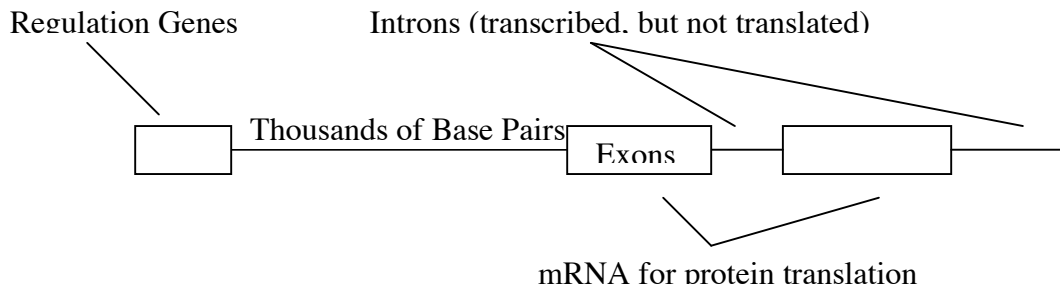


Mutation

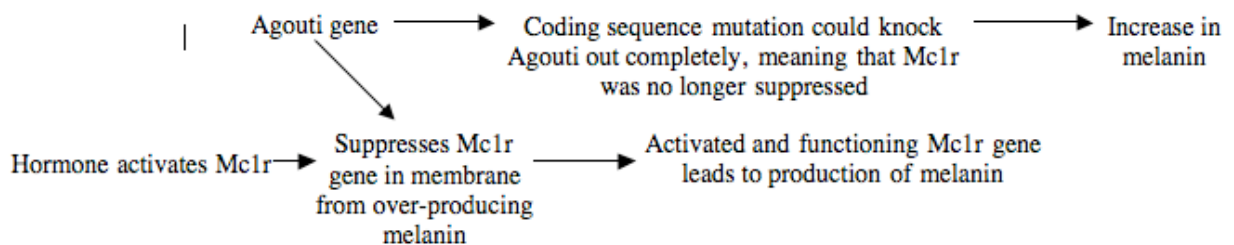
What is mutation?

- Changes in the coding sequence
- Changes in gene regulation, or how the genes are expressed as amino acids, proteins, etc.
- Changes in the copy number of genes (only a segment of a chromosome being copied and put somewhere else within the genome)
- Changes in the number of genomes copied, such as polyploidy in plants, making them 4N or 8N

Simplistic DNA Diagram:



Example: Coat Variation in Mice on Lava Floes



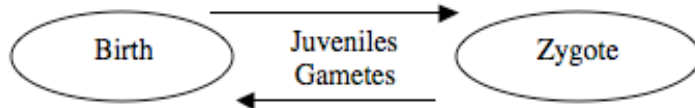
- Agouti's presence is based on one gene (two alleles), and both would need to be recessive to completely stop suppression of Mc1r, leading to a very dark colored mouse
- Some mutations could increase expression of Agouti, which would lead to a very light colored mouse (paler than normal)
- Mc1r can have dominant mutations that increase the sensitivity to the activation hormone, thus further increasing the production of melanin

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 the same value

Take, for example, a contaminated mine area:

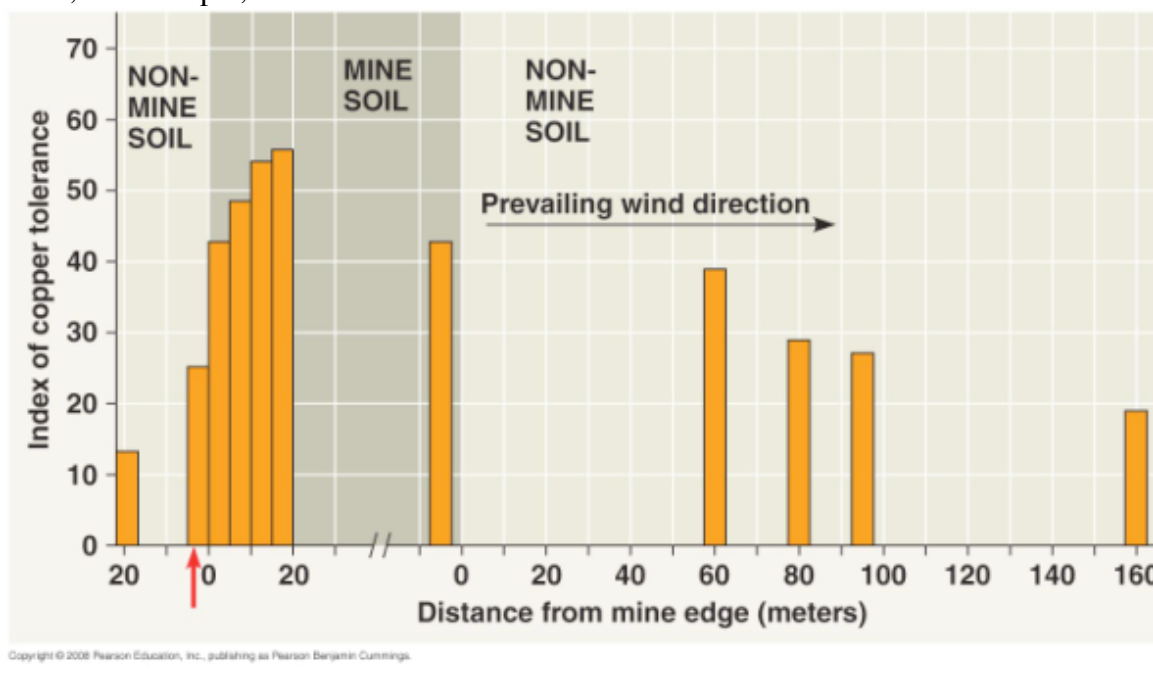
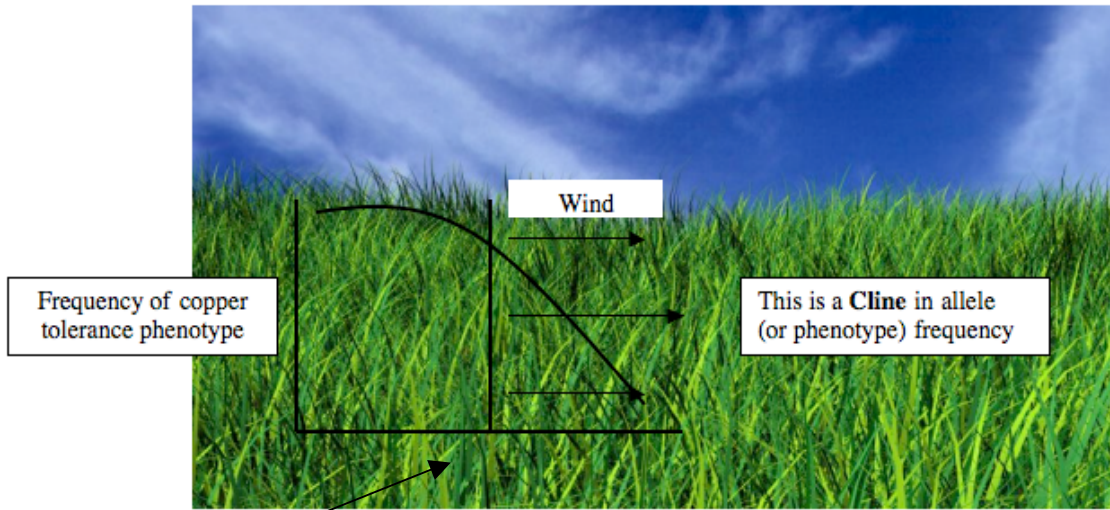
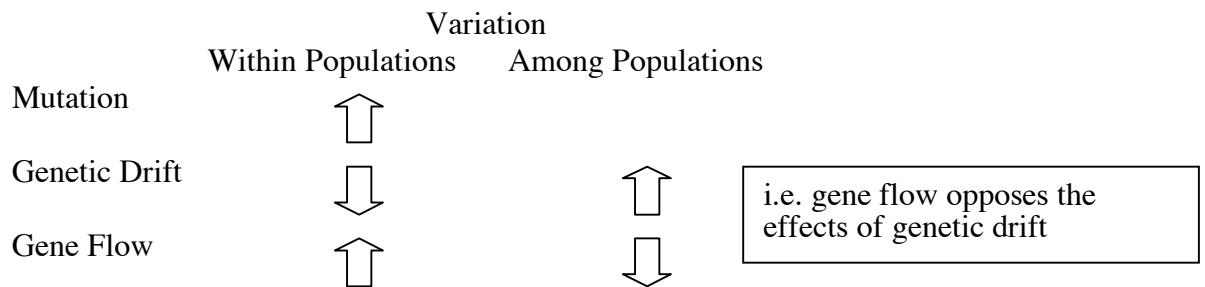


Figure 23.12 (pg. 479, 8th edition)

- 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 no selection for 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.



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

Please see below for Phenotype Distribution Charts:

Phenotype Distribution and Evolution

These graphs are affected by genetic variation (range of possible phenotypes) and environmental variation (that select for a range of traits)

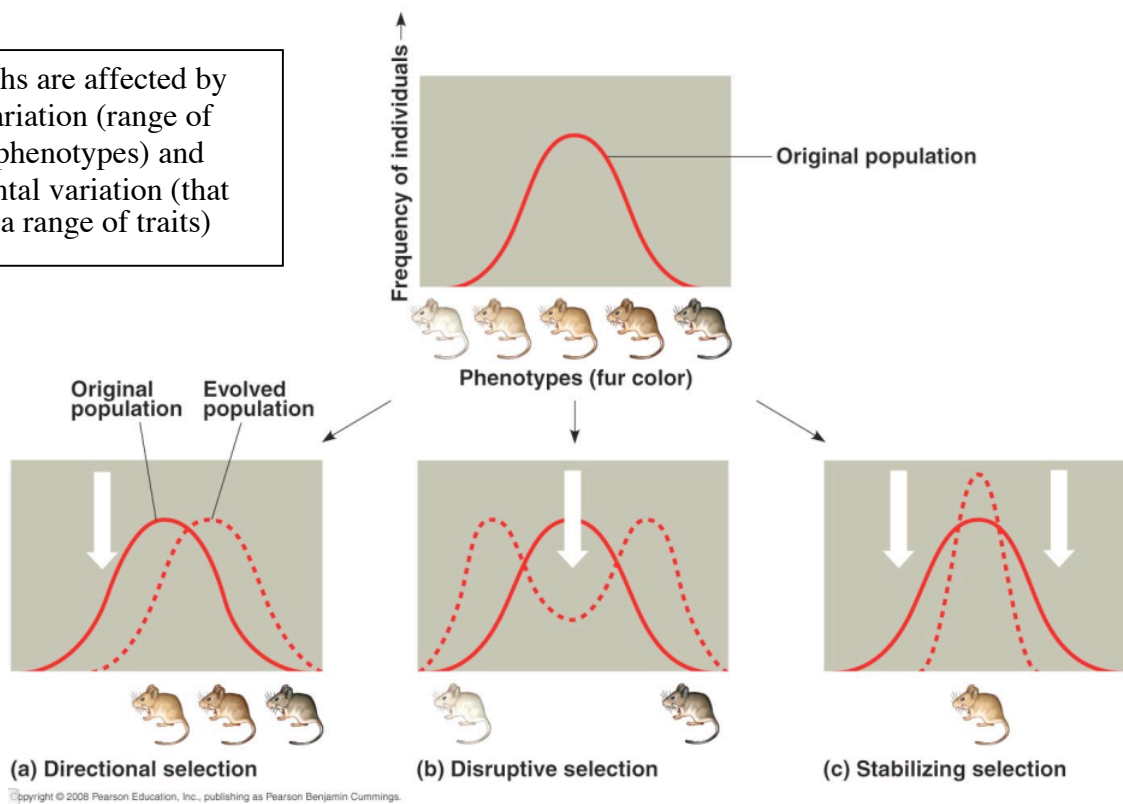


Figure 23.13 (pg. 480 8th edition)

(a) **Directional Selection:** As shown above, individuals at the left-most end of the graph have lower fitness/lower probability of surviving. As generations continue to reproduce in a stable environment, the curve is pushed to the right of the original because those phenotypes are more advantageous.

(b) **Disruptive Selection:** The middle individuals 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.

(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. This also maintains genetic variation, even with genetic drift.

Sickle-Cell Anemia Example:

In the absence of malaria, genetic fitness is as follows:



Hbb^{ss} denotes individuals who have malformed red blood cells, and thus have trouble transporting oxygen in the blood (better known as anemia). This causes health problems that reduce survival of individuals.

However, in the presence of malaria:

Fitness: 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