

### EVOLUTION, LECTURE 3: POPULATION GENETICS & MICROEVOLUTION (271–279, 468–479)

Gregor Mendel (1822) discovered his rules of inheritance in 1865, and he presented and published his work in 1866. Darwin apparently had a copy of at least one of his publications, but he does not seem to have read it. Mendel's insight into the process of heredity could have saved Darwin considerable grief, because the problem of "blending inheritance" was a major objection to Darwinian theory. In a randomly mating population, how would discrete traits be maintained if the offspring blended the phenotypes of the parents? How could natural selection produce stable adaptations to the environment? Mendel's research helped to solve this problem.

Some basic terminology (note that these are the modern terms, they were not necessarily the ones used by Mendel; please rely on the book for additional terms):

**character** = heritable feature that varies

**trait** = variant of a character

**truebreeder** = offspring has same traits as parent

**gene** = discrete, heritable unit (the basis of "particulate inheritance")

**allele** = alternative versions of a gene

**dominant** = an allele whose phenotype is observed in a heterozygote

**recessive** = an allele whose phenotype is not observed in a heterozygote

Mendel's "**Law of Segregation**" model (the fourth point is a statement of the law)

- Alternate versions of genes (alleles) account for variation in inherited characteristics.
- For each character, an organism inherits two alleles.
- Dominant alleles are fully expressed, recessive alleles are concealed.
- The two alleles for each character segregate during gamete production (Mendel's first law)

Mendel's "**Law of Independent Assortment**" (Mendel's second law) can be stated as follows: "Each pair of alleles segregates independently of each other pair of alleles during gamete formation."

Mendelian genetics involves the application of these two simple laws with two basic laws of probability: the **rule of multiplication** (the probability that independent events will occur simultaneously is the product of their individual probabilities) and the **rule of addition** (the probability that an event can occur in two or more independent ways is the sum of the separate probabilities of the different ways).

Mendel's study organisms were relatively simple cases. Several phenomena make the study of the relationship of genotype to phenotype much more complicated. In **incomplete dominance**, the dominant phenotype is not fully expressed in the heterozygote; in **codominance**, both alleles are fully expressed in the heterozygote; some populations have **multiple alleles** available for a single locus (Mendel was dealing with the special case of two possible alleles only); in **pleiotropy**, a single gene has multiple effects; in **epistasis**, one gene modifies the expression of another gene.

The **environment** plays a fundamental role in shaping phenotypes (deny a pea plant sun and water and it will not produce seeds, no matter its genotype). A phenotype is a function of the genotype, the environment, and the interaction between the genotype and the environment.

The beginning of the next lecture will focus on population genetics and the advances made in the early 20<sup>th</sup> century after the rediscovery of Mendel's Laws.