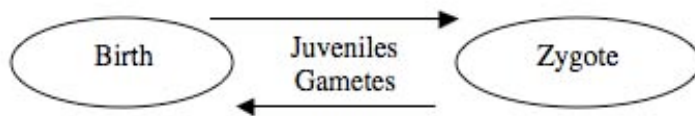# Migration

- In evolutionary terms, migration is defined as movement that will result in gene flow, or the movement of genes from one place to another

Roles in Evolution

- Spreads "successful" mutation from one population to another through migration of individuals from place of birth to place of reproduction

- Opposes the effects of genetic drift (divergence among populations) because it keeps genes flowing throughout; also opposes local selection
- With migration, two populations' allele frequencies come closer to equilibrium
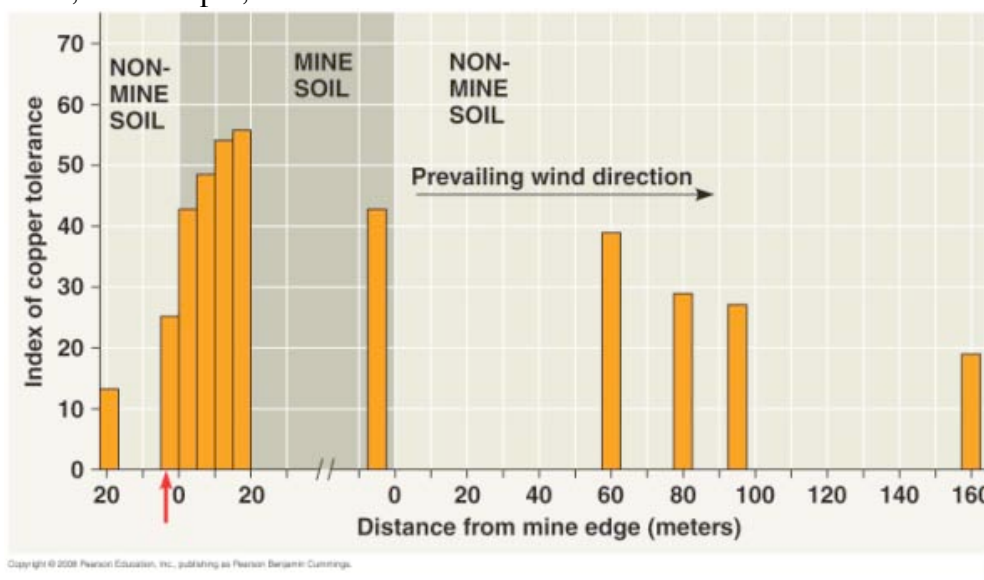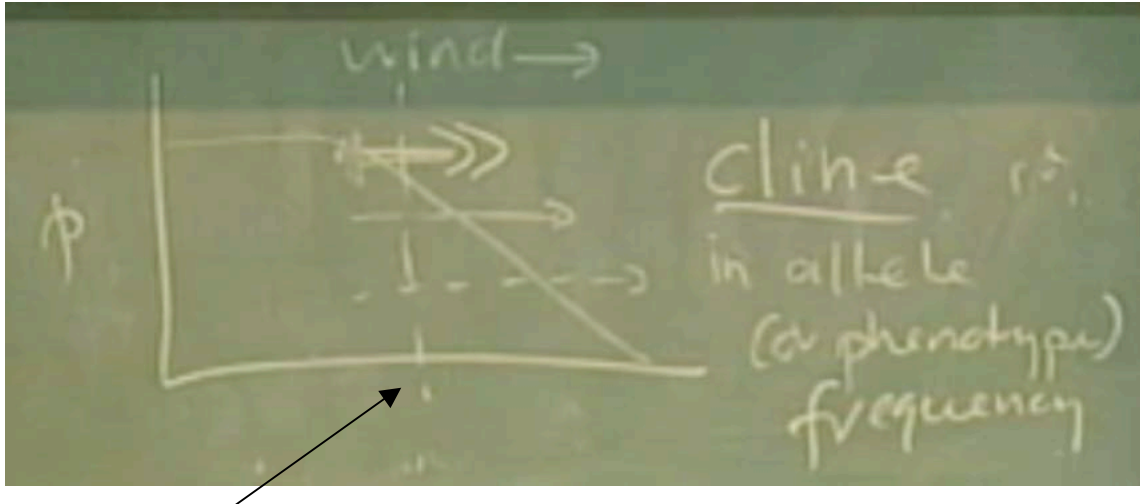
Take, for example, a contaminated mine area:

Figure 23.12 (pg. 479, 8th edition)

- A species of grass lives in both the mine soil and non-mine soil
- In the mine soil, there is local selection for copper tolerance and on the non-mine soil, there is selection against copper tolerance because it is disadvantageous to have that trait in the absence of copper
- In the contaminated soil, the frequency of the tolerance allele would be close to 1 (theoretically) whereas the frequency of the tolerance allele in the non-contaminated grass would be close to zero
- However, due to wind migration of pollen, the distribution is different than predicted. By taking a transect sample across the mine and non-mine soil, a cline can be created:

Here, the center line represents the divide between the contaminated and non-contaminated soil. P is the frequency of the phenotype for copper tolerance.

Variation

	Within Populations	Among Populations
Mutation	⇑	
Genetic Drift	⇓	⇑
Gene Flow	⇑	⇓

Selection (and Genetic Fitness)

- Fitness, as defined within evolutionary parameters, refers to an individual's ability to produce viable and fertile offspring (nothing to do with working out in the gym!)
- Natural selection acts through the phenotype (which is influenced by genotype) of individuals, and its effects are felt on the population
- Furthermore, selection acts on the survival/reproduction of a heritable pheno/genotype relative to others within the population
- Selection and fitness are environmentally dependent

Variation in phenotype is often continuous – eg. for height – and reflects both genetic variaition for that trait within a population, and environmental variation through its effects on development.
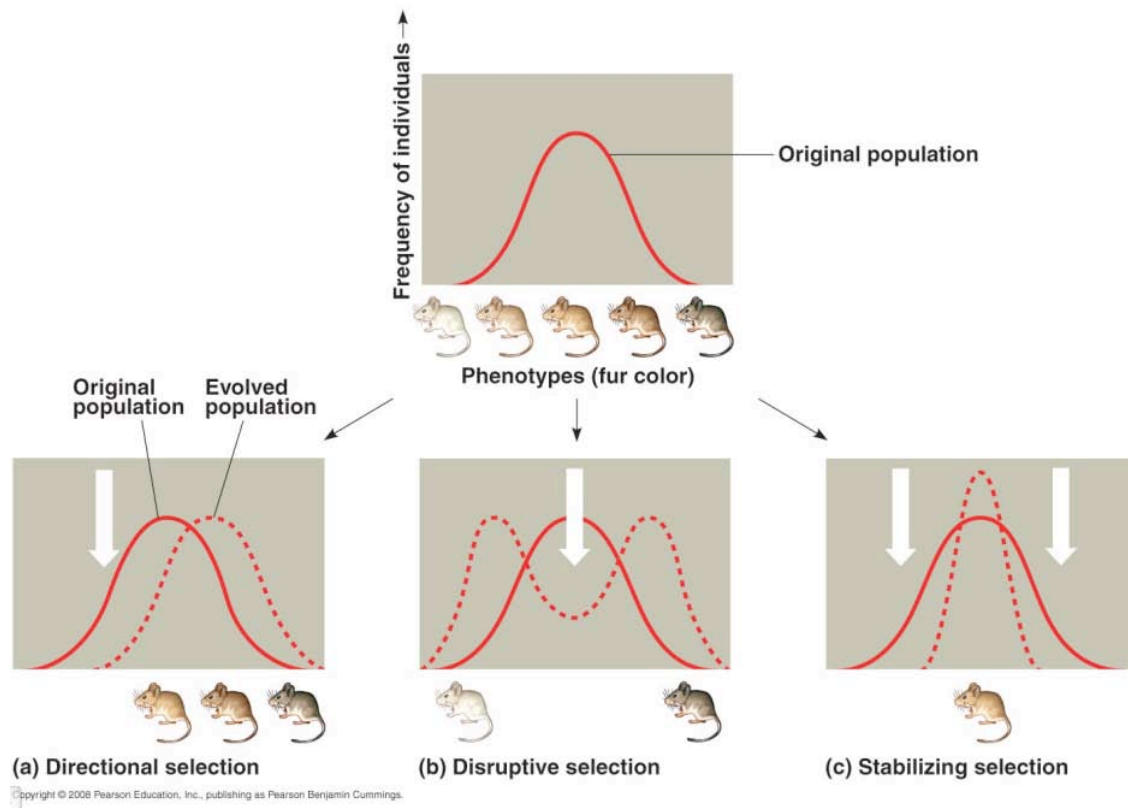
Phenotype Distribution and Evolution

Figure 23.13 (pg. 480 8th edition)

(a) Directional Selection: As shown above, individuals at the left-most end of the phenotype distribution have lower fitness &/or lower probability of surviving. As generations continue to reproduce with the same selective pressure, the curve is pushed to the right of the original because those phenotypes are more advantageous.

(b) Disruptive Selection: Individuals with intermediate phenotpytes are selected against, so individuals on each extreme survive and go on to reproduce. If the next generation reproduces randomly, the original curve will return. However, if non-random mating occurs, speciation may be the result (more on this later).

(c) Stabilizing Selection: In this case, both phenotypic extremes do not do well, so the middle phenotypic range increases in frequency. However, due to Mendelian inheritance, the generation following this selection will produce a generation similar to the original graph. However, this form of selection actively maintains genetic diversity in populations.

Sickle-Cell Anemia Example:
In the absence of malaria, genetic fitness is as follows:
$Hbb^{AA} > Hbb^{As} > Hbb^{ss}$

Hbb^{ss} denotes individuals who have malformed red blood cells, and thus have trouble transporting oxygen in the blood. This causes health problems (anaemia) that often prevent the individual from reproducing.

However, in the presence of malaria:
Hbb^{As}>Hbb^{AA}>Hbb^{ss}
This is the case because individuals with the heterozygous genotype have a slight resistance to malaria (with the s allele), but are not afflicted with Sickle-Cell Anemia

      Darwin thought that evolution by natural selection was a very slow process, however it can also be very fast, only taking a few generations.

Directional Selection is when the ideal phenotype shifts from that of the original population to a phenotype more adapted to the environment. For example, light-colored mice living on a dark lava flow are more visible to predators, leading to selection for darker colored mice and a shift in the population to a darker coat color.
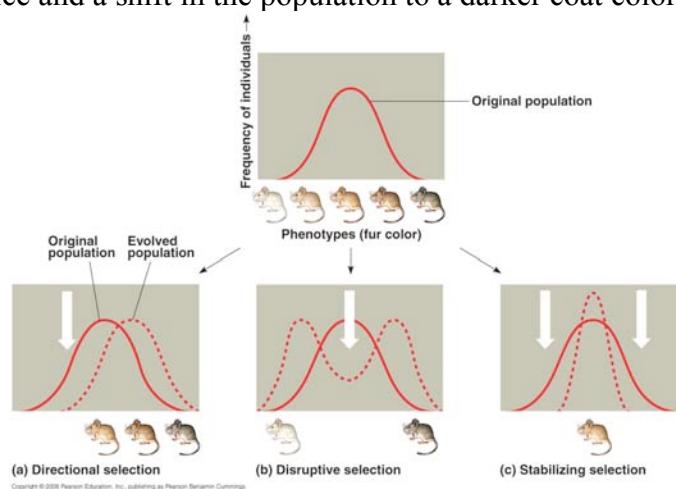

Figure 3: Different types of selection.
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      Scientists can generate **experimental evidence** using experiments with organisms that have a short life cycle, such as bacteria, yeast, and flies (Drosophila).
      For example, consider guppies. Females are more attracted to male guppies with many large brightly colored spots, than to male guppies with fewer, smaller, or duller spots. However, bright colors attract predators. So, the brightly colored guppies survive less but reproduce more, while duller fish survive more but reproduce less.
      Endlew and Reznick transplanted fish from a predator-filled pool at the bottom of a waterfall into the predator and guppy-free waters at the top of the waterfall. Therefore, a population of fish with drab colorations were moved into an environment with no predators. There, within generations the male fish quickly came to have more spots that

were larger and more brightly colored. This field experiment demonstrates the response of heritable phenotypes to a change in selection for a trait.
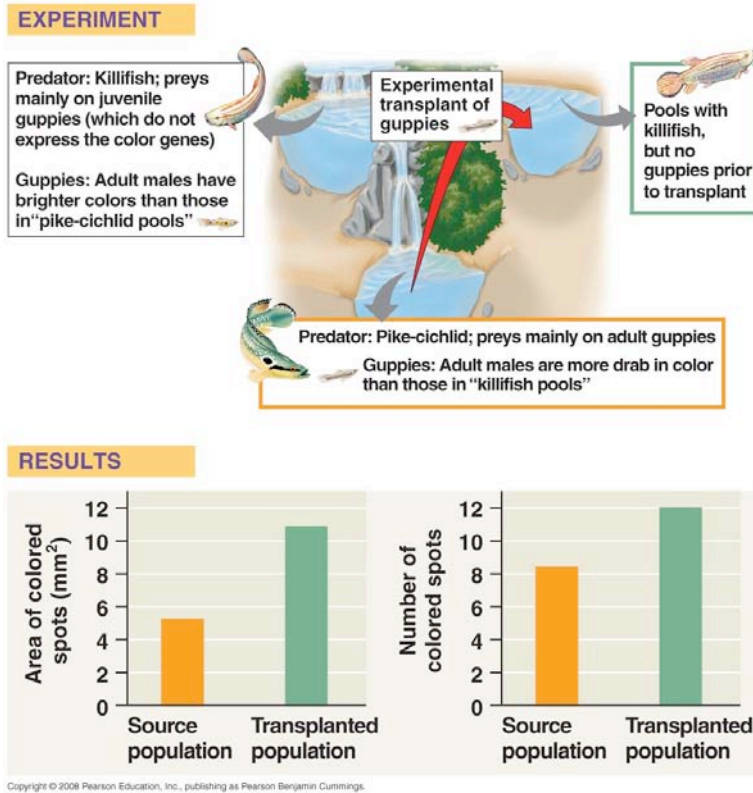
1.

EXPERIMENT

Predator: Killifish; preys mainly on juvenile guppies (which do not express the color genes)

Guppies: Adult males have brighter colors than those in "pike-cichlid pools"

Experimental transplant of guppies

Pools with killifish, but no guppies prior to transplant

Predator: Pike-cichlid; preys mainly on adult guppies

Guppies: Adult males are more drab in color than those in "killifish pools"

RESULTS

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Figure 1: Guppy Experiment

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