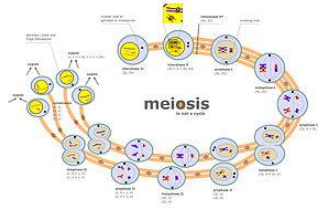
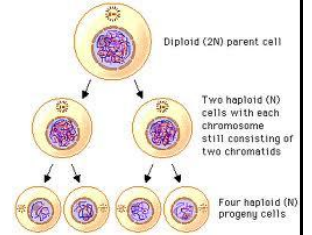


Meiosis and Reproductive Division



Purpose of Meiosis

- Create haploid reproductive cells
 - Reproductive cells are called **gametes**
 - Non-reproductive cells (produced in mitosis) are called **somatic**
- Essential to reproduction and maintaining genetic diversity



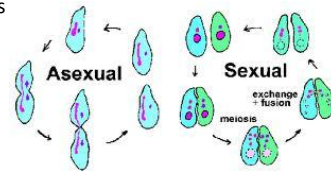
Sexual Reproduction

- The fusion of gametes to form a new cell is referred to as fertilization, or **syngamy**
- Gamete formation needs a mechanism to halve the number of chromosomes as in other cells



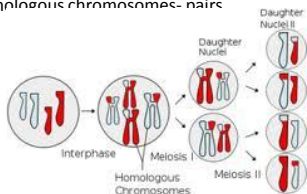
Sexual Reproduction

- Alternates meiosis and fertilization, and alternates between diploid and haploid chromosome numbers
- Compare to **Asexual reproduction** in which all cells are produced by mitosis and genetically identical to parents



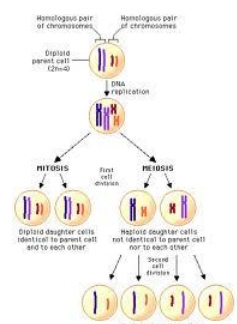
Haploid vs. Diploid

- Recall that haploid number is $1n$ while the diploid number is $2n$.
- In addition, a karyotype is a pictorial display of metaphase chromosomes from a mitotic cell
 - **Homologous chromosomes- pairs**



Haploid vs. Diploid

- **Ploidy: Number of sets of chromosomes in a cell**
 - Haploid (n)-- one set chromosomes
 - Diploid ($2n$)-- two sets chromosomes
 - Most plant and animal adults are diploid ($2n$)
 - Eggs and sperm are haploid (n)



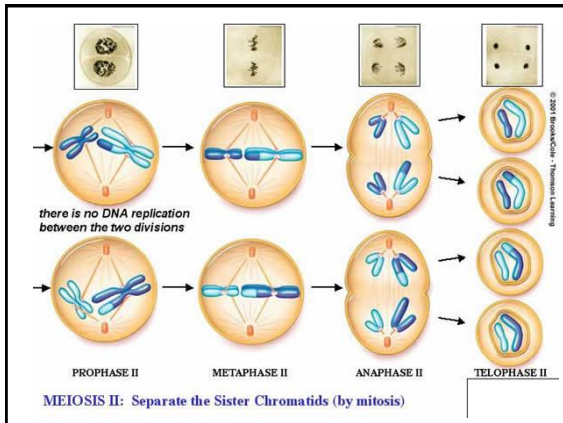
Meiosis Has Several Unique Features

- Meiosis in diploid organisms consists of two rounds of division, meiosis I and meiosis II
 - Replication only occurs at the beginning of meiosis I.
 - Meiosis I: chromosomes in a diploid cell resegment, producing four haploid daughter cells
- In prophase I of meiosis, homologues pair in **synapsis**, and crossing over occurs, allowing non-sister chromatids to exchange chromosomal material
 - This allows for genetic diversity
- Overview: https://www.youtube.com/watch?v=D1-mQS_FZ0

Sequence of Meiosis

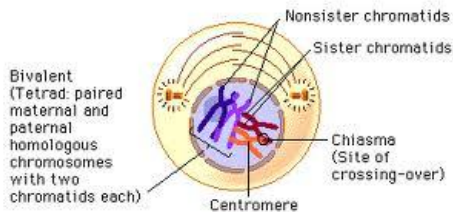
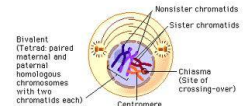
Just like mitosis, meiosis follows orderly steps

- Meiosis I
 - Prophase I
 - Metaphase I
 - Anaphase I
 - Telophase I
 - Cytokinesis
- Meiosis II
 - Prophase II
 - Metaphase II
 - Anaphase II
 - Telophase II
 - Cytokinesis



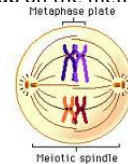
Prophase I

- Ends of the chromatids attach to the nuclear envelope at specific sites, and synapsis occurs
 - Synapsis: homologous chromosomes (matching chromosomes) hook to each other and form a **bivalent**
- Crossing over occurs between non-sister chromatids, forming chiasmata
 - Chiasmata: point on homologous chromosomes where genetic information is exchanged



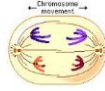
Metaphase I

- By metaphase I, the nuclear envelope has dispersed, and microtubules form a spindle
- Terminal chiasmata hold the homologous chromosomes together, and each joined pair of homologues lines up on the metaphase plate



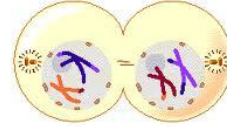
Anaphase I

- Microtubules of the spindle fibers begin to shorten, pulling the centromeres toward the poles, and thus dragging the chromosomes toward the poles as well
- Because of the random orientation of homologous chromosomes on the metaphase plate, meiosis I results in independent assortment of maternal and paternal chromosomes into the gametes
 - Either homologue could be on either side, so there is a 50-50 chance of each trait



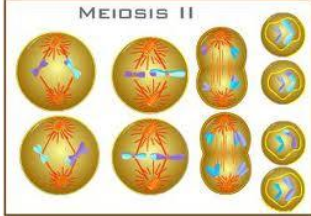
Telophase I

- chromosomes have segregated into clusters at each pole, and the nuclear membrane re-forms around each new daughter nucleus



Meiosis II

- Resembles a normal mitotic division
- EXCEPT: at the end, each of the four haploid cells contains only one set of every chromosome instead of two sets



- The corniest thing ever. Enjoy:
<https://www.youtube.com/watch?feature=endscreen&NR=1&v=JKXA dwCibSA>

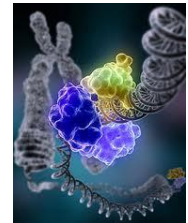
Evolution of Sex

- Simultaneously conservative and revolutionary
 - Mechanism for much genetic change but every offspring gets the necessary genetic information



Evolution of Sex

- Hypotheses for the origins of sex:
 - DNA repair: fixing old DNA/replacing DNA codes that are no longer useful



Evolution of Sex

• Hypotheses for the origins of sex:

- Red Queen– named after the Red Queen in C.S. Lewis's *Alice's Adventures in Wonderland*
- "Well, in our country," said Alice, still panting a little, "you'd generally get to somewhere else — if you run very fast for a long time, as we've been doing."
"A slow sort of country!" said the Queen. "Now, here, you see, it takes all the running you can do, to keep in the same place. If you want to get somewhere else, you must run at least twice as fast as that!"
- Involves co-evolution and adaptation



Evolution of Sex

• Hypotheses for the origins of sex:

- Muller's Ratchet Theory: Asexual reproduction accumulates deleterious mutations and cannot reverse

