Meiosis and Sexual Reproduction Chapter 11

Reproduction

Section 1

Reproduction

Key Idea: An individual formed by asexual reproduction is genetically identical to its parent.

Asexual Reproduction

- In asexual reproduction, a single parent passes a complete copy of its genetic information to each of its offspring.
- Examples:
  - binary fission
  - fragmentation
  - budding

Reading Check

What is fragmentation?

Reproduction in which the body breaks into several pieces. Some or all of these fragments regrow missing parts and develop into complete adults.

Sexual Reproduction

Key Idea: In sexual reproduction, two parents give genetic material to produce offspring that are genetically different from their parents.

- A gamete is a reproductive cell produced by each parent.
  - Male = sperm
  - Female = egg
- A zygote is a fertilized egg formed by the fusion of both gametes.

Germ Cells and Somatic Cells

- Germ cells are cells that are specialized for sexual reproduction. (gametes)
- Somatic cells are all other body cells. (skin, muscle, brain)

Advantages of Sexual Reproduction

- Sexual reproduction produces genetically diverse individuals.
- A population of diverse organisms is more likely to have some individuals that survive a major environmental change.

Chromosome Number

Key Idea: Each chromosome has thousands of genes that play an important role in determining how an organism develops and functions.

- A diploid is a cell, such as a somatic cell, that has two sets of chromosomes.
- A haploid is a cell that has one set of chromosomes.
- Homologous chromosomes are chromosomes that are similar in size, in shape, and in kinds of genes.

Haploid and Diploid Cells

- The symbol *n* is used to represent the number of chromosomes in one set.
- Human gametes have 23 chromosomes ($n = 23$).
- Human somatic cells have 46 chromosomes ($2n = 46$).

Homologous Chromosomes

- Each diploid cell has pairs of chromosomes made up of two homologous chromosomes.
- Each chromosome in a homologous pair comes from one of the two parents.

Autosomes and Sex Chromosomes

- *Autosomes* are chromosomes with genes that do not determine the sex of an individual.
- *Sex chromosomes* have genes that determine the sex of an individual.

Reading Check

What kind of cells do germ cell produce?

Gametes

Meiosis
Section 2

Meiosis

Key Idea: During meiosis, a diploid cell goes through two divisions to form four haploid cells.

- **Meiosis** is a form of cell division that produces daughter cells with half the number of chromosomes that are in the parent cell.
- **Crossing-over** is where chromatids exchange genetic material.

Stages of Meiosis

Stage 1: Prophase I - the chromosomes condense, and the nuclear envelope breaks down

Stage 2: Metaphase I - pairs of homologous chromosomes move to the equator of the cell

Stage 3: Anaphase I - the homologous chromosomes separate

Stage 4: Telophase I - the cytoplasm divides (cytokinesis), and two new cells are formed.

Stage 5: Prophase II - new spindles form.

Stage 6: Metaphase II - the chromosomes line up along the equator

Stage 7: Anaphase II - the chromatids, which are now called chromosomes, move to opposite poles of the cell

Stage 8: Telophase II - a nuclear envelope forms around each set of chromosomes

Meiosis I

- Begins with a diploid cell that has copied its chromosomes.
- Ends with both cells having one chromosome from each pair of homologous chromosomes.

Meiosis II

- The chromosomes are not copied between meiosis I and meiosis II.
- The result of meiosis is four haploid cells.

Reading Check

In what phase of meiosis is genetic material exchanged?

Prophase I

Comparing Mitosis and Meiosis

Key Idea: Mitosis makes new cells that are used during growth, development, repair, and asexual reproduction. Meiosis makes cells that enable an organism to reproduce sexually and happens only in reproductive structures.

Comparing Mitosis and Meiosis

- Mitosis produces two genetically identical diploid cells.
- Meiosis produces four genetically different haploid cells.

Reading Check

How are cells formed by mitosis different from cells formed by meiosis in relation to the number of chromosomes?

Half the number of chromosomes in meiosis

Genetic Variation

Key Idea: Three key contributions to genetic variation are crossing-over, independent assortment, and random fertilization.

The word exist means to have life.

Crossing-Over

- Crossing-over happens when one arm of a chromatid crosses over the arm of the other chromatid.
- Each chromatid contains a piece from the other chromosome.

Reading Check

How can crossing-over increase genetic variation?

New information is on the chromosome

Independent Assortment

- Independent assortment is the random distribution of homologous chromosomes during meiosis.
- The two pairs of chromosomes can line up at the equator in either of two equally probable ways.

Random Fertilization

- A zygote that forms is made by the random joining of two gametes.

Multicellular Life Cycles
Section 3

Diploid Life Cycle

Key Idea: In diploid life cycles, meiosis in germ cells of a multicellular diploid organism results in the formation of haploid gametes.

- A life cycle is all the events like growth and development an organism goes through until it reaches sexual maturity.
- Sperm are male gametes.
- An ovum is a female gamete.

Diploid Life Cycle

- All of the cells except the gametes are diploid.
- The gametes, the sperm and the egg, join during fertilization. The result is a zygote.

Reading Check

How many gametes are formed from one female germ cell?

One

Haploid Life Cycle

Key Idea: In haploid life cycles, meiosis in a diploid zygote results in the formation of the first cell of a multicellular haploid individual.

Haploid Life Cycle

- The haploid life cycle happens in most fungi and some protists.
- The zygote, the only diploid structure, goes through meiosis immediately after it is formed and makes new haploid cells.

Alternation of Generations

Key Idea: Plants and most multicellular protists have a life cycle that alternates between a haploid phase and a diploid phase called *alternation of generations.*

Alternation of Generations

- In plants, the multicellular diploid phase in the life cycle is called a *sporophyte*.
- The *gametophyte* is the haploid phase that produces gametes by mitosis.