

Chapter 13.

## Meiosis & Sexual Reproduction

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### Cell division / Asexual reproduction

- Mitosis**
  - produce cells with same information
    - identical daughter cells
  - exact copies
    - clones
  - same amount of DNA
    - same number of chromosomes
    - same genetic information

Aaaargh! I'm seeing double!

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### Asexual reproduction

- Single-celled eukaryotes reproduce asexually
  - yeast
  - Paramecium
  - Amoeba
- Simple multicellular eukaryotes reproduce asexually
  - Hydra
    - budding

What are the disadvantages of asexual reproduction?  
What are the advantages?

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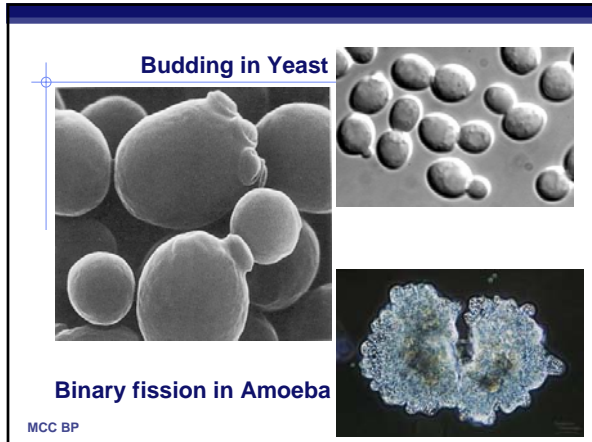
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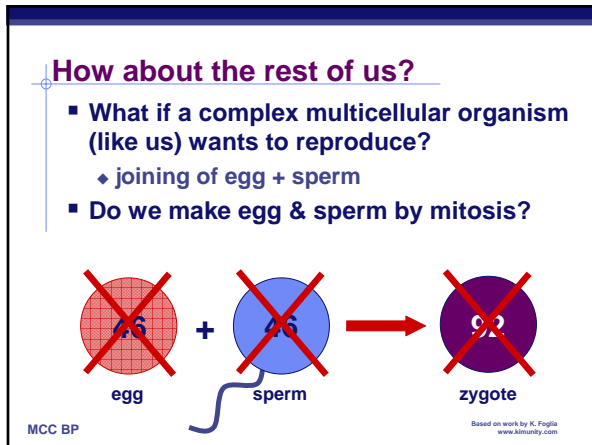
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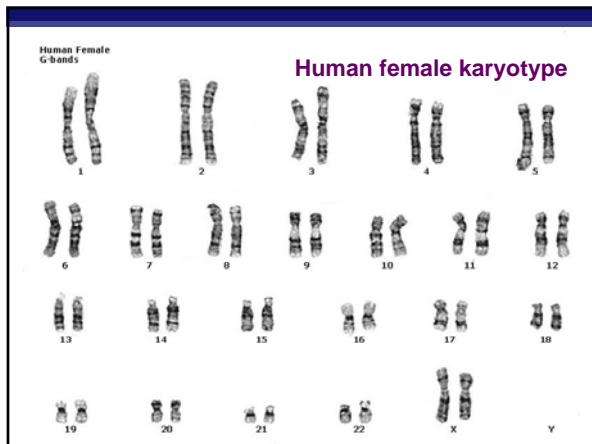
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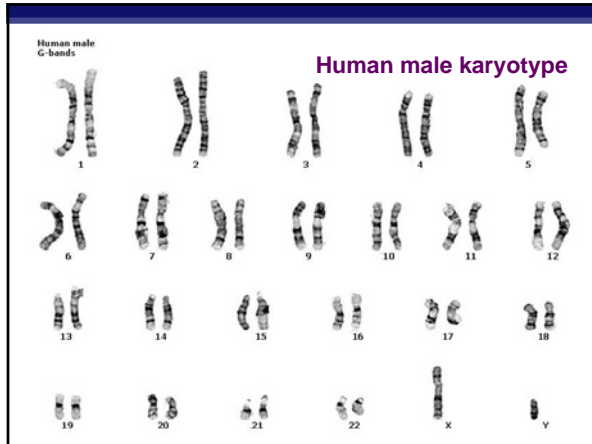
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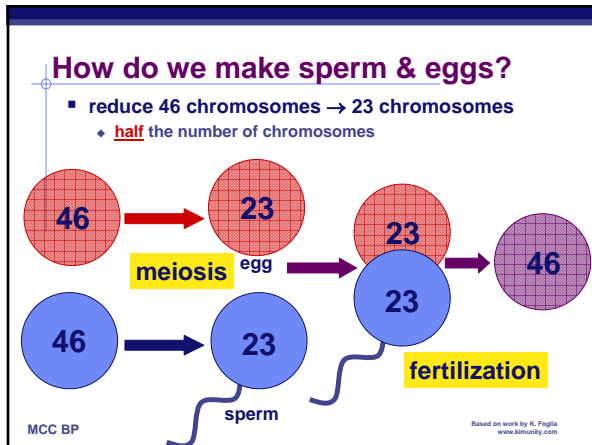
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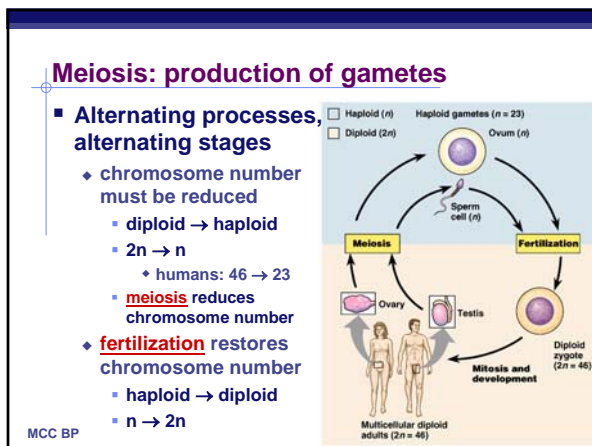
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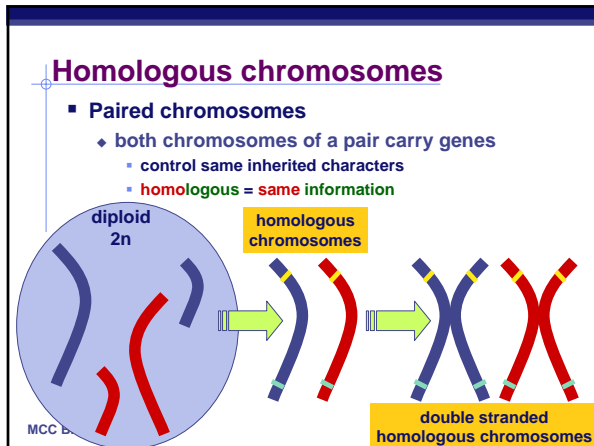
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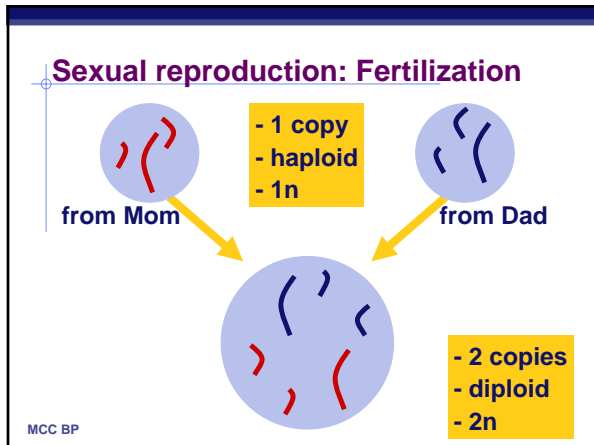
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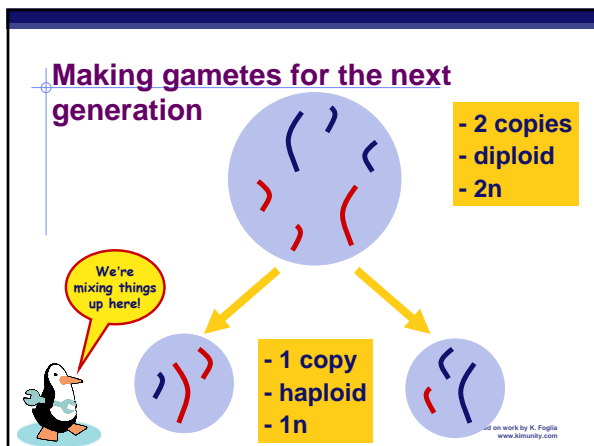
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### Meiosis = reduction division

- Meiosis
  - special cell division in sexually reproducing organisms
  - reduce  $2n \rightarrow 1n$
  - diploid  $\rightarrow$  haploid
    - half
  - makes gametes
    - sperm, eggs

**Warning:** meiosis evolved from mitosis, so stages & "machinery" are similar but the processes are radically different. Do not confuse the two!

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### Double division of meiosis

**DNA replication**

**1st division of meiosis separates homologous pairs**

**2nd division of meiosis separates sister chromatids**

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### Preparing for meiosis

- 1st step of meiosis
  - Duplication of DNA
  - Why bother?
    - meiosis evolved after mitosis
    - convenient to use "machinery" of mitosis
    - DNA replicated in S phase of **interphase of MEIOSIS** (just like in mitosis)

M1 prophase

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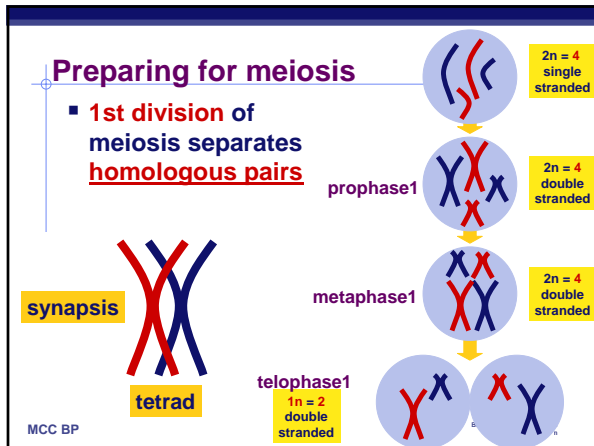
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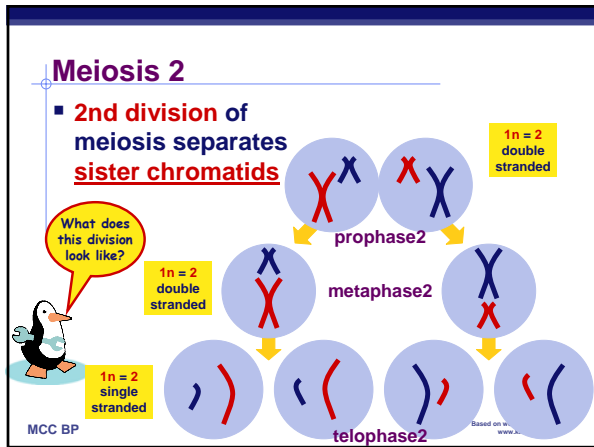
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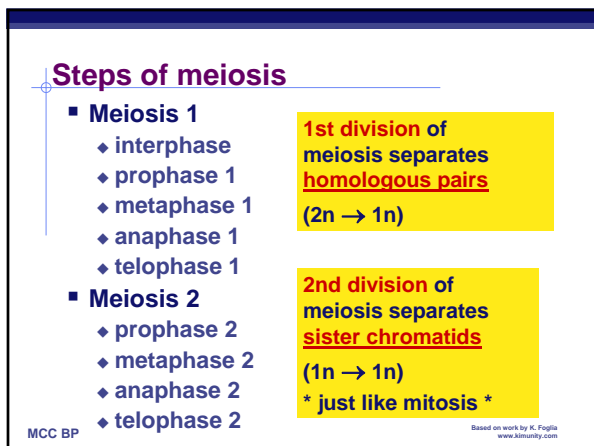
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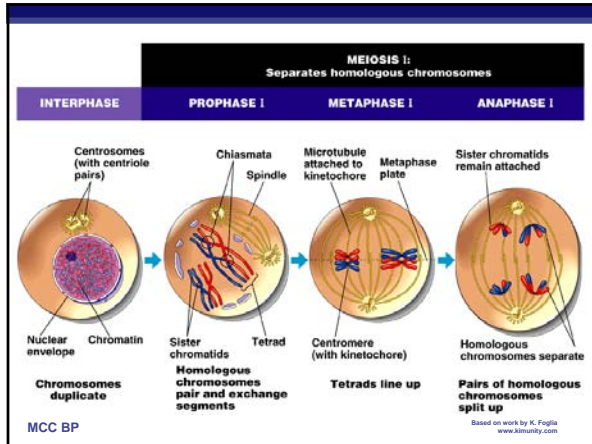
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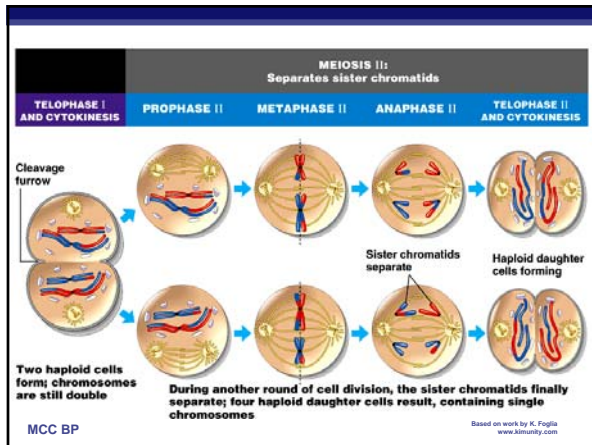
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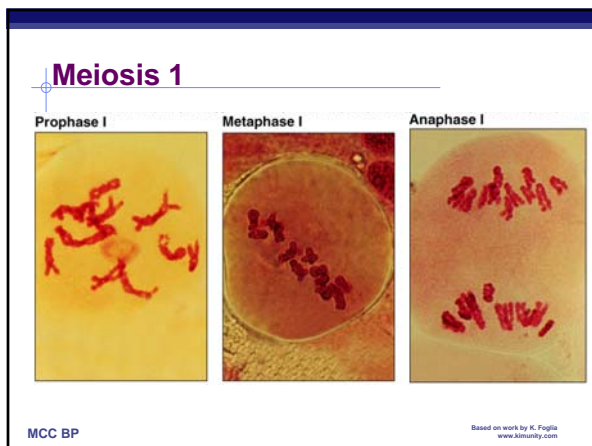
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**Crossing over**

- During Prophase 1
  - homologous pairs swap pieces of chromosome
  - sister chromatids intertwine
  - crossing over

tetrad  
synapsis

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**Crossing over**

- 3 steps
  - cross over
  - breakage of DNA
  - re-fusing of DNA
- New combinations of traits

What are the advantages of sexual reproduction?

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**Genetic variation**

- Meiosis & crossing over introduce great genetic variation to population
  - drives evolution

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### The value of meiosis

- Meiosis introduces **genetic variation**
  - gametes of offspring do not have same genes as gametes from parents
  - genetic recombination
    - random assortment in humans produces  $2^{23}$  (8,388,608) different combinations

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### And more variation...

- Crossing over**
  - creates completely new combinations of traits in next generation

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### Random fertilization

- Any 2 parents will produce a zygote with over 70 trillion ( $2^{23} \times 2^{23}$ ) diploid combinations

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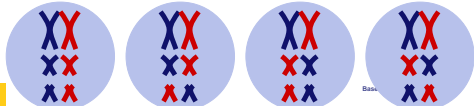
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### Sources of genetic variability

- Genetic variability in sexual reproduction
  - ♦ independent assortment
    - homologous chromosomes in Meiosis 1
  - ♦ crossing over
    - between homologous chromosomes in prophase 1
  - ♦ random fertilization
    - random ovum fertilized by a random sperm



metaphase1

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### Sexual reproduction creates variability

Sexual reproduction allows us to maintain both genetic similarity & differences.



Michael & Kirk Douglas

Baldwin brothers

Martin & Charlie Sheen, Emilio Estevez

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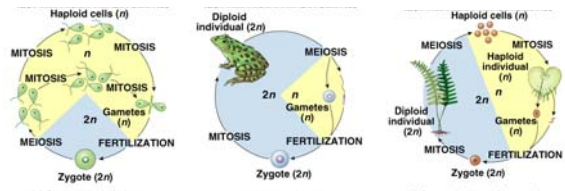
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### Differences across kingdoms

- Not all organisms use haploid & diploid stages in same way
  - ♦ which one is dominant ( $2n$  or  $n$ ) differs
  - ♦ but still alternate between haploid & diploid
    - have to for sexual reproduction



(a) Some types of algae

(b) Most animals

(c) Some plants and some algae

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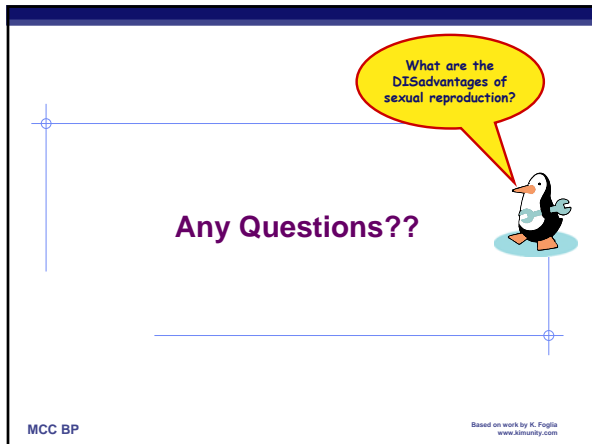
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