Biology

Meiosis and Sexual Reproduction

Interphase

Prophase I
- Synapsis and crossing over occur.

Metaphase I
- Tetrad lines up on the metaphase plate.

Anaphase I
- Homologous pairs separate.

Telophase I

Cytokinesis I

To Prophase II

Prophase II

Metaphase II
- Chromosomes line up on the metaphase plate.

Anaphase II
- Sister chromatids separate.

Telophase II

Cytokinesis II

4 haploid daughter cells are formed, each having only one chromosome of each homologous pair.
<table>
<thead>
<tr>
<th>Date</th>
<th>Assignment</th>
<th>Points Earned</th>
<th>Possible Points</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Chapter 7 Vocabulary</td>
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<td>Chapter 7 Notes</td>
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<td>Total points</td>
<td></td>
<td>74</td>
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</tbody>
</table>
Chapter 7: Meiosis and Sexual Reproduction Vocabulary

Use the glossary and don’t shorten the definition. If a page number is listed, use that page to define the term.

Section 1: Meiosis

1. meiosis –

2. crossing-over –

3. independent assortment –

4. spermatogenesis –

5. sperm –

6. oogenesis –

7. ovum –
PowerPoint Notes on Chapter 7-1 - Meiosis

Section 1: Meiosis

Objectives

- Summarize the events that occur during meiosis.
- Relate crossing-over, independent assortment, and random fertilization to genetic variation.
- Compare spermatogenesis and oogenesis.

Formation of Haploid Cells

- Meiosis is a form of cell division that ______________________________________ when forming specialized reproductive cells, such as ___________________________.
- Meiosis involves _______ divisions of the nucleus—meiosis I and meiosis II.
- Before meiosis begins, _____________________________________________________.
  Thus, meiosis starts with ________________________________________________.
- The eight stages of meiosis are:
  o **Prophase I:** The nuclear envelope ___________________________. Homologous chromosomes _______. Crossing-over occurs when portions of a chromatid on one homologous chromosome ________________________________________________
  _________________________________________________________________.
  o **Metaphase I:** The pairs of homologous chromosomes are moved by the spindle to the ________________________________________________.
  o **Anaphase I:** The chromosomes ______________________________________
  ______________________ of the cell by the spindle fibers.
  o **Telophase I:** Individual chromosomes gather at each of the poles. In most organisms, _________________________________.
  o **Prophase II:** _______________________________ around the chromosomes.
  o **Metaphase II:** The chromosomes ________________________________
  and are attached at their centromeres to spindle fibers.
  o **Anaphase II:** The centromeres divide, and the __________________________
  _________________________________________________________________.
  o **Telophase II:** _______________________________,
  and the cell undergoes __________________________. 
### Stages of Meiosis

<table>
<thead>
<tr>
<th>Stages</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Prophase I</td>
</tr>
<tr>
<td>2</td>
<td>Metaphase I</td>
</tr>
<tr>
<td>3</td>
<td>Anaphase I</td>
</tr>
<tr>
<td>4</td>
<td>Telophase I</td>
</tr>
<tr>
<td>5</td>
<td>Prophase II</td>
</tr>
<tr>
<td>6</td>
<td>Metaphase II</td>
</tr>
<tr>
<td>7</td>
<td>Anaphase II</td>
</tr>
<tr>
<td>8</td>
<td>Telophase II</td>
</tr>
</tbody>
</table>

#### Comparing Meiosis and Mitosis (Video clip)
- Both start off with the same number of chromosomes and these chromosomes are paired. Each pair contains 2 homologous chromosomes.

<table>
<thead>
<tr>
<th>Differences</th>
<th>Meiosis</th>
<th>Mitosis</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Chromosomes Line Up</strong></td>
<td>Homologous chromosomes pair up to form ___________; Crossing-over occurs; Resulting chromosomes are ___________ from parent cell.</td>
<td>Chromosomes line up ___________; No crossing over occurs.</td>
</tr>
<tr>
<td><strong>Separation of Chromosomes</strong></td>
<td>Chromatids are still attached to each other as the ___________ ___________.</td>
<td>Homologous chromosomes lined up singly and the ___________ ___________.</td>
</tr>
<tr>
<td><strong>Result of Division</strong></td>
<td>Each cell produced has only ___ ___________ ___________ of homologous chromosomes.</td>
<td>Each cell produced has one copy of ___________. Mitosis stops here.</td>
</tr>
<tr>
<td><strong>Second division</strong></td>
<td>The daughter cells divide again. This time the ___________ ___________. There are now ____ daughter cells and each cell has only ___________ ___________ ___________.</td>
<td>No second division.</td>
</tr>
</tbody>
</table>
Comparing the Results of Meiosis and Mitosis (Video clip)

<table>
<thead>
<tr>
<th>End Results</th>
<th>Meiosis</th>
<th>Mitosis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of Cells Produced</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chromosome Number</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Genetic Comparison to Parent Cell</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Meiosis and Genetic Variation**
Meiosis is an important process that allows for ________________________________
______________________________________________________________________.

Three mechanisms make key contributions to this genetic variation:
____________________________________
____________________________________
____________________________________

**Independent Assortment**
The random distribution of homologous chromosomes during meiosis is called ___________ 

**Crossing-Over and Random Fertilization**
- The DNA exchange that occurs during crossing-over ________________________________
  __________ to the independent assortment of chromosomes that occurs later in meiosis.
- Thus, the number of genetic combinations that can occur among gametes is __________
  ________________________________________________.
- Furthermore, the zygote that forms a new individual is created by __________________
  ________________________________________________.
Crossing-Over of Chromosomes

Importance of Genetic Variation
- Meiosis and the joining of gametes are _________________________________.
  No genetic process generates variation more quickly.
- The pace of evolution is sped up by ___________________________. The combination
  of genes from two organisms results in a third type, _____________________________.

Meiosis in Males
- The process by which sperm are produced in male animals is called ________________
- Spermatogenesis occurs in the ____________________ (male reproductive organs), and
  produces male gametes called ________________.

Formation of Sperm (Video clip)
- During sperm formation, the cytoplasm is divided ________ after the 1st meiotic division.
- The cytoplasm is divided ________________ again after the 2nd meiotic division.
- Thus, ________________ result from each cell that begins meiosis.

Meiosis in Females
- The process by which gametes are produced in female animals is called ________________
- Oogenesis occurs in the ____________________ (female reproductive organs) and
  produces female gametes called ________________.

Formation of the Egg Cell (Video clip)
- During egg formation, the cytoplasm is divided ________ after both meiotic divisions.
- __________ larger cell and __________ smaller cells result.
- The 3 smaller cells ____________.
- Thus only __________________________ results from each cell that begins meiosis.

Meiosis in Male and Female
In the space provided, write the name of the stage of meiosis that is being described.

5. The centromeres divide, and the chromatids move to opposite poles of the cell.

6. The homologous chromosomes separate. The chromosomes of each pair are pulled to opposite poles of the cell by the spindle fibers. The chromatids do not separate at their centromeres.

7. The chromosomes condense, and the nuclear envelope breaks down. Homologous chromosomes pair all along their length and then cross over.

8. After one division of the nucleus, a new spindle forms around each group of chromosomes.

9. Individual chromosomes line up along the equator, attached at their centromeres to spindle fibers.

10. A nuclear envelope forms around each set of chromosomes. Two cells undergo cytokinesis, forming haploid offspring cells.

11. Individual chromosomes gather at each of the two poles. In most organisms, the cytoplasm divides, forming two new cells.

12. The pairs of homologous chromosomes are moved by the spindle to the equator of the cell. The homologous chromosomes, each made up of two chromatids, remain together.

What is meiosis?

Explain the difference between meiosis I and meiosis II.
Read each question, and write your answer in the space provided.

13. What is crossing-over? During which phase of meiosis does crossing-over occur?

14. What is independent assortment? During which phase(s) of meiosis does independent assortment occur?

15. What are spermatogenesis and oogenesis?

16. What is the difference between undifferentiated sperm cells and sperm?

17. Why does meiosis produce four sperm cells but only one ovum?
Section: Meiosis

Read the passage below. Then answer the questions that follow.

Meiosis is a form of cell division that halves the number of chromosomes when forming specialized reproductive cells, such as gametes or spores. Meiosis involves two divisions of the nucleus—meiosis I and meiosis II.

The stages of meiosis I are as follows:

**Prophase I:** The chromosomes condense, and the nuclear envelope breaks down. Homologous chromosomes pair along their length and then cross over.

**Metaphase I:** The pairs of homologous chromosomes are moved by the spindle to the equator of the cell. The homologous chromosomes, each made up of two chromatids, remain together.

**Anaphase I:** The homologous chromosomes separate. As in mitosis, the chromosomes of each pair are pulled to opposite poles of the cell by the spindle fibers. But in meiosis, the chromatids do not separate at their centromeres.

**Telophase I:** Individual chromosomes gather at each of the poles. In most organisms, the cytoplasm divides, forming two new cells.

**SKILL: READING EFFECTIVELY**

Match each statement with the stage of meiosis I it describes by writing in the spaces provided, **PI** to represent Prophase I, **MI** to represent Metaphase I, **AI** to represent Anaphase I, or **TI** to represent Telophase I.

1. cytoplasm divides
   - ****
2. nuclear envelope breaks down
   - **
3. homologous chromosomes separate
   - **
4. spindle moves homologous chromosomes to the cell’s equator
   - **
5. crossing-over occurs
   - **
6. two new cells form
   - **
7. homologous chromosomes move to opposite poles of the cell
   - **
8. chromosomes condense
   - **
Read the passage below. Then answer the questions that follow.

The stages of meiosis II are as follows:

**Prophase II:** A new spindle forms around the chromosomes.

**Metaphase II:** The chromosomes line up along the equator, attached at their centromeres to spindle fibers.

**Anaphase II:** The centromeres divide, and the chromatids (now called chromosomes) move to opposite poles of the cell.

**Telophase II:** A nuclear envelope forms around each set of chromosomes. The spindle breaks down, and the cell undergoes cytokinesis. The result of meiosis is four haploid cells.

Match each statement with the stage of meiosis II it describes by writing in the spaces provided, PII to represent Prophase II, MII to represent Metaphase II, AII to represent Anaphase II, or TII to represent Telophase II.

1. centromeres divide
2. new spindle forms
3. cell undergoes cytokinesis
4. chromosomes line up at equator
5. spindle breaks down
6. chromosomes move to opposite poles of the cell
7. four haploid cells form

In the space provided, write the letter of the term or phrase that best completes the statement.

8. Between meiosis I and meiosis II, chromosomes do **NOT**
   a. replicate.
   b. change position.
   c. divide.
   d. Both (a) and (b)
Section: Meiosis

In the space provided, write the letter of the term or phrase that best completes each statement or best answers each question.

1. Crossing-over occurs during
   a. prophase II.
   b. fertilization.
   c. prophase I.
   d. metaphase II.

2. Cytoplasm divides unequally in meiosis during production of
   a. spores.
   b. sperm cells.
   c. cytokinesis.
   d. egg cells.

3. Which of the following does NOT provide new genetic combinations?
   a. random fertilization
   b. cytokinesis
   c. independent assortment
   d. crossing-over

4. DNA replication occurs
   a. after telophase I.
   b. prior to prophase I.
   c. in both meiosis I and meiosis II.
   d. when the chromosomes align at the cell’s equator.

5. Spermatogenesis results in
   a. two haploid cells.
   b. three polar bodies.
   c. one haploid sperm cells and three polar bodies.
   d. four haploid sperm cells.

In the space provided, write the letter of the description that best matches the term or phrase.

6. meiosis
   a. chromosomes become visible
   b. results in one egg cell and three polar bodies
   c. results in four haploid cells
   d. halves the number of chromosomes and results in gametes or spores
   e. results in exchange of chromatid portions between homologous chromosomes

7. prophase I

8. crossing-over

9. telephase II

10. oogenesis
Using the terms and phrases provided below, complete the concept map showing the process of meiosis.

- chromatids
- homologous chromosomes
- crossing-over
- meiosis II
- haploid reproductive cells

Meiosis

- includes
  - meiosis I
    - which involves
    - which separates
  - meiosis II
    - which separates
  - sexual reproduction

- results in
  - which unite during
  - sexual reproduction

1.
2.
3.
4.
5.
Biology Homework: Mitosis/Meiosis

Compare the two types of nuclear division, mitosis and meiosis, for each of the following categories.

<table>
<thead>
<tr>
<th>Categories</th>
<th>Mitosis</th>
<th>Meiosis</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Where it occurs and in what type of cell.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Number of nuclear divisions.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Number of cells formed.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Kind of cells made.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. Number and kind of chromosomes in the nuclei after division as compared to the original cell.</td>
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</tr>
<tr>
<td>6. Variation in the offspring.</td>
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</table>