

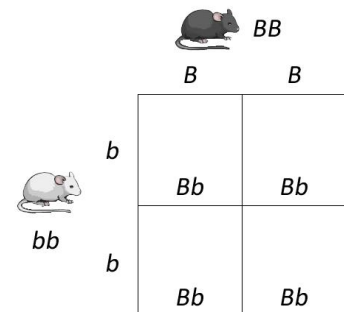
Genetics: Red-Hair Mystery - Scientific Background

In 1866, Gregor Mendel published a paper called *Experiments in Plant Hybridization*, summarizing years of careful experiments with pea plants. Although his work was ignored during his life, his discoveries form the foundation of what we know about how traits are passed down from parents to their offspring.

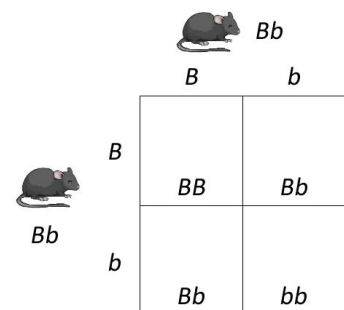
The *Genetics* Investigation Series explores Mendel's Laws of Inheritance.

- Each trait is determined by a pair of alleles. Each offspring organism inherits one allele from each parent. (Law of Segregation)
- Some alleles are dominant and some are recessive. If the dominant allele is present, the organism will display the dominant trait. If two copies of the recessive allele are present, the organism will display the recessive trait. (Law of Dominance and Uniformity)
- The inheritance of one trait does not affect the inheritance of other traits. (Law of Independent Assortment)

For a simple trait such as the black and white fur color illustrated in the *Genetics* Investigation, there are two alleles: a dominant black-fur allele (B) and a recessive white-fur allele (b). The combination of alleles (such as Bb) is referred to as the *genotype*, and the resulting physical trait (in this case, black fur) is the *phenotype*. If both alleles in a genotype are the same (BB or bb), the organism is *homozygous* for that trait. If the alleles are different (Bb) the organism is *heterozygous* for that trait.



The possible results of a genetic cross can be illustrated with a Punnett square (right), which is used by students in lesson 3. When a homozygous BB mouse is bred to a bb mouse, each offspring will have the genotype Bb . When two Bb mice are bred, this results in one BB , two Bb , and one bb offspring. This explains the mystery of Sadie's red hair. If both of her parents carry the recessive red-hair allele, there is a 25% chance that their child will inherit both of the recessive alleles and have red hair.



In humans, red hair is associated with some variants of the MC1R gene found on chromosome 16. These variants are known as RHC (red hair color) alleles. Individuals who possess two RHC alleles are likely to have red hair. These alleles are also associated with fair skin, lack of ability to tan, and freckles.