Meiosis Notes
Foldable

• You need 6 pieces of printer paper

• Stagger the pages about 1cm (width of pinky finger) **DO NOT** make the tabs too large!!!!!

• Fold the stack of pages to make the foldable as diagramed on the next slide

• On the cover write “MEIOSIS”

• On the back put your Name and Period
Foldable Layout

- Label the tabs of the foldable according to the diagram to the right.
- Use some way (choice is yours) to show which tabs make up Meiosis I and which tabs make up Meiosis II.

Meiosis Introduction

<table>
<thead>
<tr>
<th>Meiosis I</th>
<th>Meiosis II</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interphase</td>
<td></td>
</tr>
<tr>
<td>Prophase I</td>
<td>Prophase II</td>
</tr>
<tr>
<td>Metaphase I</td>
<td>Metaphase II</td>
</tr>
<tr>
<td>Anaphase I</td>
<td>Anaphase II</td>
</tr>
<tr>
<td>Telophase I &amp; Cytokinesis</td>
<td>Telophase II &amp; Cytokinesis</td>
</tr>
</tbody>
</table>

Mitosis vs. Meiosis Comparison Table
Note Taking Key

• Text in black will be copied into your flipbook

• Vocabulary words will be like this → **Meiosis** Highlight them as well in your flipbook, so that you know to memorize them and definition for the test.

• Interesting facts will have slide Headings and text in blue like this → **Mitosis vs Meiosis**

  You do not have to copy blue text into your flipbook unless you want to
Mitosis Diagram

There is not room for you to draw this diagram, but know what it means.
Meiosis vs Mitosis

**Meiosis** creates 4 genetically different gametes (haploid)

**Mitosis** creates 2 identical daughter cells (diploid)
Meiosis Introduction (1st tab upper half)

- Process of reduction division

- **Purpose:** Produces **gametes** (sex cells) – sperm & egg

- Meiosis is NOT a cycle like mitosis.
Diploid vs. Haploid

- **Diploid** – a cell that contains homologous chromosomes (one from each parent)
  - represented by the symbol $2n$
  - Found in somatic or body cells (ex. Skin, digestive tract)
    - Example: Humans $\rightarrow 2n = 46$

- **Haploid** – a cell that contains only a single set of chromosomes (one from either parent, not both);
  - represented by the symbol $n$
  - Found in gametes or sex cells – sperm & egg
    - Example: Humans $\rightarrow n = 23$
Meiosis Introduction (1st tab middle)

Chromosome Numbers

• Somatic cells: (diploid = 2n = 46 chromosomes in humans)
• Gametes: (haploid = n = 23 chromosomes in humans)

You DO NOT have to draw these pictures on the 1st tab for Meiosis Introduction.

Just write the Somatic and Gamete info above.
### Chromosome Numbers of Some Common Organisms

<table>
<thead>
<tr>
<th>Organism</th>
<th>Body Cell (2n)</th>
<th>Gamete (n)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Human</td>
<td>46</td>
<td>23</td>
</tr>
<tr>
<td>Garden Pea</td>
<td>14</td>
<td>7</td>
</tr>
<tr>
<td>Fruit fly</td>
<td>8</td>
<td>4</td>
</tr>
<tr>
<td>Tomato</td>
<td>24</td>
<td>12</td>
</tr>
<tr>
<td>Dog</td>
<td>78</td>
<td>39</td>
</tr>
<tr>
<td>Chimpanzee</td>
<td>48</td>
<td>24</td>
</tr>
<tr>
<td>Leopard frog</td>
<td>26</td>
<td>13</td>
</tr>
<tr>
<td>Corn</td>
<td>20</td>
<td>10</td>
</tr>
<tr>
<td>Apple</td>
<td>34</td>
<td>17</td>
</tr>
<tr>
<td>Indian fern</td>
<td>1260</td>
<td>630</td>
</tr>
</tbody>
</table>
Meiosis Introduction (1st tab middle)

- Similar to Mitosis’ IPMATC

- Meiosis involves two distinct divisions, called Meiosis I and Meiosis II

- By the end of Meiosis II, the diploid cell that entered meiosis has become haploid cells
Meiosis Introduction (1^{st} \text{tab} \text{ bottom half})

- Draw the general cell division stages and label them.
- Do NOT worry about drawing the chromosomes at this time.
Interphase (2nd tab)

- Stage before prophase I
  (no interphase before prophase II)

- Contains: centrioles and chromatin

- Made of stages:
  G1 – basic cell growth
  S – replication and repair of DNA
  G2 – final preparation for cell division
Meiosis I

- (You do not need to draw these, just showing you the stages)
Prophase I
(3rd tab – upper half of page)

- Corresponding homologous chromosomes from each parent pair up to form **homologous pairs**

- When homologous chromosome overlap its called **crossing over.**

Draw and label this picture in your flipbook

Centrioles
Spindle fibers
Homologous Pairs (Humans have 23 pairs making 46 total chromosomes)
Prophase I
(3rd tab lower half of page)

- Crossing over happens when parts of the homologues chromosomes switch places after overlapping.

Draw this diagram and use 2 different colors to show the exchanged genetic material.
How can siblings look alike but not exactly the same if they come from the same parents?
Importance of crossing over

• The gene combinations that a person gets from his or her parents will be different, to varying degrees, than the combination a sibling may get.

• Crossing over increases genetic diversity

Add this statement to the Prophase 1 page on the 3rd tab
More sibling similarities
Metaphase I (4th tab)

- The **centrioles** send out **spindle fibers** to line up **homologous pairs** in the middle of cell along the metaphase plate.

Draw and label this picture in your flipbook.
Anaphase I (5th tab upper half)

- The **centrioles** use the **spindle fibers** to separate the **homologous pairs**

- Each **homologous chromosome** is pulled to the opposite pole of the cell

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**Draw and label this picture in your flipbook**
Anaphase I

(5th tab upper half)

• If the centrioles do not properly attach the spindle fibers to the homologous chromosome before they start to pull, then a **Nondisjunction** will occur.

Draw and label this picture in your flipbook.
Anaphase I

Nondisjunction in Meiosis I

- In the first picture you see how the lower red chromosome is being pulled to the wrong side.
- In the second picture it caused one pole of the cell to have an extra chromosome.
- A nondisjunction causes the gametes to have the wrong amount of chromosomes.
Telophase I & Cytokinesis

(6th tab)

- Telophase I – the cell creates a temporary nucleus around the two homologous chromosome sets

- Cytokinesis – the cell divides into two cells

Draw and label this picture in your flipbook

Centrioles

Homologous Chromosomes

Nuclear Membrane
Prophase II (7th tab)

• The next slide has information about starting **Meiosis II**.

• Write this information on the Prophase II (7th tab upper half) and draw a box around it.

• You do not have to draw the picture for all of Meiosis II because you’ll draw each stage individually.

• The **lower half** of the 7th tab will be Prophase II. Describe and diagram that slide
Meiosis II (7th tab upper half)

• The **two** new cells produced by meiosis I now enter a **second** meiotic division

• The cells do NOT replicate DNA resulting in four haploid cells

• Each cell has half of the original DNA

• $2n \div 2 = n$

Do NOT draw this picture in your flipbook
Prophase II (7th tab lower half)

• Each of the Meiosis II stages are running in 2 cells at the same time.

• Similar to Prophase of Mitosis

• Centrioles attach spindle fibers to the chromosomes

Draw and label this picture in your flipbook
Metaphase II (8th tab)

• Similar to Metaphase of Mitosis

• Centrioles use spindle fibers to line up the chromosomes in the middle at the metaphase plate

Draw and label this picture in your flipbook
Anaphase II (9th tab upper half)

- The centrioles use the spindle fibers to separate the chromosomes into individual **chromatids**.

- Each **chromatid** is pulled to the opposite pole of the cell.

Draw and label this picture in your flipbook.
Anaphase II

(9th tab upper half)

- If the centrioles do not properly attach the spindle fibers to the chromosome before they start to pull, then a nondisjunction will occur.

Draw and label this picture in your flipbook.
Anaphase II
Nondisjunction in Meiosis II

- In the third picture you see how the lower red chromosome only has one spindle fiber attached.
- In the fourth picture it caused one gamete to have an extra chromatid and the other gamete to be missing one.
- A nondisjunction causes the gametes to have the wrong amount of chromosomes.

![Diagram showing anaphase II and nondisjunction in meiosis II]
Telophase II & Cytokinesis

(10th tab)

- Telophase II – the cells creates a permanent nucleus around the two haploid chromosome sets

- Cytokinesis – the cells divides into four haploid daughter cells

Draw and label this picture in your flipbook.
In male animals (including humans), the haploid gametes produced by meiosis are called sperm.

4 sperm cells are produced from one meiotic division.
Gamete (Sex Cell) Formation

- In **female** animals (including humans), the **haploid** gametes produced by meiosis are called **eggs**.

- The cell divisions at the end of meiosis I & II are **uneven**, so that 1 large **egg** is produced along with 3 other cells, called **polar bodies**, which are discarded and not involved in reproduction.
Meiosis Animation

• Video from Thursday if you want to watch again)

• https://www.youtube.com/watch?v=rqPMp0U0HOA
The next slides will go through the vocabulary you need to know.

You should have all these words already defined in your notebook, but if not use this to do so and STUDY them.
Vocabulary

**Haploid** – A cell that has half the amount of chromosomes. A cell that is “N” for chromosome amount

**Diploid** – A cell that has twice the amount of chromosome. A cell that is “2N” for chromosome amount

**Gamete** – the haploid “sex” cells (in animals they are sperm and egg cells)

**Somatic Cell** – all diploid cells (body cells) that are not gametes

**Zygote** – fertilized egg cell formed form the joining of the gametes (sperm and egg)
Vocabulary

**Centrioles** – Organelles in the cell that help to move chromosomes during cell division

**Chromatin** – What you call the DNA during Interphase, Very easy to access the genes for transcription and translation to create proteins

**Chromosome** – What you call the DNA during the actual cell division stages (Pro-, Meta-, Ana-, and Telophase).

  Condensed/packed DNA for easy movement during cell division

**Chromatid** – One of the “arms” of a chromosome ‘X’. Each chromatid is identical to the other because it is created by replication.

  A chromosome is made of two Sister Chromatids.

**Spindle Fiber** – fibers created and used by the centrioles to move the chromosomes around during the division stages.
Vocabulary

**Homologous Chromosomes** – the same numbered chromosome that pair up from mother and father (ex: mom’s chromosome 1 and dad’s chromosome 1)

**Crossing Over** – A kind of chromosomal mutation that happens in Prophase 1 of meiosis.
   Homologous chromosomes overlap and exchange pieces of the chromosome which caused genetic variability.

**Fertilization** – The process of making a zygote. When egg and sperm cells fuse and combine their genetic information (DNA)
Mitosis and Meiosis Comparison Table

- Set up your table as shown
- USE A RULER SO IT IS NEAT

<table>
<thead>
<tr>
<th></th>
<th>Mitosis</th>
<th>Meiosis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of Starting cells</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of ending cells</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of Human Chromosomes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Genetic Make up of cells</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Type of cells</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
• Use the following slides to complete the table you just made.

• The text is in blue so you don’t have to write it all, but you will have to include some to complete the table.
Comparing Mitosis & Meiosis

- Number of cells at **beginning** of process
  - Mitosis = 1 Diploid cell
  - Meiosis = 1 Diploid Cell

- Number of cells at the **end** of the process
  - Mitosis = 2 Diploid Cells
  - Meiosis = 4 Haploid Cells
Comparing Mitosis & Meiosis

- **Number of chromosomes at the START**
  - Mitosis = 46 (Diploid, “two sets”)
  - Meiosis = 46

- **Number of chromosomes at the END**
  - Mitosis = 46
  - Meiosis = 23 (Haploid, “one set”)
Comparing Mitosis & Meiosis

- Is the genetic make-up of the daughter cells UNIQUE or IDENTICAL?
  - Mitosis produces 2 IDENTICAL CELLS
  - Meiosis produces 4 UNIQUE CELLS
Comparing Mitosis & Meiosis

- Type of cell in the human body that can undergo each phase
  
  - Mitosis produces **Somatic** BODY cells (example: skin)
  
  - Meiosis produces **Gamete** SEX cells (sperm or eggs)
The next two slides have interesting facts about male and female gametes.
Interesting Facts - FEMALES

- Females produce all their eggs at once, and store them at a very early age (They release one each month during menstruation)
- During fetal life, there are about 6 million to 7 million eggs. From this time, no new eggs are produced.
- At birth, there are approximately 1 million eggs; and by the time of puberty, only about 300,000 remain.
- Of these, only 300 to 400 will be ovulated during a woman's reproductive lifetime.
Interesting Facts - MALES

• Males continuously make sperm from puberty until they die.

• It takes about 2 days to make sperm.

• It takes only one sperm to fertilize an egg, there are roughly 200 million competitors to fertilize the egg.