THE HUMAN LIFE CYCLE
and CELL DIVISION

BODY CELLS ARE DIPLOID- (2n)
They contain two copies of each chromosome. One set from the dad’s sperm and one set from the mom’s egg. These replicate by MITOSIS.

GAMETES ARE HAPLOID- (n)
They contain one copy of each chromosome randomly chosen (and mixed up) from the two that are available. They are haploid so that they can combine to form a diploid zygote.

DNA - Deoxyribonucleic Acid
GENOME - all the genes an organism has
CHROMOSOMES - structures made of DNA and proteins
CHROMATIDS - “half-chromosomes”
CHROMATIN - DNA/protein complex that makes up chromosomes

• The DNA in a cell is packed into an elaborate, multilevel system of coiling and folding
Chromosome?
Sister Chromatids?
What’s in name?

When the cell divides, the sister chromatids separate from each other and are called chromosomes again.

TWO PHASES OF THE CELL CYCLE

Interphase
- Cell growth and replication of DNA

Mitosis
- Cell divides

Interphase
- Interphase has three parts
  - $G_1$: Organelle duplication
  - $S$: DNA replication
  - $G_2$: Proteins needed for mitosis are produced
  - Cell spends most of its time in interphase and DNA stays loosely packed in the nucleus as chromatin
Mitosis and Cytokinesis

- Mitosis has 4 phases
  - Prophase
  - Metaphase
  - Anaphase
  - Telophase
  AND
  - Cytokinesis
  - We will go through each individually
Figure 8.8a

(a) Animal cell cytokinesis

Cell undergoing Mitosis

Cancer:
Cells Growing Out of Control
MEIOSIS:
THE BASIS OF SEXUAL REPRODUCTION

Gametes and the Life Cycle of a Sexual Organism

• The life cycle of a multicellular organism is the sequence of stages leading from the adults of one generation to the adults of the next.

Gametes
- Haploid gametes (n = 23)
- Egg cell
- Sperm cell
- Fertilization

Diploid zygote (2n = 46)

Multicellular diploid adults (2n = 46)

Mitosis and development

Homologous Chromosomes

Pair of homologous chromosomes
- Centromere
- Sister chromatids

A karyotype
• The life cycles of sexual organisms involve an alternation of diploid and haploid stages

![Diagram of meiosis](image)

**The Process of Meiosis**

- Haploid gametes are produced in diploid organisms
- Two consecutive divisions occur, meiosis I and meiosis II, preceded by interphase
- **Crossing over** occurs

![Diagram of meiosis stages](image)

**Meiosis I**

- Prophase I
- Metaphase I
- Anaphase I
- Telophase I and Cytokinesis

![Diagram of meiosis I stages](image)
• Meiosis II

During another round of cell division, the sister chromatids finally separate; four haploid daughter cells result, containing single chromosomes.

**Independent Assortment of Chromosomes**

Figure 8.17

Combination a Combination b Combination c Combination d
Random Fertilization

- The human egg cell is fertilized randomly by one sperm, leading to genetic variety in the zygote.

Crossing Over

- Homologous chromosomes exchange genetic information.
- Genetic recombination occurs.

Down Syndrome: An Extra Chromosome 21

Figure 8.19
- The incidence of Down Syndrome increases with the age of the mother

**Accidents During Meiosis Can Alter Chromosome Number**

- **NONDISJUNCTION**
  - The members of a chromosome pair fail to separate during anaphase
  - Gametes with an incorrect number of chromosomes are produced

**(a) Nondisjunction in meiosis I**

**(b) Nondisjunction in meiosis II**
• The result of nondisjunction

![Figure 8.22](image)

Other Chromosomal Abnormalities

Part of Chromosome #5 is missing
- Cat-like cry (malformed larynx)
- Deformed ears/eyelids
- Severe retardation

Fragile X Syndrome
- X chromosome is broken

Abnormal Numbers of Sex Chromosomes

• Nondisjunction
  - Also affects the sex chromosomes

<table>
<thead>
<tr>
<th>Table 8.1</th>
<th>Abnormalities of Sex Chromosome Number in Humans</th>
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<tbody>
<tr>
<td>Sex</td>
<td>Syndrome</td>
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<tr>
<td>Chromosomes</td>
<td></td>
</tr>
<tr>
<td>XY</td>
<td>Klinefelter syndrome (male)</td>
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<tr>
<td>XY</td>
<td>Rheas (unbalanced)</td>
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<tr>
<td>XXX</td>
<td>Monosomy X</td>
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<tr>
<td>XO</td>
<td>Turner syndrome (female)</td>
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</tbody>
</table>
Breast development

Constriction of aorta

Under-developed ovaries

(A) A woman with Turner syndrome (XO)

Poor breast development

Under-developed testes

(B) A man with Klinefelter syndrome (XXY)

Web of skin

Poor beard growth