

36) Continuing previous lecture— Gene Flow

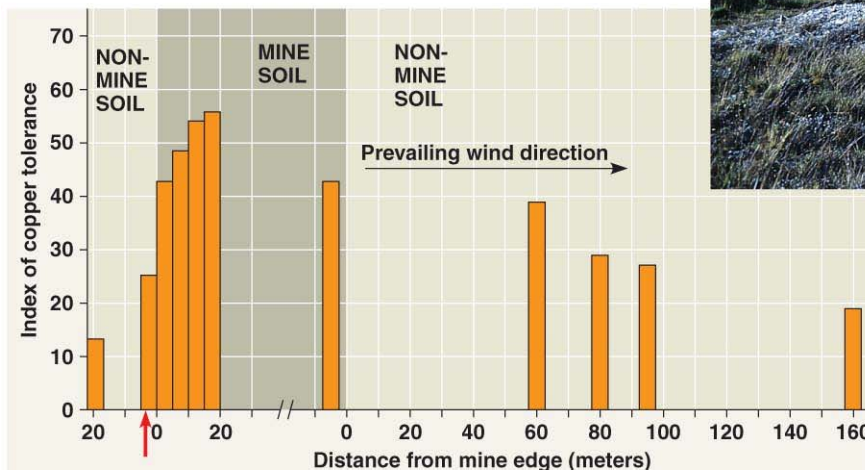
- **Gene flow** consists of the movement of alleles among populations
- Alleles can be transferred through the movement of fertile individuals or gametes (for example, pollen)
- Gene flow tends to reduce differences between populations over time
- Gene flow is more likely than mutation to alter allele frequencies directly

37) Gene Flow—cont.

- Gene flow can decrease the fitness of a population
- See Fig. 23.12 (next slide)

38) Gene Flow—cont.

- In bent grass, alleles for copper tolerance are beneficial in populations near copper mines, but harmful to populations in other soils
- Windblown pollen moves these alleles between populations
- The movement of unfavorable alleles into a population results in a decrease in fit between organism and environment



39) Gene Flow—cont.

- Gene flow can increase the fitness of a population
- Insecticides have been used to target mosquitoes that carry West Nile virus and malaria
- Alleles have evolved in some populations that confer insecticide resistance to these mosquitoes
- The flow of insecticide resistance alleles into a population can cause an increase in fitness

40) A Closer Look at Natural Selection

- Only natural selection consistently results in adaptive evolution
- Natural selection brings about adaptive evolution by acting on an organism's phenotype
- From the range of variations available in a population, natural selection increases frequencies of certain genotypes, fitting organisms to their environment over generations

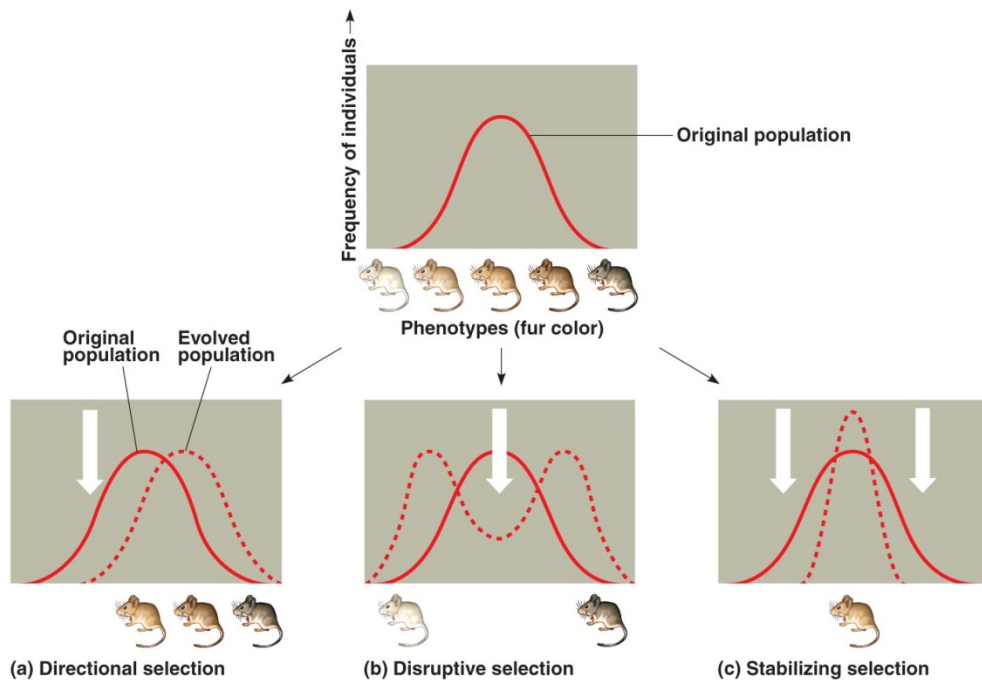
41) Fitness and Relative Fitness

- The phrases “struggle for existence” and “survival of the fittest” are misleading as they imply direct competition among individuals
- Reproductive success is generally more subtle and depends on many factors
- **Relative fitness** is the contribution an individual makes to the gene pool of the next generation, relative to the contributions of other individuals
- Selection favors certain genotypes by acting on the phenotypes of certain organisms

42) Directional, Disruptive, and Stabilizing Selection

- Three modes of selection:
 - 1) **Directional selection** favors individuals at one end of the phenotypic range
 - 2) **Disruptive selection** favors individuals at both extremes of the phenotypic range
 - 3) **Stabilizing selection** favors intermediate variants and acts against extreme phenotypes
- See Fig. 23.13 (next slide)

43) The 3 Modes of Selection



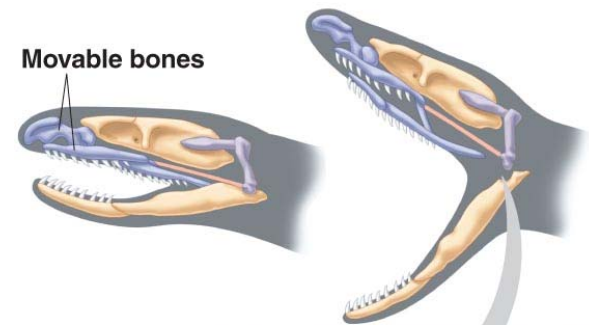
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44) Reminder: Natural selection plays a key role in adaptive evolution

- Natural selection increases the frequencies of alleles that enhance survival and reproduction
- **Adaptive evolution** occurs as the match between an organism and its environment increases
- Some examples of adaptations (Fig. 23.14):



(a) Color-changing ability in cuttlefish



(b) Movable jaw bones in snakes

45) Adaptive evolution—cont.

- Because the environment can change, adaptive evolution is a continuous process
- Genetic drift and gene flow do not consistently lead to adaptive evolution as they can *increase* or *decrease* the match between an organism and its environment

46) Sexual selection

- **Sexual selection** is natural selection for mating success
- It can result in **sexual dimorphism**, marked differences between the sexes in secondary sexual characteristics



47) Sexual selection—cont.

- **Intrasexual selection** is competition among individuals of one sex (often males) for mates of the opposite sex
- **Intersexual selection**, often called mate choice, occurs when individuals of one sex (usually females) are choosy in selecting their mates
- Male showiness due to mate choice can increase a male's chances of attracting a female, while decreasing his chances of survival

48) More about mate selection

- The favored hypothesis as to how female preferences evolve is that if a trait is related to male health, both the male trait and female preference for that trait should be selected for
- This is called the *good genes* hypothesis
- see Fig. 23.16 showing the evidence for female selection for “long call” males

49) The Preservation of Genetic Variation

- Various mechanisms help to preserve genetic variation in a population
- We will examine some of these mechanisms, including diploidy, balanced dimorphism, heterozygous advantage, etc.

50) Diploidy

- **Diploidy** maintains genetic variation in the form of hidden recessive alleles

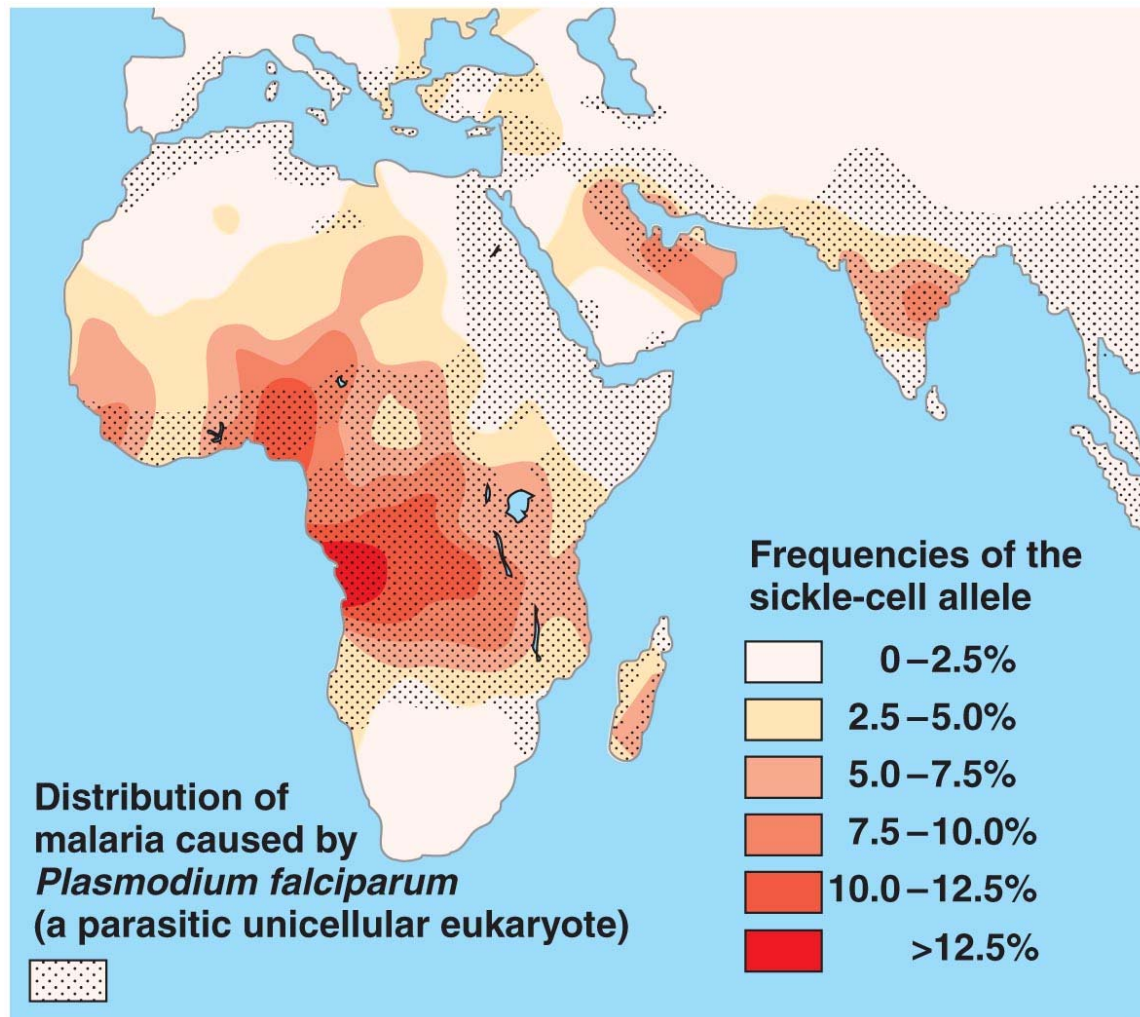
51) Balancing Selection

- **Balancing selection** occurs when natural selection maintains stable frequencies of two or more phenotypic forms in a population
- Balancing selection leads to a state called **balanced polymorphism**

52) Heterozygote Advantage

- Some individuals who are heterozygous at a particular locus have greater fitness than homozygotes
- This is called **heterozygous advantage**
- Natural selection will tend to maintain two or more alleles at that locus
- The persistence of *sickle-cell anemia* is a classic example of this, because it confers malaria resistance in spite of distortion of erythrocytes
- See Fig. 23.17 (next slide)

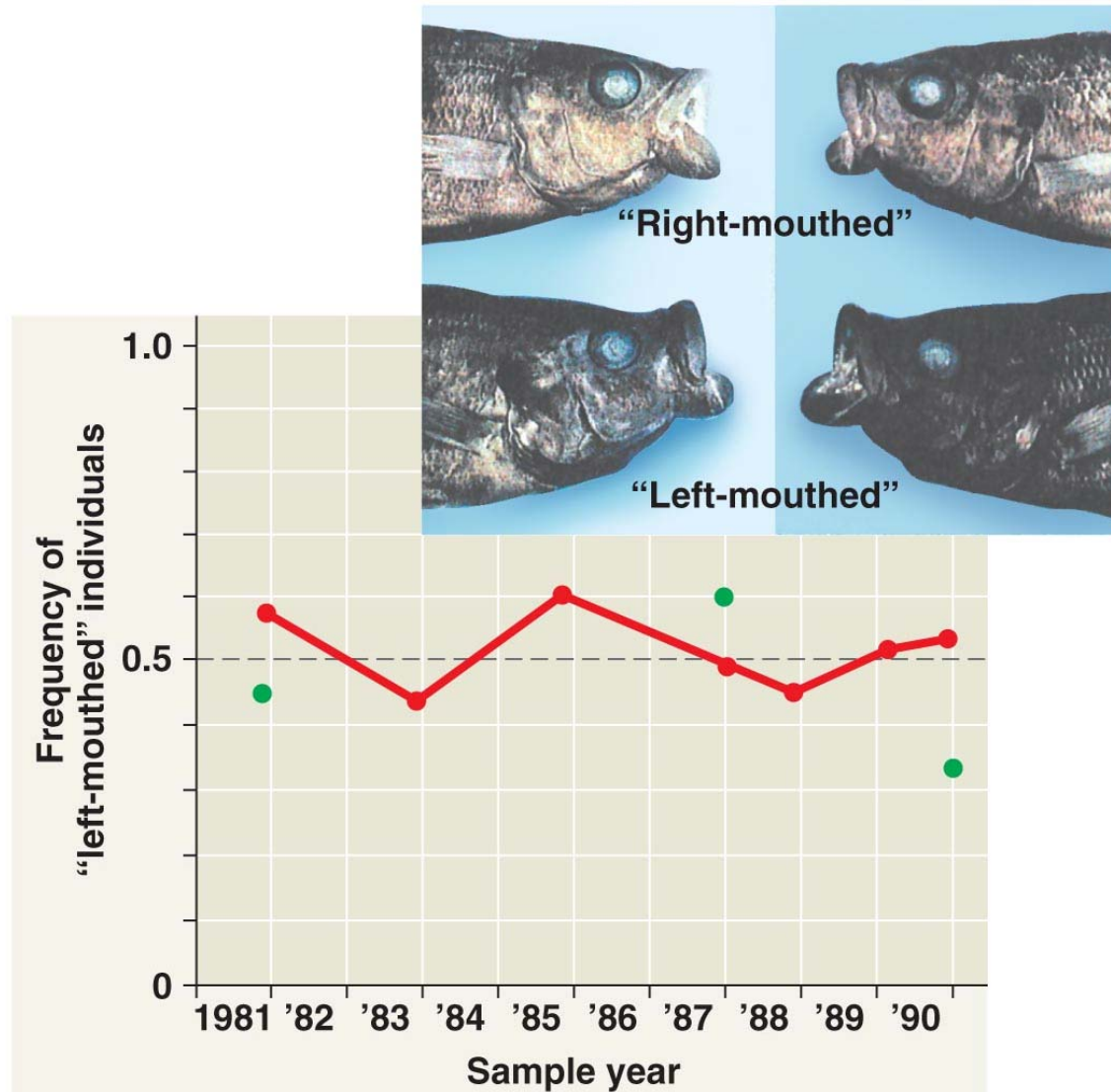
53) Distribution of the sickle-cell allele



54) Frequency-Dependent Selection

- In **frequency-dependent selection**, the fitness of any phenotype declines if it becomes too common in the population
- Selection can favor whichever phenotype is less common in a population
- Great example in the scale-eating fish; Fig. 23.18 (next slide)

55) Example of frequency-dependent selection:



56) Neutral Variation

- **Neutral variation** is genetic variation that appears to confer no selective advantage
- For example,
 - Variation in noncoding regions of DNA
 - Variation in proteins that have little effect on protein function or reproductive fitness

57) Why Natural Selection Cannot Fashion Perfect Organisms

1. Selection can act only on existing variations
2. Evolution is limited by historical constraints
3. Adaptations are often compromises (see Fig. 23.19, next slide)
4. Chance, natural selection, and the environment interact

58) An example of an evolutionary compromise

