Cell division – part 2

meiosis

Cell Division

binary fission = Prokaryotic cell division

Mitosis = eukaryotic somatic (body) cell division
.

Meiosis = germ cell division (cells destined to become sperm in males or ova in females)

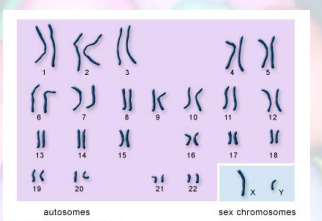
Cell Division

- Before somatic cell division (aka mitosis), the DNA of the cell must REPLICATE
- Results in the formation of two "daughter" cells that are identical (containing the SAME DNA)

DNA During Division

- DNA + Proteins = Chromosomes
- Each organism has a different number of chromosomes

  Camel 70 Opossum 22 Bat 44 Lentil 14
  Goat 60 Chicken 78 Housefly 22 Corn 24
  Apple 34 Rice 24 Barley 14 Lettuce 12
  HUMANS HAVE 46!
- Regardless of the number, before a cell can divide, it must copy each chromosome



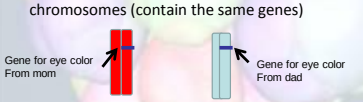
22 pairs of autosomes = regular chromosomes

1 pair of sex chromosomes = determine gender

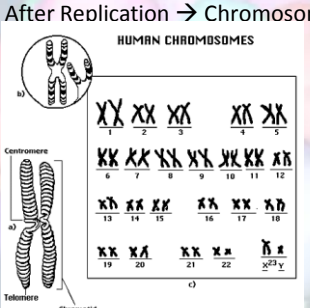
Homologous Chromosomes

- In a **diploid** (2N)
  - **two** versions of each chromosome

  1 from mom 1 from dad
- Each human gets 23 from each parent (46 total)
  - 44 are **autosomes** and two are **sex chromosomes**
- ***homologous chromosomes*** = pairs of corresponding chromosomes (contain the same genes)



After Replication → Chromosomes



Cell division

- Mitosis → produces somatic cells →2 diploid (2N)
- Meiosis → produces gamete cells →4 haploid (1N)
- When a sexually reproducing organism produces gametes (sex cells) they must somehow separate these pairs of chromosomes so gametes only get one set. WHY?

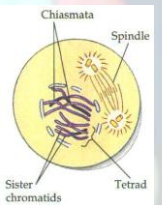
Steps of Meiosis

Steps of Meiosis

- Divided into two distinct stages
  - Meiosis I
  - Meiosis II
- Starts with **one diploid cell** and ends with **4 haploid daughter cells**
- Before meiosis begins, DNA undergoes replication just like in mitosis!

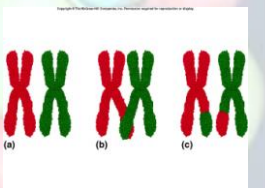
Meiosis I → Prophase I

- Chromosomes form
- Homologous chromosome pair up forming a **tetrad**
  - **Crossing over** occurs
    - during this alignment chromatid arms may overlap and temporarily fuse (**chiasmata**), resulting in **exchange of genetic information**
- centrioles develop the spindle fibers
- nuclear membrane (envelope) breaks down



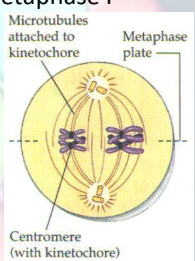
What is Crossing Over?

- Paired-up homologous chromosomes, may exchange portions of their chromatids
- Advantage?



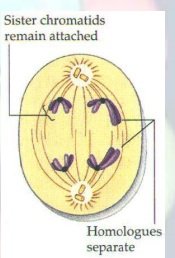
Meiosis I → Metaphase I

- **Homologous pairs** line up in the middle (equator)
- NO PARTICULAR ORDER for lining up!
- Genetic recombination



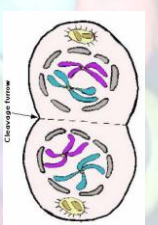
Meiosis I → Anaphase I

- spindle fibers contract and pull **homologous pairs away** from each other



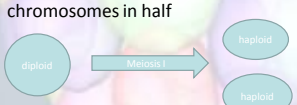
Meiosis I → Telophase I & Cytokinesis

- Nuclear envelopes may reform
- Spindle fibers disappear
- Cytokinesis follows to produce two cells
- Meiosis II begins quickly!



End of Meiosis I

- Meiosis I produces: two daughter cells with a single set of chromosomes
  - half the total number in the original cell where the chromosomes were present in pairs.
- **reduction division** = reducing the number of chromosomes in half



Meiosis II

- Meiosis II = a mitotic division of each of the haploid cells produced in Meiosis I.
  - PMAT(C) for both haploid cells
- There is no Interphase between Meiosis I and Meiosis II

Meiosis II → Prophase II

- A new set of spindle fibers forms
- Nuclear envelopes disappear

Meiosis II → Metaphase II

- chromosomes in the two cells line up in the middle

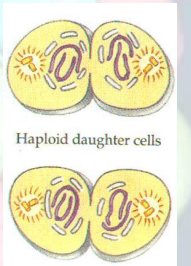
Meiosis II → Anaphase II

- Sister chromatids separate as they are pulled by spindle fibers (in both cells)

Meiosis II → Telophase II

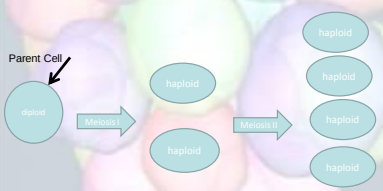
- Nuclear envelopes develop
- Spindle fibers disappear
- Chromosomes de-condense into **chromatin**
- Cytokinesis occurs
  - A cleavage furrow develops

END OF MEIOSIS II!
Cells can enter Interphase

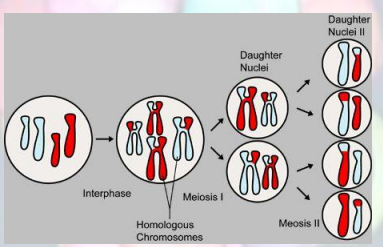


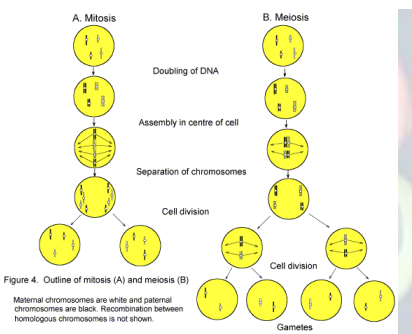
End of Meiosis II

- Meiosis II produces: four daughter cells with half the number of chromosomes in the original cell



Overview of meiosis





Advantages/Disadvantages of sexual reproduction?

- Recombination of maternal and paternal chromosomes in the gamete results in genetic variation among the offspring. In an environment which changes, this allows the process of natural selection to occur.

Compare and Contrast

Mitosis

- ?

Meiosis

- ?