Meiosis

• Meiosis is the process of nuclear division which occurs during the final stage of gamete formation.

• Meiosis is consist of two cell divisions
  - Meiosis I (reduction phase)
  - Meiosis II
Meiosis
Meiosis I

- This is sometimes referred to as the reduction division because it is during the first meiotic division that the chromosome number is reduced from 46 to 23.
- Meiosis I consist of four stages: prophase I, metaphase I, anaphase I, and telophase I.
Meiosis I: Prophase I

- The prophase stage of meiosis I is relatively long and can be subdivided into five stages.
  - Leptotene
  - Zygotene
  - Pachytene
  - Diplotene
  - Diakinesis
Meiosis I

Leptotene: Chromosomes become visible

Zygotene: synapsis

Pachytene: shorter and thicker

Diplotene: crossovers visible as chiasmata; see pairs of chromatids

Diakinesis: further shortening

Metaphase I: alignment along central plane

Anaphase I: separation of homologs

Telophase I: form nuclear membrane

Interphase I: form separate cells
Crossing Over
Prophase I: Leptotene

• The chromosomes become visible as they start to condense.
Prophase I: Zygotene

- Homologous chromosomes align directly opposite each other and are held together at several points along their length.
Prophase I: Pachytene

- Each pair of homologous chromosomes becomes tightly coiled.
Prophase I: Diplotene

- The homologous recombinant chromosomes now begin to separate but remain attached at the points where crossing over has occurred.
Prophase I: Diakinesis

- Separation of the homologous chromosome pairs proceeds as the chromosomes become maximally condensed.
Metaphase I

• The nuclear membrane disappears and the chromosomes become aligned on the equatorial plane of the cell where they have become attached to the spindle as in metaphase of mitosis.
Anaphase I

- The chromosomes now separate to opposite poles of the cell as the spindle contracts.
Telophase I

- Each set of haploid chromosomes has now separated completely to opposite ends of the cell which cleaves into two new daughter gametes, so-called oocytes.
Meiosis II

• This is essentially similar to an ordinary mitotic division.
• Each chromosome, which exists as a pair of chromatids, becomes aligned along the center of the cell and then splits leading to the formation of two new daughter gametes, known as spermatids or ova.
## Mitosis vs. Meiosis

<table>
<thead>
<tr>
<th></th>
<th>Mitosis</th>
<th>Meiosis</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Site</strong></td>
<td>Somatic cell</td>
<td>Germ cell</td>
</tr>
<tr>
<td><strong>Cell division</strong></td>
<td>Single division</td>
<td>Two division</td>
</tr>
<tr>
<td><strong>Chromosomes</strong></td>
<td>46</td>
<td>23</td>
</tr>
</tbody>
</table>
Meiosis differs from mitosis in three fundamental ways:

1- Mitosis results in each daughter cell having a diploid chromosome complement (46). Where as in meiosis the mature gamete have a haploid complement of 23 chromosomes.
2- Mitosis takes place in somatic cells and during the early cell divisions in gamete formation. Meiosis occurs only at the final division of gamete maturation.

3- Mitosis occurs as a single one-step process. Meiosis can be considered as two cell divisions known as meiosis I and meiosis II, each of which can be considered as having prophase, metaphase, anaphase and telophase stages as in mitosis.
Meiosis