically. Instead of crossing varieties of pea plants and observing the results as Mendel did, we now use restriction enzymes, electrophoresis, and basepair sequencing to learn more about traits and their expression. Yet even with these advances, the basic concepts of genetic inheritance described by Mendel so many years ago still stand.

### *Drosophila* Use in Genetic Research

*Drosophila melanogaster*, the common fruit fly, was first used in genetic experiments in 1907 by Thomas Hunt Morgan of Columbia University, and has been a staple of genetic research ever since. *Drosophila* specimens are well suited to investigations into Mendelian patterns of inheritance; they are small, produce large numbers of offspring, have many easily discernible mutations, have only four pairs of chromosomes, and complete their entire life cycle in approximately 12 days. Additionally, *Drosophila* are relatively easy to maintain, as they are hardy and have simple food requirements. Since the fruit fly was selected for study nearly a hundred years ago, a great deal has been learned about its genome. In fact, the first chromosome map of any kind was constructed to detail the fruit fly. Chromosomes 1 (the X chromosome), 2, and 3 are very large, and the Y chromosome—number 4—is extremely small. Thousands of genes reside on these four chromosomes, many of which are universal in nature, existing in most eukaryotic forms, including humans. The similarities between the

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**Judd E. Hollander**



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