Evolution 2
Adaptation

- Beak size and shape changed in populations of medium ground finch and cactus finch over 30 years.
- Changes in size and shape were correlated with weather and seed availability.
Adaptation

Process: the changes caused by natural selection leading to a greater fit between the population and its environment across generations

Trait: a trait that confers higher fitness on individuals that have it compared to individuals with any alternative trait
Population

• A group of organisms of the same species that:
  – Occupy a particular geographic region
  – Are substantially more likely to mate with each other than with members of other populations
Wrentit Distribution in California
• Wrentit Distribution
  – Population centers
Fitness

• The relative amount of genetic information contributed by an individual to the next generation
  – Usually measured in terms of reproductive success relative to the population average
  – Very fit if you produce more than average
**Disease evolution**

**THE BATTLE WITH BACTERIA**

Incorrect usage and prescription of antibiotics is greatly contributing to the emergence of new "super bugs" that can no longer be treated with conventional drugs.

- **Infected person**
- **Partially resistant bacteria**
- **With continued antibiotic treatment, all bacteria are eliminated.**
- **Further mutation turns highly resistant bacteria into a completely resistant strain. Antibiotic becomes ineffective.**
- **Without treatment, bacteria grows back. Some partially resistant bacteria undergo mutation to further resistance.**
- **After 2 weeks, symptoms gone, but few bacteria.**
- **High resistance bacteria.**

**SOURCE:** Genetics; from Genes to Genomes by L.H. Hartwell, M.L. Goldberg, A.E. Reynolds, L.M. Silver, R.C. Veres
Disease evolution

• **Selection** acts on bacteria
  – Individuals with good adaptations (resistance) survive to reproduce
  – Individuals without those adaptations don’t survive

• Population evolves
  – Future generations carry traits of those that survived to reproduce
Disease evolution

• Change in resistance
• Also change in **virulence**
  • Relative ability to cause a disease
  • High virulence = dangerous
• **Virulence may be a function of environment**
  • Selection on the disease
    – By the host (immune response, etc)
    – By the vectors (water, mosquito, contact)
Disease evolution

• **Vectors**
  – Rhinoviruses- Common cold
  – Passed by contact
  – Selection for milder forms of the cold
    • Severe symptoms result in less mobility
    • Restricts contact
      – No reproduction!
Disease evolution

• Selection by the host
  – HIV is virus that attacks host’s immune system (T4 or helper T cells)
    • T cells function to eliminate cells infected by other disease organisms
  – HIV is recognized by B cells
    • Cells naturally produced by immune system to recognize (and help eliminate) most foreign bodies
Which of the following statements BEST describes how selection is acting on rhinoviruses?

1. Rhinoviruses don’t want the species to go extinct, so they reduce their rates of reproduction so that everyone benefits.
2. Rhinoviruses with rapid rates of reproduction become different diseases.
3. Rhinoviruses that reproduce rapidly don’t get their offspring passed to a new host and are eliminated from the population.
4. Rhinoviruses are not under selection.
Why do levels decrease?
Selection and the environment

- Natural selection is a function of the current environment
  - As environments change, so do populations
  - There is no single, best set of traits
    - If environment changes, may result in change in population characteristics
    - May result in creation of new groups
How can populations change?

Stabilizing selection

- Pale flowers not recognized by pollinators = low fitness
- Dark flowers not recognized by pollinators = low fitness
- Pollinators more likely to visit similar colored flowers = high fitness

Population stabilizes, nearly all the individuals are the same color.

Figure 10-14b  Biology: Science for Life, 2/e
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How can populations change?

Directional selection

Not favored by pollinator = low fitness

Preferred by pollinator = high fitness

Population evolves in the direction of a darker pink color.

Figure 10-14a Biology: Science for Life, 2/e
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How can populations change?

Diversifying selection

- One type of pollinator specializes in pale flowers = high fitness
- Another pollinator specializes in dark flowers = high fitness
- Neither pollinator chooses intermediate color = low fitness

Population diversifies into pale variety and dark variety.

Figure 10-14c  Biology: Science for Life, 2/e
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How can populations change?

1. Initial infection by HIV particles.
2. Immune response: Most HIV particles are targeted by antibodies and destroyed.
3. Antibody-resistant HIV variants proliferate, and new variants arise.
4. Immune response.
5. Antibody-resistant HIV variants proliferate, and new variants arise.
6. Immune response.
7. Antibody-resistant HIV variants proliferate.

Figure 10-15 Biology: Science for Life, 2/e © 2007 Pearson Prentice Hall, Inc.