

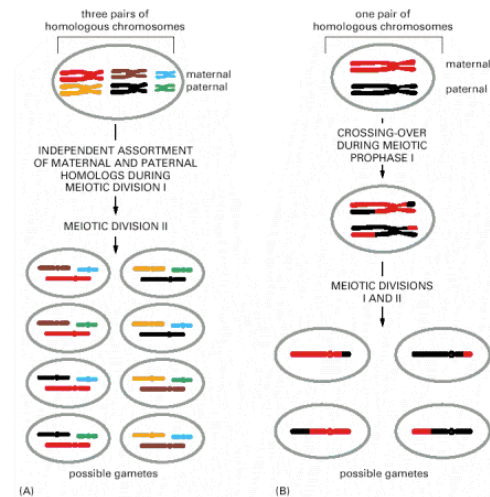
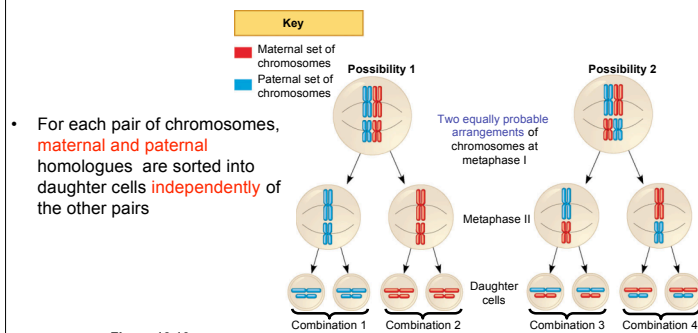
Lecture Outline 10/26/05

- Consequences of meiosis
 - Gametes are genetically variable
 - Independent assortment
 - Crossing over
- Lots of practice problems
- Errors in meiosis
- Why reproduce sexually?

Mitosis vs meiosis:

- **Mitosis** ensures exact replication of the parent cell
- **Meiosis** produces variable, haploid, gametes.
 - Gametes are not identical, because of:
 - **Independent assortment**
 - **Crossing over**

Independent Assortment

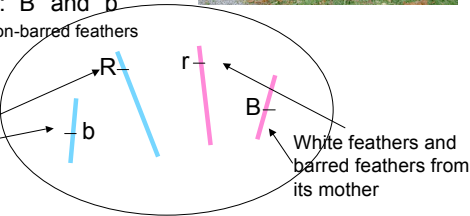


Consequences for genetic variation

- Label two alleles of a gene "R" and "r"
Red vs white feathers
- Another gene on a different chromosome: "B" and "b"
Barred vs non-barred feathers



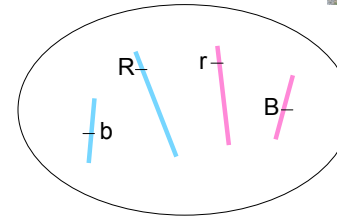
This individual inherited a chromosomes with alleles for Red feathers and non-barred feathers from its father



White feathers and barred feathers from its mother

Consequences for genetic variation

What kinds of gametes will it produce through independent assortment?



Crossing Over

- Produces **recombinant chromosomes** that carry genes derived from two different parents

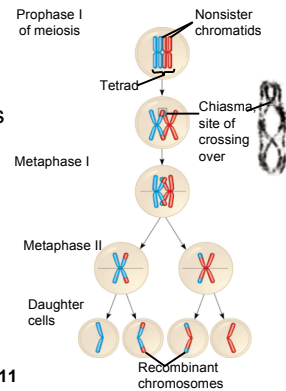
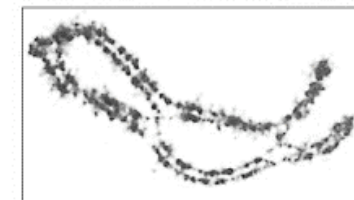
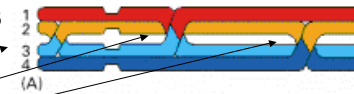


Figure 13.11

The location of crossovers is random

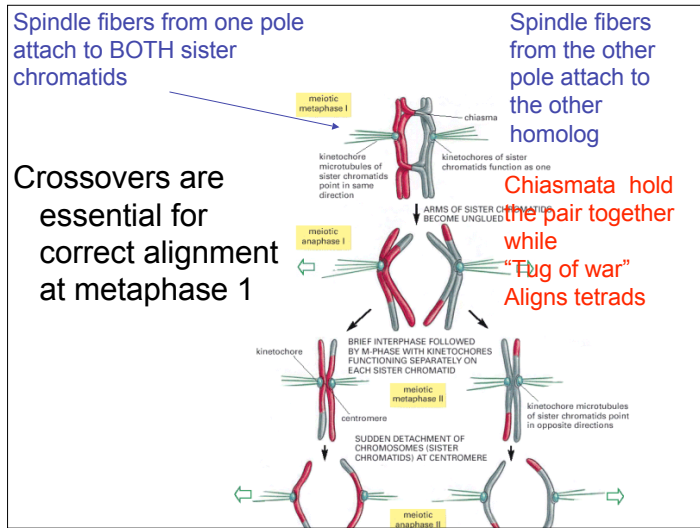
This tetrad has 3 crossovers:

- 2&3
- 1&3
- 2&4



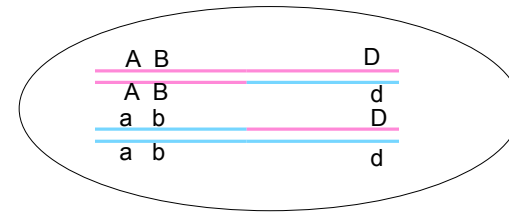
Can occur between any pair of chromatids

(B)



Crossovers are random

- If two genes are close together on the chromosome, they are likely to be inherited together.



Consequences for genetic variation

Red vs white feathers

Brown vs white eggs



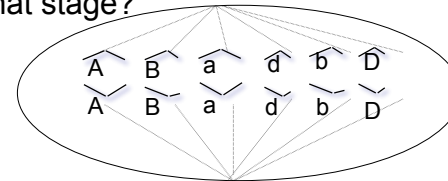
What kinds of gametes can it produce?

Test yourself:

Assume the individual is diploid with 3 pairs of chromosomes A||a B||b D||d

Is this mitosis or meiosis? Why?

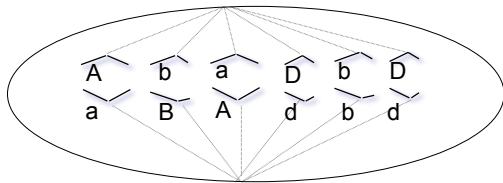
What stage?



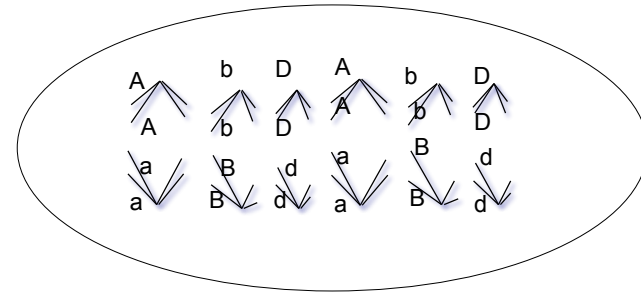
What is wrong with this picture?

Again, assume the individual is diploid with 3 pairs of chromosomes

A||a B||b D||d

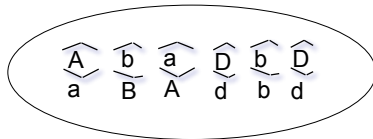


What is wrong with this picture?

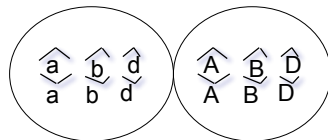


More practice

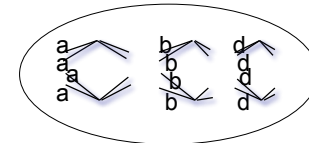
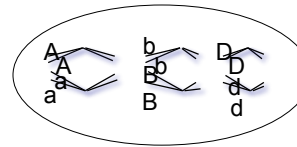
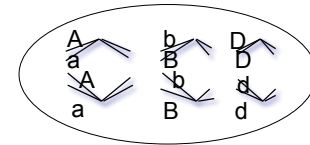
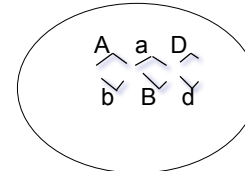
Mitosis or meiosis?
Is it correct?



Mitosis or meiosis?
Is it correct?



Even more practice



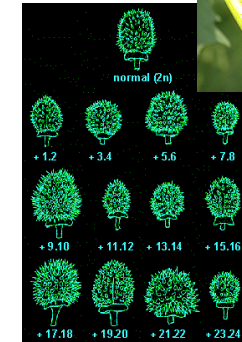
Errors in meiosis

- Polyploidy
 - duplications of entire genomes
 - Seen in many plant species
 - Consequences for reproductive isolation
 - AAAA x AA --> AAA
 - How does meiosis work in that triploid?
 - Sterile



Errors in meiosis

- Aneuploidy
 - duplications or deletions of single chromosomes



Errors in meiosis: aneuploidy

- Most human aneuploids are fatal.
- Exception: trisomy 21 (Downs Syndrome)
- Exception: XXY Turner's syndrome males



Natural variation in chromosome number

- Species differ greatly in chromosome number:

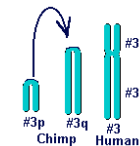
- E. coli: 1 circular chromosome
- Drosophila melanogaster: 4 chromosomes
- Wood fern: 2N=164

Chimps and gorillas have 2N=48

Humans have 2N=46

- How would that affect reproduction in pre-hominid/pre-chimp ancestors?

- Imagine meiosis and the duplication/deletions that would be in the hybrid zygotes
- How would the hybrid (2N=47) make gametes? How would chromosomes pair?



Why sex?

Disadvantages:

- Need to find a mate
- Only pass on half of your genes
- That new combination of genes might be worse . . .

Advantages of sex:

- Avoid disease
- Don't purchase the same lottery ticket twice
- Purge mutations



Advantages of sex:

Avoid disease

- Bananas are propagated asexually
- "Cavendish" variety accounts for almost all of the commercial bananas
- Panama disease (Fusarium wilt) is spreading through Asia
- It's predecessor variety, the "Gros Michel" suffered a similar fungal blight that wiped out that crop in the 1950s



- One solution: Breed resistant varieties
 - Imagine that two parental varieties differ in 15 single genes. To get the desired allele at each locus,

$$0.5^{15} = 1/30,000$$



That's a lot of bananas . . .

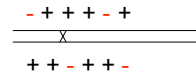


Some organisms have both sexual and asexual stages



Advantages of sex

- Purge deleterious mutations
 - Mutations occur every generation
 - ← Most of them are deleterious
 - Over time, each chromosome will accumulate several deleterious mutations
 - Without meiosis, the number of mutations on a chromosome will only increase



Different lineages will acquire different mutations

Crossing over can produce some gametes with fewer mutations +++-