

EVOLUTION, LECTURE 4: POPULATION GENETICS AND NATURAL SELECTION (479–486)

Mendelian inheritance was rediscovered in 1900, and by the 1920s there was a consensus that all biological inheritance was a function of particulate genes.

The foundations of modern **population genetics** was established during the 1920s, and during the decade from 1936–1947, Mendelian inheritance, population genetics, and Darwinism were unified in the **Modern Evolutionary Synthesis**, or the worldview known as **neo-Darwinism**. The ideas from that period form the basis of our understanding of **microevolution** today.

G. H. Hardy and W. Weinberg independently derived what is now known as the **Hardy-Weinberg Principle**, a prediction of the allele and genotype frequencies of a group of offspring given the allele frequencies of the parental generation. The H-W principle demonstrates that, in the absence of external forces, allele and genotype frequencies do not change across generations. This is important because if allelic frequencies *are* observed to change, it usually indicates that an interesting evolutionary force has acted.

The material from lecture pertaining to the mathematics of the H-W equation was taken directly from the assigned reading, so please consult your text.

Mutation is the result of errors in DNA replication, and it is the source of new genetic variation. **Point mutations** are changes in single nucleotides, and in most plants and animals the point mutation rate is low ($\sim 2 \times 10^{-9}$ per nucleotide per year). Neutral point mutations have no effect on fitness, but some point mutations are of great consequence (such as in sickle-cell anemia).

Other types of mutation involve the deletion or duplication of small or large pieces of chromosomes, or even the duplication of whole chromosomes (as in Down's syndrome). Whole genomes can be duplicated.

Allele frequencies in a population change by the combined effect of **genetic drift** (including **founder effect** and **bottleneck effect**), **gene flow**, and **natural selection**. Although mutation is the source of new alleles, the rate of mutation is so low that it tends to have little effect on the relative abundance of previously existing alleles.

In sexually reproducing organisms, genetic variation is driven by the shuffling of alleles during recombination. Of course, this does not introduce new alleles into the population, but it does create genotype variation in the offspring relative to the parents.

In the next lecture, we will study the mechanisms of **natural selection** and **sexual selection**, we will establish our species concepts for this course, and we will examine the processes by which new species arise.