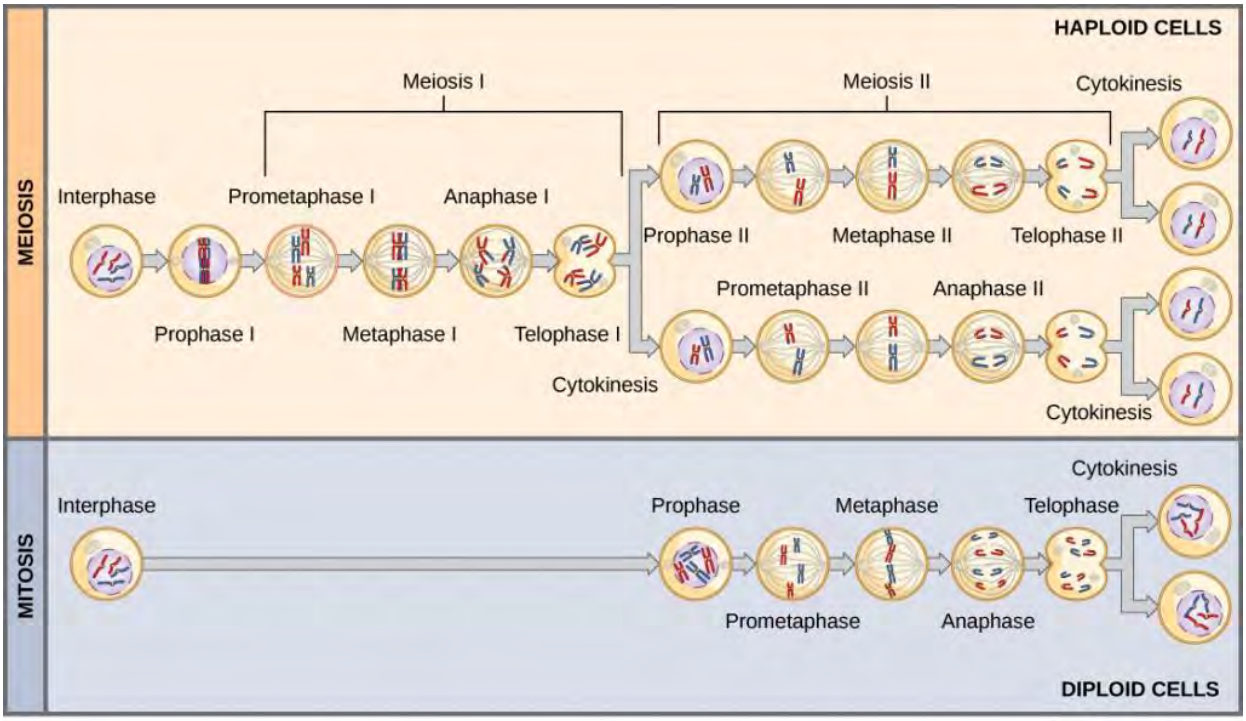

						OUTCOME
PROCESS	DNA synthesis	Synapsis of homologous chromosomes	Crossover	Homologous chromosomes line up at metaphase plate	Sister chromatids line up at metaphase plate	Number and genetic composition of daughter cells
MEIOSIS	Occurs in S phase of interphase	During prophase I	During prophase I	During metaphase I	During metaphase II	Four haploid cells at the end of meiosis II
MITOSIS	Occurs in S phase of interphase	Does not occur in mitosis	Does not occur in mitosis	Does not occur in mitosis	During metaphase	Two diploid cells at the end of mitosis

Figure 8.29 Meiosis and mitosis are both preceded by one round of DNA replication; however, meiosis includes two nuclear divisions. (credit: Clark et al./ Biology 2E OpenStax)

CONCEPTS IN ACTION- For an animation comparing mitosis and meiosis, go to this website.

Section Summary

Sexual reproduction requires that diploid organisms produce haploid cells that can fuse during fertilization to form diploid offspring. Meiosis is the process used to produce haploid cells. Meiosis is a series of events that arrange and separate chromosomes into daughter cells. During the interphase of meiosis, each chromosome is duplicated. In meiosis, there are two rounds of nuclear division, resulting in four genetically unique haploid daughter cells. During meiosis, variation in the daughter cells is introduced because of crossing over in prophase I and independent assortment in metaphase I.

Meiosis and mitosis share similarities but have distinct outcomes. Mitotic divisions are single nuclear divisions that produce daughter nuclei that are genetically identical and have the same number of chromosomes as the original cell. Meiotic divisions are two nuclear divisions that produce four haploid daughter cells that have half as many chromosomes as the original parent cell. The main differences between the processes occur in the first division of meiosis. The homologous chromosomes separate into different nuclei during meiosis I causing a reduction of ploidy level. The second division of meiosis is much more similar to a mitotic division.

Exercises

1. Meiosis produces _____ daughter cells.
    a. two haploid
    b. two diploid
    c. four haploid
    d. four diploid
2. At which stage of meiosis are sister chromatids separate from each other?
    a. prophase I
    b. prophase II
    c. anaphase I
    d. anaphase II
3. A part of meiosis that is similar to mitosis is _____.
    a. meiosis I
    b. anaphase I
    c. anaphase II
    d. interkinesis
4. If a somatic muscle cell of an organism contains 32 chromosomes, how many would you find in a gamete?
    a. 8
    b. 16
    c. 32
    d. 64
5. Explain how the independent assortment of homologous chromosomes during metaphase I contribute to variation in gametes produced by meiosis.
6. In what ways is meiosis II similar to and different from mitosis of a diploid cell?

Answers

1. (c)
2. (d)
3. (c)
4. (b)
5. Random alignment leads to new combinations of traits. The chromosomes that were initially inherited by the gamete-producing individual came equally from the egg and the sperm. In metaphase I, the duplicated copies of these maternal and paternal homologous chromosomes line up across the center of the cell to form a tetrad. The orientation of each tetrad is random. There is an equal chance that the maternally derived chromosomes will be facing either pole. The same is true of the paternally derived chromosomes. The alignment should occur differently in almost every meiosis. As the homologous chromosomes are pulled apart in anaphase I, any combination of maternal and paternal chromosomes will move toward each pole. The gametes formed from these two groups of chromosomes will have a mixture of traits from the individual's parents. Each gamete is unique.
6. The two divisions are similar in that the chromosomes line up along the metaphase plate individually, meaning unpaired with other chromosomes (as in meiosis I). Also, each chromosome consists of two sister chromatids that will be pulled apart. The two divisions are different because in meiosis II there is half the number of chromosomes that are present in a diploid cell of the same species undergoing mitosis. This is because meiosis I reduced the number of chromosomes to a haploid state.