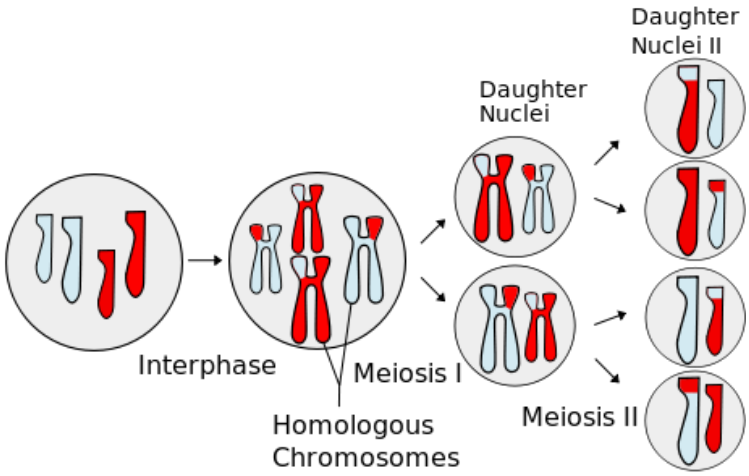
CONCEPT: MEIOSIS

Overview

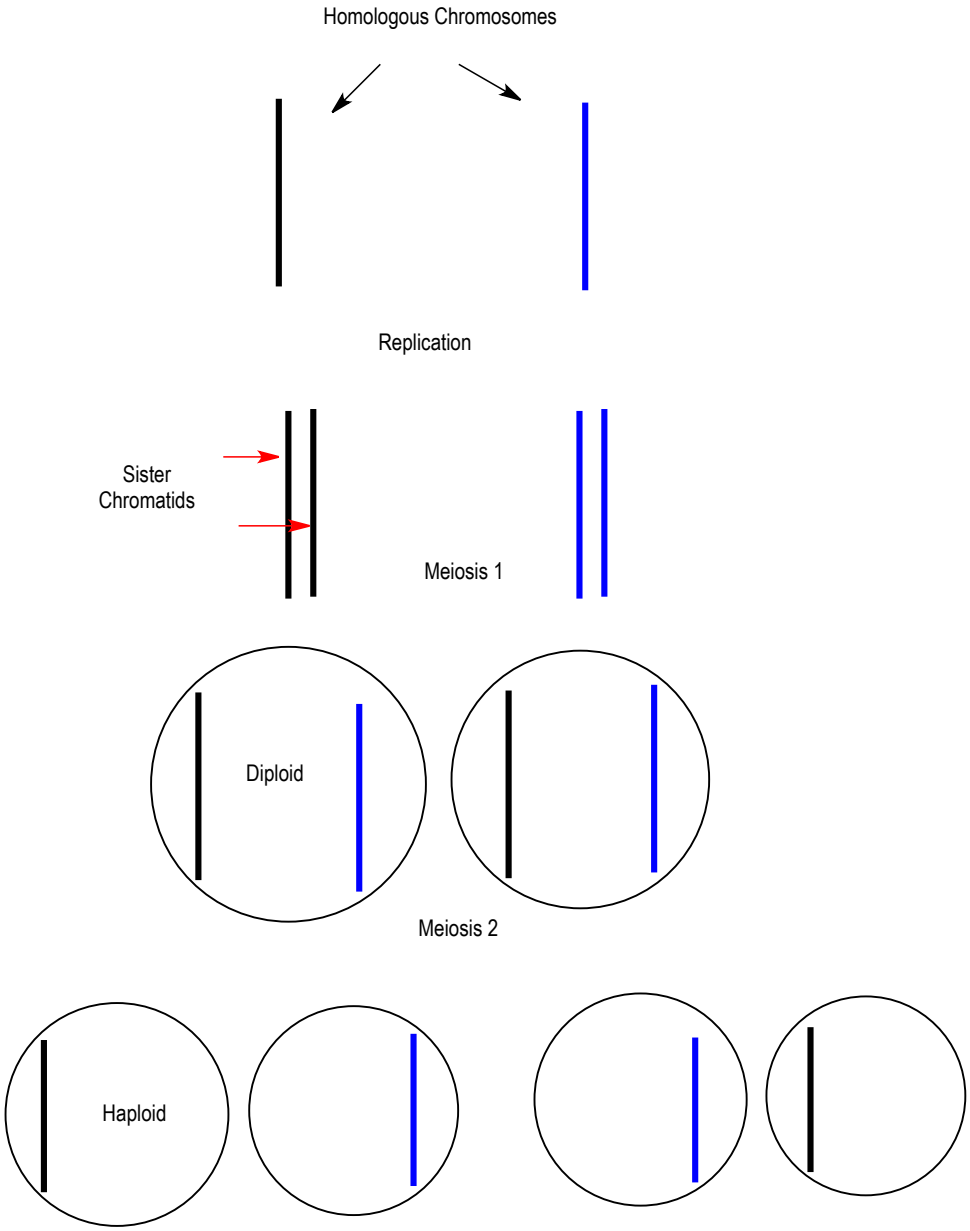
- **Meiosis** is the process of creating **germ cells** (sex cells) that are used to _____
  - □ **Meiosis I** involves replicating the DNA and creating two cells containing a single set of chromosomes
  - □ **Meiosis II** involves dividing the two cells into four cells with a single set of sister chromatids

EXAMPLE: Overview of meiosis



- Meiotic DNA duplication results in a lot of different chromosome _____
  - □ **Sister chromatids** are two copies (one pair) of each duplicated chromosome
    - Separate during Meiosis II
  - □ **Homologous chromosomes** are two copies (maternal and paternal) of both sister chromatids
    - **Bivalent** is when the four sister chromatids stick together
    - Separate during Meiosis I
  - □ **Haploid(n)** cells have only ½ the chromosomes of a **diploid(2n)** cell which have two copies of a chromosome

EXAMPLE:


Homologous Chromosomes
Replication
Sister
Chromatids
Meiosis 1
Diploid
Meiosis 2
Haploid

Genetic Variation

● In meiosis, DNA is reorganized and _____ to produce genetically distinct offspring

□ **Homologous recombination** exchanges similar DNA sequences between chromosomes

- *DNA-repair* uses identical DNA sequence from sister chromatid to repair DNA

- *Meiosis* uses non-identical DNA sequences from non-sister chromatids in the bivalent

□ **Crossing over** is when maternal and paternal homologs physically swap chromosomal segments

- **Chiasma/Chaismata** hold bivalents together where cross over events occur

- Chiasmata are extremely important in keeping the bivalents together during meiosis

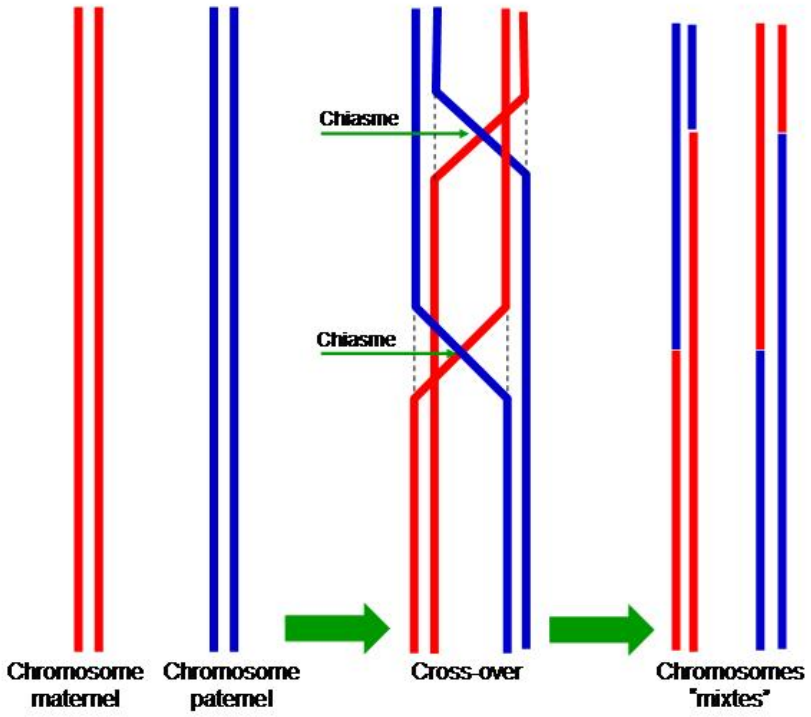
□ **Reassortment** is the random division of chromosomes into the cells

- As chromosomes line up in metaphase, they randomly assort to one side or the other and go into that cell

- **Nondisjunction** occurs when homologs _____ to separate

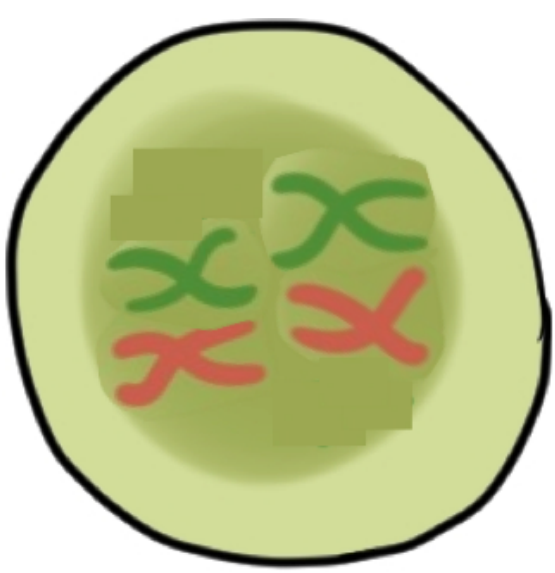
- Causes **aneuoploidy** which are eggs with wrong number of chromosomes (down syndrome)

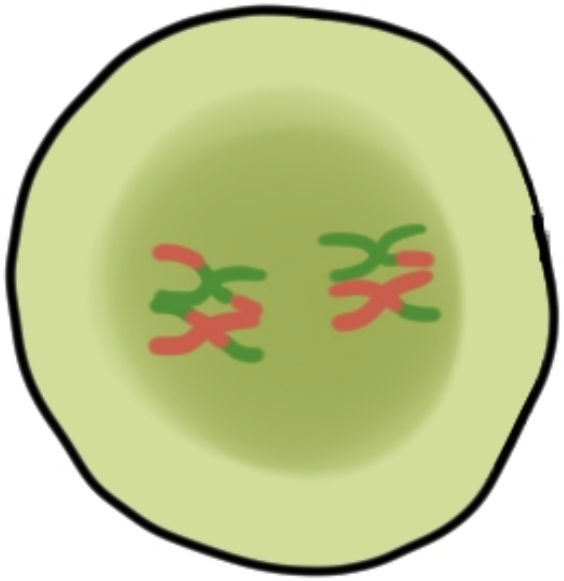
EXAMPLE: Chiasmata during crossing over



Meiosis I Steps

- Meiosis I uses 4 steps to go through the first round of division
    1. **Prophase I** is a long, complex phase with four stages that occurs after DNA replication
        a. *Leptotene* – Condensation of chromatin fibers
        b. *Zygotene* – More condensation and homologous chromosomes are paired (form bivalents)
        c. *Pachytene* – Crossing over occurs
        d. *Diplotene* – Pausing phase where chromosomes decondense a bit, but are still attached by chaisamata
        e. *Diakinesis* – Chromosomes recondense, nuclear envelop break down, spindle forms

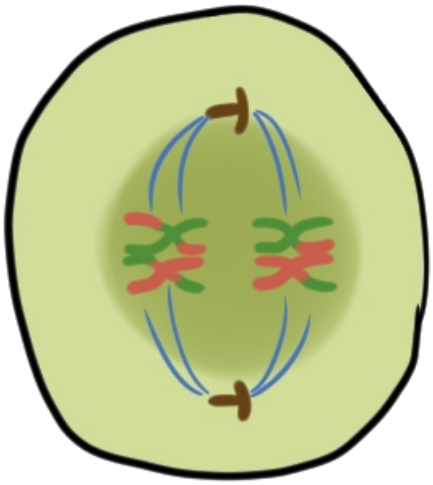


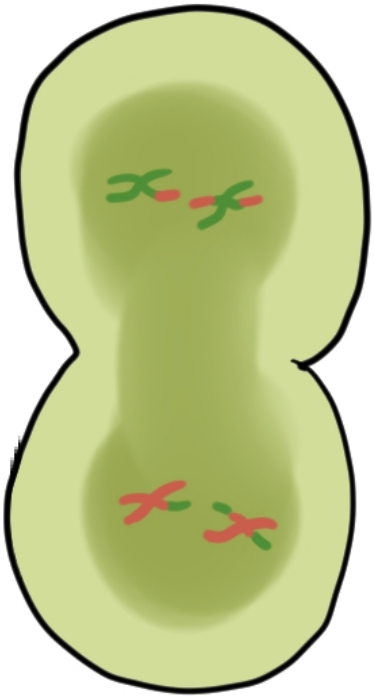


2. **Metaphase I** is when bivalents align at spindle equator

    - Chaismata keep homologous chromosomes together

3. **Anaphase I** is when homologous chromosomes move to opposite poles

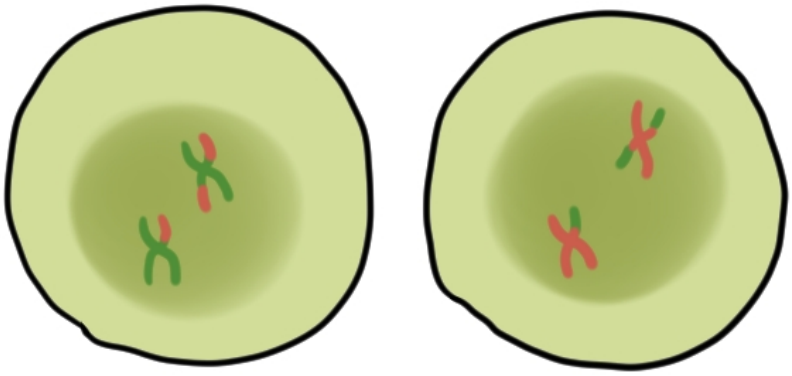




4. **Telophase I** and **Cytokinesis** is when two cells are produced

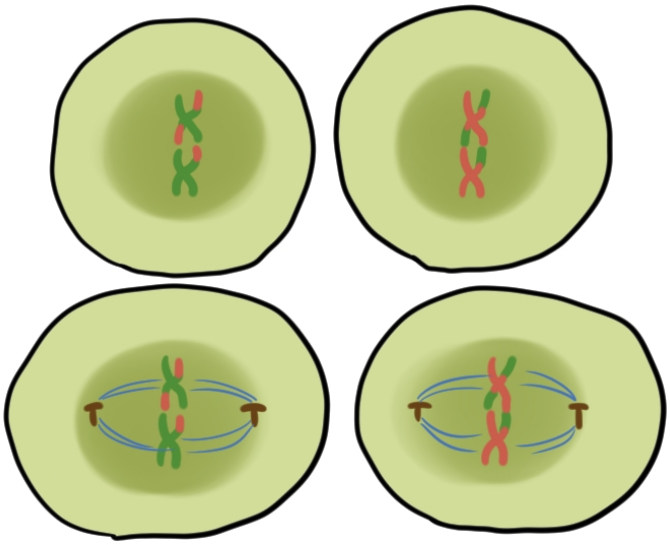
    - These cells contain a single set of randomly sorted chromosomes (two sister chromatids)

    - These cells are haploid (haploid set of chromosomes)

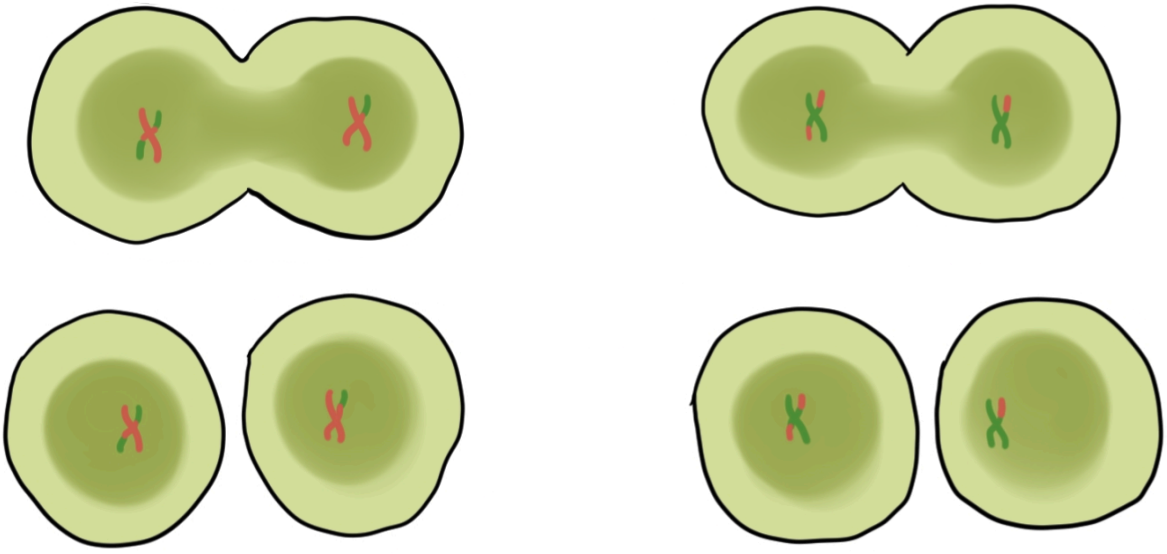


- Meiosis II uses 4 steps to go through the second round of division

1. **Prophase II** is a short, almost nonexistent phase – occurs immediately after cytokinesis (NO DNA replication)
2. **Metaphase II** is when the chromosomes line up at equator



3. **Anaphase II** is when each sister chromatid is pulled towards opposite poles
4. **Telophase II** and **Cytokinesis** is when two cells are produced
    - These cells contain a set of sister chromatids
    - These cells are referred to as haploid (n)

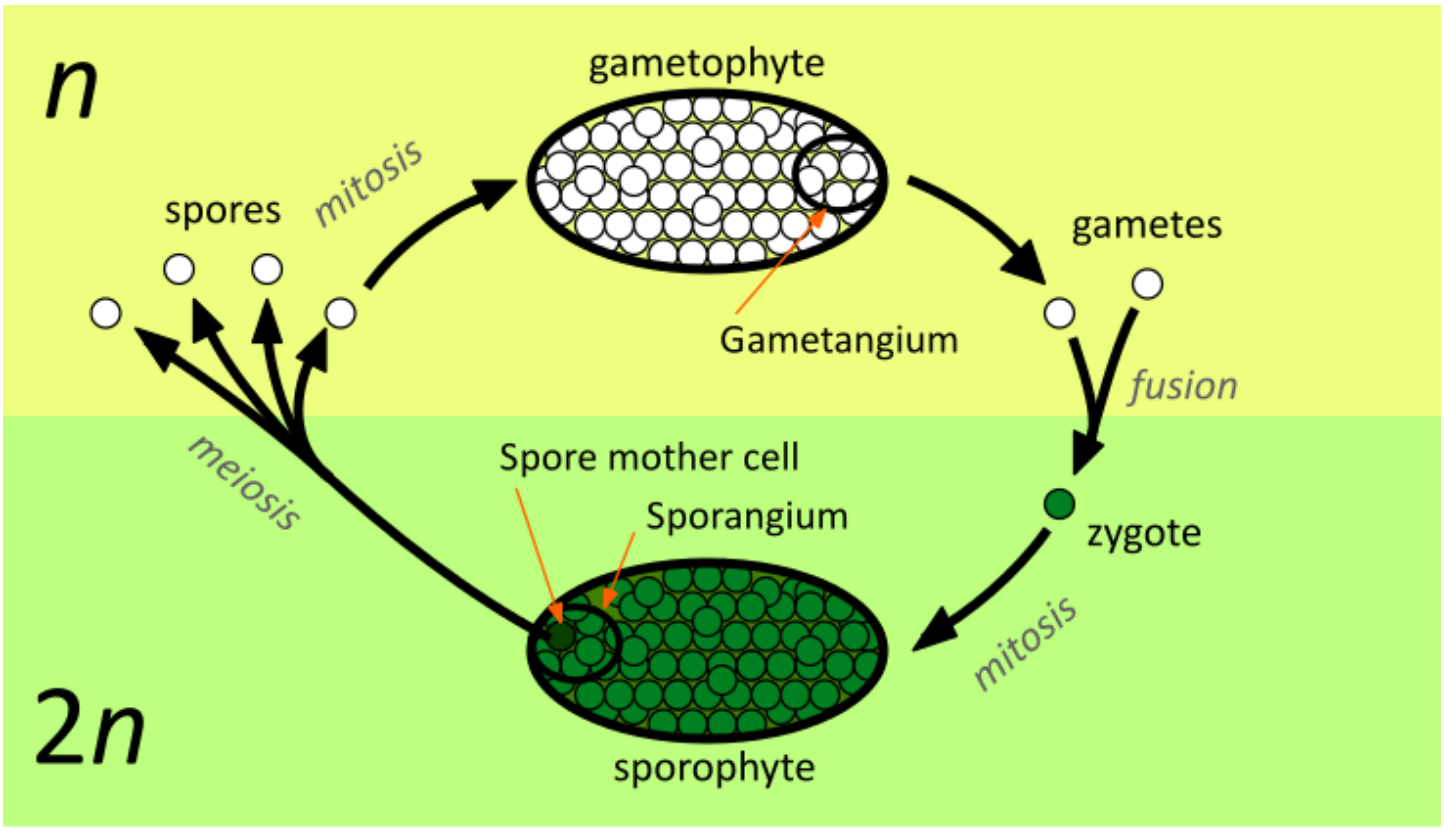


Mitosis and Animal Life Stages

● Animals are classified into three _____ based on when in their life cycle they perform meiosis

1. **Gametic/terminal meiosis** are organisms that use meiosis to produce haploid **gametes** (sex cells)
    - Most living organisms (including humans)
    - Meiosis is completed after fertilization (which forms a diploid cell)
2. **Zygotic/Initial meiosis** are organisms that use meiosis after fertilization
    - Uses meiosis to produce haploid spores
    - Diploid cells are only used as gametes
3. **Sporic/Intermediate meiosis** are organisms where meiosis occurrence has nothing to do with gamete formation
    - **Sporophyte** are diploid zygotes that undergo mitosis
    - **Sporogenesis** occurs through meiosis which produces **gametophytes**
        - Gamteophyes are used to produce gametes through mitosis

EXAMPLE: Example of sporic/intermediate meiosis



PRACTICE:

1. In which of the following phases does crossing over occur?
    a. Metaphase I
    b. Prophase I
    c. Anaphase II
    d. Prophase II

2. In which of the following steps of prophase I does crossing over occur?
    a. Leptoene
    b. Zygotene
    c. Pachytene
    d. Diplotene
    e. Diakinesis

3. True or False: The cells produced from meiosis I and meiosis II are both haploid?
    a. True
    b. False

4. Fill in the blanks. In anaphase I the _____ separate, while in anaphase II the _____ separate.
    a. Sister chromatids, homologous chromosomes
    b. Homologous chromosomes, sister chromatids
    c. Homologous chromosomes, Homologous chromosomes
    d. sister chromatids, sister chromatids

5. Which of the following life cycles uses meiosis after fertilization?
    a. Gametic meiosis
    b. Zygotic meiosis
    c. Sporic meiosis