Mader/*Biology*, 11/e – Chapter Outline

Chapter 10

10.3 The Phases of Meiosis

1. Both meiosis I and meiosis II have four phases: prophase, metaphase, anaphase, and telophase.

A. Prophase I
   1. Nuclear division is about to occur: nucleolus disappears; nuclear envelope fragments; centrosomes migrate away from each other; and spindle fibers assemble.
   2. Homologous chromosomes undergo synapsis to form bivalents; crossing-over may occur at this time in which case sister chromatids are no longer identical.
   3. Chromatin condenses and chromosomes become microscopically visible.

B. Metaphase I
   1. Bivalents held together by chiasmata have moved toward the metaphase plate at the equator of the spindle.
   2. In metaphase I, there is a fully formed spindle and alignment of the bivalents at the metaphase plate.
   3. Kinetochores, protein complexes just outside the centromeres attach to spindle fibers called *kinetochore spindle fibers*.
   4. Bivalents independently align themselves at the metaphase plate of the spindle.
   5. Maternal and paternal homologues of each bivalent may be oriented toward either pole.

C. Anaphase I
   1. The homologues of each bivalent separate and move toward opposite poles.
   2. Each chromosome still has two chromatids.

D. Telophase I
   1. In animals, this stage occurs at the end of meiosis I.
   2. When it occurs, the nuclear envelope reforms and nucleoli reappear.
   3. This phase may or may not be accompanied by cytokinesis.

E. Interkinesis
   1. **Interkinesis** between meiosis I and II is similar to the interphase between mitotic divisions; however, no DNA replication occurs (the chromosomes are already duplicated).

F. Meiosis II and Gamete Formation
   1. During metaphase II**,** the haploid number of chromosomes align at the metaphase plate.
   2. During anaphase II**,** the sister chromatids separate at the centromeres; the two *daughter chromosomes* move toward the poles.
   3. Due to crossing-over, each gamete can contain chromosomes with different types of genes.
   4. At the end of telophase II and cytokinesis, there are four haploid cells.
   5. In animals, the haploid cells mature and develop into gametes.
   6. In plants, the daughter cells become **spores** and divide to produce a haploid generation; these haploid cells fuse to become a zygote that develops into a diploid generation.
   7. The type of life cycle of alternating haploid and diploid generations is called **alternation of generations.**