The Evolution of Sex: Origins

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Summary

- what is sexual reproduction?
- historical sequence
  - mitosis
  - bacterial recombination
  - syngamy
  - meiosis
  - mating types
  - anisogamy
What is sexual reproduction?

Chlamydomonas life cycle
Historical sequence

- sexual reproduction involves many different phenomena
- the historical sequence probably is
  - asexual reproduction (binary cell division, mitosis)
  - limited recombination in bacteria
  - fusion between genetically dissimilar cells (syngamy)
  - meiosis (with segregation and crossing over)
  - mating types
  - anisogamy and gender
- when we think of sexual reproduction we usually think of organisms that went through the complete sequence
  - but this does not help us to understand the origin of sexual reproduction

Mitosis

- asexual reproduction (binary cell division, mitosis)
  - cell division in prokaryotes
Mitosis

- asexual reproduction (binary cell division, mitosis)
  - mitosis in diploid eukaryotes

Bacterial recombination

- limited recombination in bacteria
  - of parasitic origin?
Syngamy

- fusion between genetically dissimilar cells

Meiosis

from Stearns & Hoekstra 2005
Meiosis

- segregation and crossing-over

![Diagram of Meiosis](image)

from Stearns & Hoekstra 2005

Meiosis

- gene conversion is involved in DNA repair and it uses cellular mechanisms similar to crossing-over
- recombination could have originated from DNA repair mechanisms

![Diagram of Gene Conversion and Crossover](image)
Mating types

- mating types

from http://biodidac.bio.uottawa.ca

Mating types

- why two mating types?

from Maynard Smith and Szathmary 1995
Anisogamy

• the origin of ‘males’ and ‘females’
  • males make the small gametes and females make the big gametes
• the origin of the twofold cost of sex
  • the ‘main’ cost of sexual reproduction only appeared after evolution of anisogamy, so sex initially may not have needed a big advantage

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  • syngamy
  • meiosis
  • mating types
  • anisogamy
Reading

- read until page 162 and skip the crossed-out boxes and figures (the crosses are only visible before printing)
- concentrate on the mechanistic aspects for the moment, the costs and benefits of sex will be discussed later

9 The Origin of Sex and the Nature of Species

9.1 Introduction
9.2 Cellular mechanisms of the haploid-diploid cycle
9.3 Ancient haploid-diploid cycles
   Why a haploid-diploid cycle without syngamy?
   Why did syngamy replace reduplication?
   Box 9A: Do haploids grow faster?
   Why crossing-over?
   Why a two-step method?
   Box 9B: Some alternatives to a two-step method
   Conclusions
9.4 Matting types and the origin of sexuagamy
9.5 Sex and the nature of species
   Clones
   Observations
   Conclusions