VOCABULARY:

- **Diploid cell**: a cell containing TWO sets of chromosomes.
  - one set inherited from each parent
  - \(2n\) (number of chromosomes)
  - \(\text{somatic cells}\)

- **Haploid cell**: a cell with only ONE set of chromosomes.
  - \(1n\) (number of chromosomes)
  - \(\text{gametes}\)

- **Sex cells**: sex cells
  - \(\text{male gamete}\)
  - \(\text{female gamete}\)

- **Homologous chromosomes**: paired chromosomes that have genes for the same traits arranged in the same order.
  - One homologous chromosome is inherited from the organism's father, the other from the mother.

- **Meiosis**: a two stage type of cell division that results ingametes with HALF the number of chromosome number as the body cells.

- **Crossing over**: when nonsister chromatids of homologous chromosomes exchange genetic information, results in a new combination of genes.

- **Fertilization**: the process of joining gametes.

- **Zygote**: when sperm (haploid) fertilizes the egg (haploid), the resulting cell is the zygote (diploid).
I. GENES, CHROMOSOMES, AND NUMBERS:

- In humans, each ______________(any cell other than a sperm or egg, has ___ chromosomes)
  - 46 chromosomes $\rightarrow$ ___________(humans get __________from each parent)
- ____________________________ - determine the sex of an individual
  - last pair of chromosomes—23rd pair for humans
    - $XX =$ ______________
    - $XY =$ ______________
- The ______________________for an organism is NOT related to the __________________________of that organism!!
  - Ex: A dog has 78 body chromosomes and humans have 46 body chromosomes
- A thousand or more genes are lined up on a chromosomes at one time

- Diploid & Haploid Numbers:
  - Each ______________of an organism contains __________chromosomes.
    - Half of each pair came from each parent. These cells are said to have 2n chromosomes, or a full set.
      - They are **DIPLOID**.
        - Ex: Humans have 46 body chromosomes
  - Each ______________of an organism contains only __________a chromosome set.
    - These cells are **HAPLOID** and have 1n chromosomes
      - Ex: Humans have 23 chromosomes in their gametes (egg or sperm cell)
      - Sex cells will fuse with another sex cell during fertilization to create a ____________________________.
        - So if human sperm and egg both have 23 chromosomes, after fertilization an embryo would have 46 chromosomes!
2 Reasons Why MEIOSIS Is Significant:

1. ____________is another form of cell division that ______________ _________to be used for reproduction.
   - If mitosis was the only form of cell division, then new offspring would always have __________ as many ____________________ as their parents.
   - Eventually, there would be so many chromosomes, the organism would ____________or be severely__________________.

2. Meiosis provides__________________________ - the reshuffling of genes carried by the individual members of a population.

II. MEIOSIS vs. MITOSIS:
   - Remember: _______________ = asexual division of diploid body cells

<table>
<thead>
<tr>
<th></th>
<th>MEIOSIS</th>
<th>MITOSIS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cell type of parent</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of daughter cells</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of cell divisions</td>
<td></td>
<td></td>
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<tr>
<td>Genetic relationship of</td>
<td></td>
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<tr>
<td>daughter cells to parent</td>
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</tr>
<tr>
<td>Genetic relationship of</td>
<td></td>
<td></td>
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<tr>
<td>daughter cells to one another</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
MEIOSIS I:

- Separates _________________ of chromosomes, NOT sister chromatids of individual chromosomes.

1. Interphase I
   - Metabolic activities & replicate chromosomes
2. Prophase I
   - Occurs - the pairing of homologous chromosomes
   - Each pair of chromosomes come together to form a (4 part structure)
   - Genetic material is exchanged in a process called (swapping portions of adjacent DNA)
     - Must be done with great precision so that neither chromatid gains or loses any genes!

3. Metaphase I
   - line up at the in pairs

4. Anaphase I
   - Homologous chromosomes separate and move to opposite ends of the cell.
     - This occurs because the do NOT split like in mitosis
   - This ensures that each will receive only for each homologous pair.
5. Telophase I
   o The new cells are ______________so another division is required to create ______________cells

![Image of Telophase I]

MEIOSIS II:
- The mechanisms of ______________is almost the same as ______________
  o However, the chromosomes DO NOT replicate between meiosis I and meiosis II, the final outcome of meiosis is ______________the number of chromosomes per cell.

![Diagram of Meiosis II]

1. Interphase II
   o ______________
   o Allows the new cells to become ______________
2. **Prophase II**
   - Same as Prophase I except NO _______________are formed

3. **Metaphase II**
   - Chromosomes line up at the___________________________.

4. **Anaphase II**
   - ________________move to the opposite ends of the cell

5. **Telophase II**
   - Creates 4__________________cells (gametes)
Meiosis Provides for Genetic Variation in 2 Ways:

1. ______________________________ of homologous chromosomes during meiosis I
   - The amount of different chromosomes that can be produced increases greatly as the number of chromosomes an organism has.
   - A pea plant has 7 pairs of chromosomes. Each pair can line up 2 different ways. Therefore, each gamete can have $2^7 = 128$ possibilities!!
   - Humans: $n=23$; so the number of different kinds of eggs or sperms a person can produce is more than 8 million ($2^{23}$)
     - When fertilization occurs, $2^{23} \times 2^{23}$ zygotes are possible or 70 trillion!!
     - No wonder brothers and sisters can be so different.

2. ______________________________ between homologous chromosomes during prophase of meiosis I
   - Increases the number of genetic variations

Meiosis is NOT Flawless:

- It is estimated that from 10-20% of all human fertilized eggs contain chromosome abnormalities, and these are the most common cause of pregnancy failure (35% of the cases).
- These chromosome abnormalities:
  - Arise from errors in meiosis, usually __________
  - Occur more often (90%) during ______________ than during sperm formation
  - Become more frequent as a woman_____________.
MEIOSIS REVIEW WORKSHEET

Part 1: VOCABULARY: Answer the following question using the best vocabulary word.

1) A cell with two of each kind of chromosome is called a(n) ________________ cell.
2) A cell with one of each kind of chromosome is a(n) __________________ cell.
3) __________________ are sperm or egg cells.
4) __________________ chromosomes have genes for the same traits in the same order on both chromosomes.
5) Parent cells make gametes in a process called ____________________.
6) A ________________ is the cell created when a sperm enters an egg.
7) When nonsister chromatids exchange genes, it is called ____________________.
8) All cells, other than sperm or egg cells are called______________________________.
9) The process of joining a sperm cell with an egg cell is called ____________________.

Part 2: SHORT ANSWER: Answer the following questions in a clear and concise manner.

1) What is the diploid number of chromosomes in humans? ______________
2) What is the haploid number of chromosomes in humans? ______________
3) Would egg and/or sperm cells be considered haploid or diploid? ______________
4) Would somatic cells (skin, hair, muscle cells, etc.) be considered haploid or diploid? ______________
5) Is the chromosome number related to the complexity of the organism? Explain.

6) When does the process of crossing over occur? ________________________
7) How many daughter cells are created at the end of meiosis I? ______
8) How many daughter cells are created at the end of meiosis II? ______ Are these cells considered haploid or diploid? ______________
9) In humans, how many chromosomes are present in each cell at the end of meiosis I? ______________
10) In humans, how many chromosomes are present in each cell at the end of meiosis II? ______________
11) What is the important outcome of meiosis I?

12) What is the important outcome of meiosis II?

13) Why is meiosis important? List 2 reasons.

14) In what 2 ways does meiosis provide genetic variation? Explain how each provides genetic variety.
## COMPARING MITOSIS & MEIOSIS

Determine whether the following characteristics apply to mitosis, meiosis or both by putting a check in the appropriate column(s).

<table>
<thead>
<tr>
<th></th>
<th>MITOSIS</th>
<th>MEIOSIS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. no pairing of homologs occurs</td>
<td></td>
<td></td>
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<tr>
<td>2. two divisions</td>
<td></td>
<td></td>
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<tr>
<td>3. four daughter cells produced</td>
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<td></td>
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<tr>
<td>4. associated with growth and asexual reproduction</td>
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<td></td>
</tr>
<tr>
<td>5. associated with sexual reproduction</td>
<td></td>
<td></td>
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<tr>
<td>6. one division</td>
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<td></td>
</tr>
<tr>
<td>7. two daughter cells produced</td>
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<td></td>
</tr>
<tr>
<td>8. involves duplication of chromosomes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9. chromosome number is maintained</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10. chromosome number is halved</td>
<td></td>
<td></td>
</tr>
<tr>
<td>11. crossing over between homologous chromosomes may occur</td>
<td></td>
<td></td>
</tr>
<tr>
<td>12. daughter cells are identical to parent cell</td>
<td></td>
<td></td>
</tr>
<tr>
<td>13. daughter cells are not identical to parent cell</td>
<td></td>
<td></td>
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<tr>
<td>14. produces gametes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>15. a synapsis occurs in prophase</td>
<td></td>
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</tbody>
</table>
MEIOSIS Vocabulary

Review the Key Terms
Use the key terms below and match each term with its definition by writing the letter of the term on the line provided.

- A. meiosis I
- B. somatic cells
- C. male
- D. meiosis II
- E. female
- F. independent assortment

1. Body cells
2. XX
3. XY
4. Separates homologous pairs of chromosomes
5. Halves the number of chromosomes per cell
6. homologous chromosomes separate randomly and independently of one another

Use the key terms in the box below and review the definitions of the terms. Then use the terms to fill in the blanks in the sentences below. You will not use all the terms.

diploid  haploid  heterozygous  sexual reproduction  homologous

crossing over  meiosis  zygote  genetic recombination  gametes  dominant

7. A cell with two of each kind of chromosome is called _____________________.
8. ______________________ are sperm or egg cells.
9. A cell with one of each kind of chromosome is a(n) _______________________ cell.
10. ______________________________ chromosomes have genes for the same traits in the same order on both chromosomes.
11. Parent cells make gametes in a process called ________________________________.
12. A(n) _______________________ is the cell created when a sperm enters an egg.
13. _________________________________ occurs when male and female gametes form to make a new living organism.
14. When nonsister chromatids exchange genes, it is called ________________________.
15. ________________________________ results in genetic variety.
## Unit Learning Map (5 days):

### Meiosis

**Class:** Biology B – PA Standard: 3.3.10: Describe how genetic information is inherited and expressed. Compare and contrast the function of mitosis and meiosis

### Unit Essential Question(s):

What is the purpose of meiosis?

### Optional Instructional Tools:

- Reebop Activity
- Online meiosis activity

<table>
<thead>
<tr>
<th>Concept</th>
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<th>Concept</th>
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<tbody>
<tr>
<td>Meiosis</td>
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</table>

### Lesson Essential Questions:

- How is meiosis different from mitosis?

### Vocabulary:

- Gamete
- Egg
- Sperm
- Haploid
- Diploid
- Crossing over
- Meiosis
- Homologous chromosomes
- Fertilization
- Zygote
- Somatic cell
- Sex chromosomes
- Synapsis
- Meiosis I
- Meiosis II
- Independent assortment
Meiosis Vocabulary:

1) **Gamete** = sex cell

2) **Egg** = female gamete

3) **Sperm** = male gamete

4) **Haploid** = a cell with only ONE set of chromosomes

5) **Diploid** = a cell containing TWO sets of chromosomes

6) **Crossing over** = when nonsister chromatids of homologous chromosomes exchange genetic information, results in a new combination of genes

7) **Meiosis** = a two stage type of cell division that results in gametes with half the number of chromosome number as the body cells

8) **Homologous chromosomes** = paired chromosomes that have genes for the same traits arranged in the same order
   - One homologous chromosome is inherited from the organism’s father, the other from the mother.

9) **Fertilization** = the process of joining gametes

10) **Zygote** = when sperm (haploid) fertilizes the egg (haploid), the resulting cell is the zygote (diploid)

11) **Somatic cell** = body cell (skin, hair, muscle, etc.)

12) **Sex chromosomes** = determine the sex of an individual; XX = female; XY = male

13) **Meiosis I** = Separates homologous pairs of chromosomes, NOT sister chromatids of individual chromosomes

14) **Meiosis II** = the mechanisms of meiosis II is almost the same as mitosis. However, the chromosomes DO NOT replicate between meiosis I and meiosis II, the final outcome of meiosis is halving the number of chromosomes per cell

15) **Independent assortment** = during meiosis I the homologous chromosomes separate randomly and independent of one another.