Pair of homologous replicated chromosomes

Centromere

Sister chromatids

Metaphase chromosome

5 μm
Key
- Maternal set of chromosomes ($n = 3$)
- Paternal set of chromosomes ($n = 3$)

$2n = 6$

- Two sister chromatids of one replicated chromosome
- Two nonsister chromatids in a homologous pair
- Pair of homologous chromosomes (one from each set)
Key
- Haploid (n)
- Diploid (2n)

Haploid gametes (n = 23)

Egg (n)

Sperm (n)

MEIOSIS

FERTILIZATION

Ovary

Testis

Diploid zygote (2n = 46)

Mitosis and development

Multicellular diploid adults (2n = 46)
Key
- Haploid (n)
- Diploid (2n)

(a) Animals
- Diploid multicellular organism
- Mitosis
- Zygote
- Gametes
- MEIOSIS
- FERTILIZATION

(b) Plants and some algae
- Diploid multicellular organism (sporophyte)
- Mitosis
- Spores
- Gametes
- MEIOSIS
- FERTILIZATION

(c) Most fungi and some protists
- Haploid unicellular or multicellular organism
- Mitosis
- Gametes
- MEIOSIS
- FERTILIZATION

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Interphase

Homologous pair of chromosomes in diploid parent cell

Chromosomes replicate

Homologous pair of replicated chromosomes

Sister chromatids

Diploid cell with replicated chromosomes

Meiosis I

1. Homologous chromosomes separate

Haploid cells with replicated chromosomes

Meiosis II

2. Sister chromatids separate

Haploid cells with unreplicated chromosomes
Prophase I

Metaphase I

Anaphase I

Telophase I and Cytokinesis

Prophase II

Metaphase II

Anaphase II

Telophase II and Cytokinesis

- Centrosome (with centriole pair)
- Sister chromatids
- Chiasmata
- Spindle
- Homologous chromosomes
- Fragments of nuclear envelope
- Centromere (with kinetochore)
- Microtubule attached to kinetochore
- Metaphase plate
- Sister chromatids remain attached
- Homologous chromosomes separate
- Cleavage furrow
- Sister chromatids separate
- Haploid daughter cells forming
MITOSIS

Prophase

Replicated chromosome

Metaphase

Anaphase

Telophase

2n

Daughter cells of mitosis

MEIOSIS

MEIOSIS I

Parent cell

Chiasma

Homologous chromosome pair

2n = 6

Prophase I

Metaphase I

Anaphase I

Telophase I

Haploid

n = 3

Daughter cells of meiosis I

MEIOSIS II

Daughter cells of meiosis II

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<table>
<thead>
<tr>
<th>Property</th>
<th>Mitosis</th>
<th>Meiosis</th>
</tr>
</thead>
<tbody>
<tr>
<td>DNA replication</td>
<td>Occurs during interphase before mitosis begins</td>
<td>Occurs during interphase before meiosis I begins</td>
</tr>
<tr>
<td></td>
<td>One, including prophase, metaphase, anaphase, and telophase</td>
<td>Two, each including prophase, metaphase, anaphase, and telophase</td>
</tr>
<tr>
<td>Number of divisions</td>
<td></td>
<td>Occurs during prophase I along with crossing over between nonsister</td>
</tr>
<tr>
<td></td>
<td></td>
<td>chromatids; resulting chiasmata hold pairs together due to sister</td>
</tr>
<tr>
<td></td>
<td></td>
<td>chromatid cohesion</td>
</tr>
<tr>
<td>Synapsis of homologous</td>
<td>Does not occur</td>
<td>Four, each haploid ( n ), containing half as many chromosomes as</td>
</tr>
<tr>
<td>chromosomes</td>
<td></td>
<td>the parent cell; genetically different from the parent cell and from</td>
</tr>
<tr>
<td></td>
<td></td>
<td>each other</td>
</tr>
<tr>
<td>Number of daughter cells and</td>
<td>Two, each diploid ( 2n ) and genetically identical to the parent cell</td>
<td>Produces gametes; reduces number of chromosomes by half and introduces</td>
</tr>
<tr>
<td>genetic composition</td>
<td></td>
<td>genetic variability among the gametes</td>
</tr>
<tr>
<td>Role in the animal body</td>
<td>Enables multicellular adult to arise from zygote; produces cells for</td>
<td></td>
</tr>
<tr>
<td></td>
<td>growth, repair, and, in some species, asexual reproduction</td>
<td></td>
</tr>
</tbody>
</table>
Possibility 1

Two equally probable arrangements of chromosomes at metaphase I

Possibility 2

Metaphase II

Daughter cells

Combination 1
Combination 2

Combination 3
Combination 4
Prophase I of meiosis

Pair of homologs

Nonsister chromatids held together during synapsis

Chiasma

Centromere

TEM

Anaphase I

Anaphase II

Daughter cells

Recombinant chromosomes

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