Bio1B Evolution 6

Last lecture:

Evolutionary processes

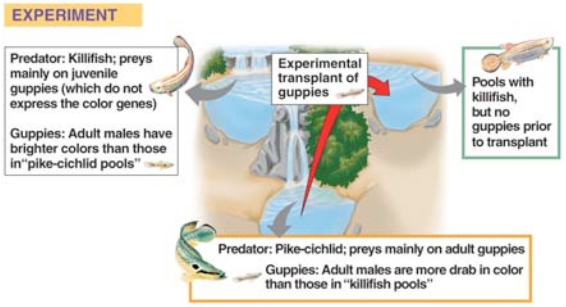
- Mutation as the ultimate source of variation; effects on fitness
- Migration (as gene flow)
- Selection
  - Fitness
  - Forms of selection
  - Heterozygote advantage - eg. sickle cell anaemia
  - Directional selection - eg. coat color in mice

Today

Evolutionary processes

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

Experimental evidence for rapid evolution due to selection



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

- Others - microbial evolution etc etc

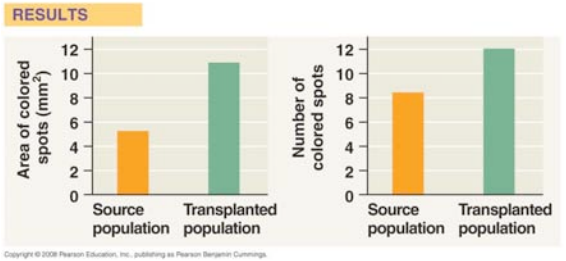
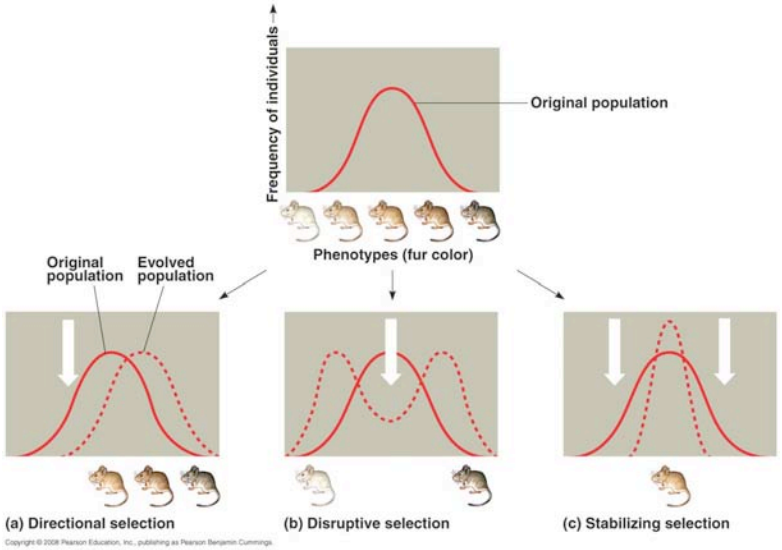


Fig. 22.13

Forms of selection (Fig. 23.13)

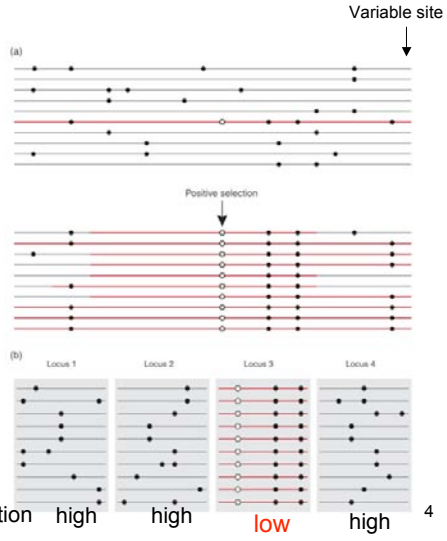


Genomic signatures of recent selection

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

Genomic signatures of selection; localized reductions in diversity

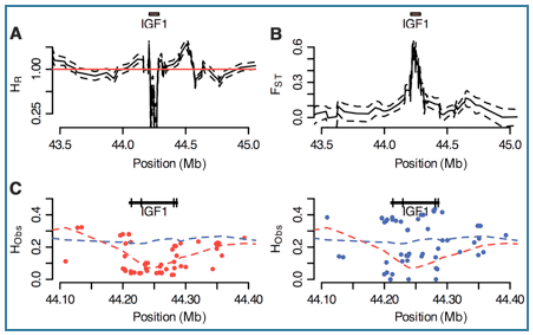
A Single *IGF1* Allele Is a Major Determinant of Small Size in Dogs

What's with my crazy dog?

Sutter et al. 2007
Science 316:112

GENOMICS

The dog has its day



Coevolution

species 1 ⇄ species 2 (selection / selection)

<u>Mutualistic</u>

- Symbioses, mutualisms; eg. attine ants ↔ fungi

Leaf-cutter ants (Fig 31.22)

<u>Antagonistic</u>

- Host ↔ pathogen
- Predator ⟷ prey

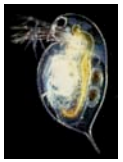
Garter snake and poisonous pacific newt

Why have sex?

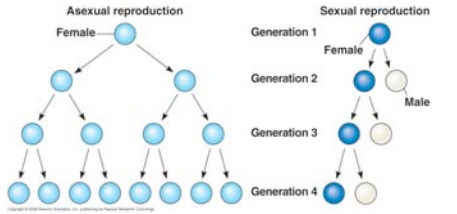
<u>Alternatives - asexual</u>: **parthenogenesis** in animals (pp 998-999); **apomixis** in plants (pp. 812-813)

<u>Why not sex</u>?

Inefficient, risky, breaks up good gene combinations



Daphnia - asexual in good times, sexual in harsh conditions



Cost of sex (Fig. 46.3)

Parthenogenetic whiptail lizards

Apomictic dandelion

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

} Long-term and only if sexual populations are large (weak drift)

3. Generates genetically diverse offspring
   - Advantage in variable environment
   - Increases ability to resist pathogens & parasites (coevol "arms race" => Red Queen hypothesis

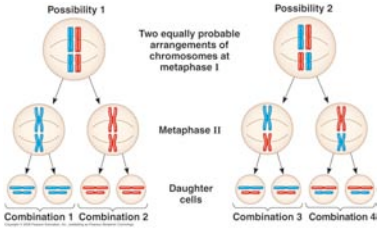
"The Red Queen has to run faster and faster in order to keep still where she is. That is exactly what you all are doing!"

Sex and genetic variation

Sexual reproduction produces genetically variable offspring through:

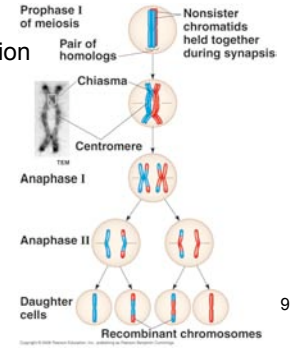
- Random mating
- Independent assortment across loci
- Recombination between loci
- See pp. 258-260

Independent assortment (Fig. 13.11)

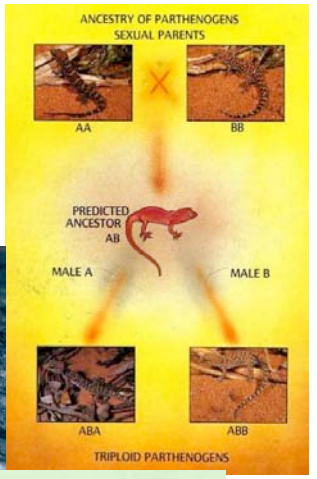


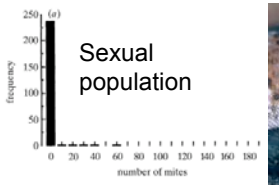
Recombination

Fig. 13.12

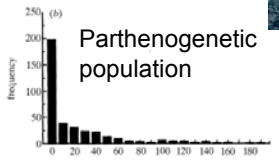


Evolution & consequences of parthenogenesis in an Australian gecko (*Heteronotia binoei*)





Sexual population



Parthenogenetic population

Mite load

Rapid spread, but more parasites