

Lecture 36 Natural-selection

Reading: 762-765 (2nd ed. pp. 682-3)

- Random mating alone will not change allele frequencies but differences in survival and reproduction can do so. Natural selection changes allele frequencies provided that there are genotypic differences in average survival rates and average fecundity, called *fitness* or more precisely *reproductive fitness*. Even very slight differences in genotypic fitnesses can result in relatively rapid evolution. Differences in fitness among genotypes results in selection.
- It is worth distinguishing different kinds of selection—*viability, sexual, and fertility*.
- We will consider only **viability selection** because calculation are done in terms of **genotypes frequencies** rather than **family frequencies**. To compute the change in allele frequency, **you work forward from first principles**, which are described in **Figure 21.5**. Only the **relative** and not **absolute viabilities matter**: $w, w, w(1-s)$; the w cancels. The absolute fitnesses determine how many individuals there are, but the relative fitnesses determine changes in allele frequencies.
- **I do not expect you to memorize formulas** but I do expect you to know how to work from first principles to compute changes in allele frequencies in one generation.
- There are several simple things that selection theory tells us. (1) Allele frequencies change much more slowly when an allele is rare than when it is common. (2) **Selection against rare recessives** is particularly ineffective. (3) The accumulated effect of selection is rapid when considered on an evolutionary time scale. Continued selection of intensity s can increase an allele from low to high frequency in roughly $1/s$ generations. This shows that natural selection combined with Mendelian inheritance can account for evolution, something that formed the basis for the **neo-Darwinian synthesis** of the 1930s and 1940s. (4) Selection in favor of or against an allele, called *directional selection* leads to the loss of fixation of alleles and removed genetic variability.
- **Very strong selection can result in very rapid evolution**. Both antibiotic resistance and insecticide resistance evolve very quickly in all exposed species. Parasites and pests have such large population sizes that resistant mutants are almost certain to be present. If they are or if they are introduced by immigration, then it takes only a few generations to increase to high frequency or be fixed.
- **There is often a cost to resistance**. When DDT usage was stopped, DDT resistant genotypes disappeared.

Problems: 21: 17-19 (2nd edition, Ch. 20: 15, 16, 17, 18)