Bio1B Evolution 6

**Evolutionary processes**
- Mutation as the ultimate source of variation; effects on fitness
- Migration (as gene flow)
- Selection
  - Fitness
  - Forms of selection
  - Heterozygote advantage - e.g. sickle cell anaemia
  - Directional selection - e.g. coat color in mice

**Today**

- **Evolutionary processes**
  - Selection
    - Directional selection - expt evidence; genome signatures
  - Coevolution - mutualistic & antagonistic
  - Why have sex - cost of sex, alternatives, proposed advantages

### Forms of selection (Fig. 23.13)

- **Directional selection**
- **Disruptive selection**
- **Stabilizing selection**

### Genomic signatures of recent selection

New mutation arises that increases fitness

Under directional selection increases to $p = 1$; drags linked sites with it

Results in a region of low variation relative to others

Storz 2005

**Experimental evidence for rapid evolution due to selection**

Eg. guppy color - field experiments; text pp. 460)

- Others - microbial evolution etc etc

Fig. 22.13
Genomic signatures of selection; localized reductions in diversity

A Single IGF1 Allele Is a Major Determinant of Small Size in Dogs

What’s with my crazy dog?
Sutter et al. 2007
Science 316:112

Why have sex?
Alternatives - asexual: parthenogenesis in animals (pp 998-999); apomixis in plants (pp. 812-813)

Why not sex?
Inefficient, risky, breaks up good gene combinations

Daphnia - asexual in good times, sexual in harsh conditions

Coevolution

species 1

selection

species 2

selection

Mutualistic
- Symbioses, mutualisms; eg. attine ants ↔ fungi

Antagonistic
- Host ↔ pathogen
- Predator ↔ prey

Hypotheses for advantages of sex (pp 998-999)

1. Reduces accumulation of disadvantageous mutations (“Mueller’s ratchet”)
2. Brings together independent mutations that together increase fitness
3. Generates genetically diverse offspring
   - Advantage in variable environment
   - Increases ability to resist pathogens & parasites (coevol “arms race” => Red Queen hypothesis

"The Red Queen has to run faster and faster in order to keep still where she is. That is exactly what you all are doing!"
Sex and genetic variation

Sexual reproduction produces genetically variable offspring through:

- Random mating
- Independent assortment across loci
- Recombination between loci
- See pp. 258-260

Evolution & consequences of parthenogenesis in an Australian gecko (Heteronotia binoei)

Rapid spread, but more parasites