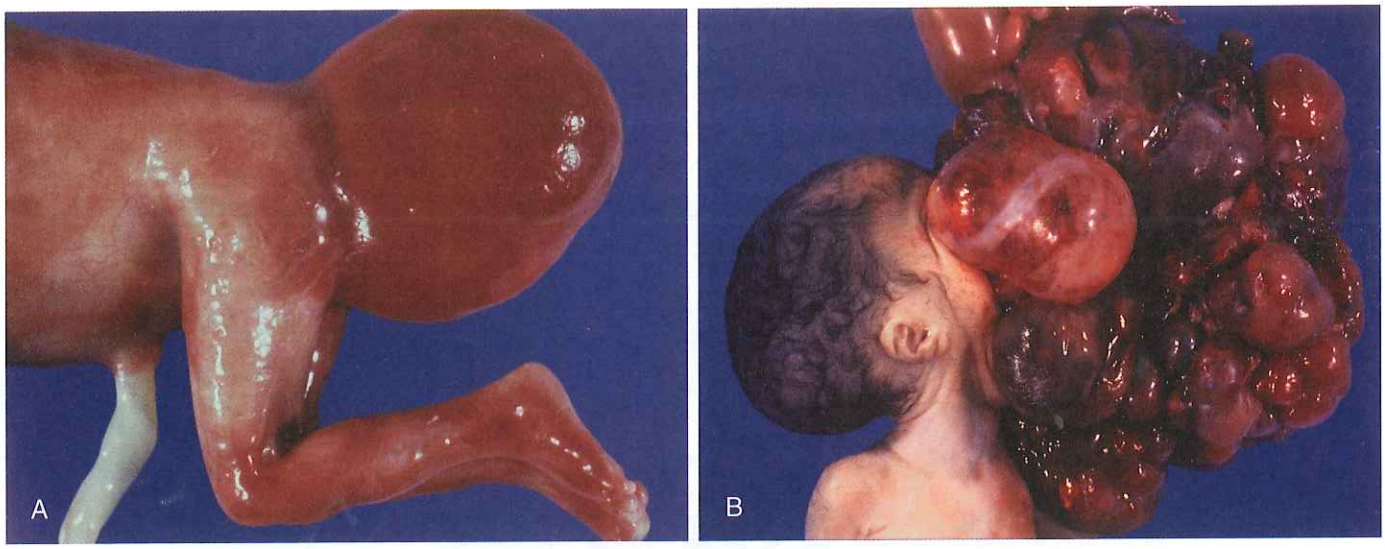

FIGURE 1-2. A, Sacrococcygeal teratoma in a fetus. **B,** Massive oropharyngeal teratoma. (Courtesy M. Barr, Ann Arbor, Mich.)

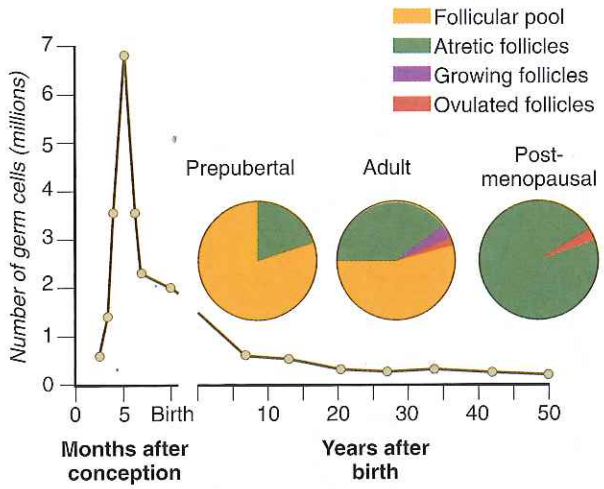

FIGURE 1-3. Changes in the number of germ cells and proportions of follicle types in the human ovary with increasing age.(Based on studies by Baker TG: In Austin CR, Short RV: *Germ cells and fertilization (reproduction in mammals)*, vol 1, Cambridge, England, 1970, Cambridge University Press, p 20; and Goodman AL, Hodgen GD: *Recent Progr Hormone Res* 39:1-73, 1983.)

of these divisions enter meiosis as synchronous groups. This pattern of spermatogonial mitosis continues throughout life.

PHASE 3: REDUCTION IN CHROMOSOMAL NUMBER BY MEIOSIS

Stages of Meiosis

The biological significance of meiosis in humans is similar to that in other species. Of primary importance are (1) reduction of the number of chromosomes from the diploid (2n) to the **haploid** (1n) number so that the species number of chromosomes can be maintained from generation to generation, (2) independent reassortment of maternal and paternal chromosomes for better mixing of genetic characteristics, and (3) further redistribution of maternal and paternal genetic information through the process of crossing-over during the first meiotic division.

Meiosis involves two sets of divisions (Fig. 1-4). Before the first meiotic division, deoxyribonucleic acid (DNA) replication has already occurred, so at the beginning of meiosis, the cell is 2n, 4c. (In this designation, **n** is the species number of chromosomes, and **c** is the amount of DNA in a single set [n] of chromosomes before DNA replication has occurred.) The cell contains the normal number (2n) of chromosomes, but as a result of replication, its DNA content (4c) is double the normal amount (2c).

In the first meiotic division, often called the **reductional division**, a prolonged prophase (see Fig. 1-4) results in the pairing of homologous chromosomes and frequent **crossing-over**, resulting in the exchange of segments between members of the paired chromosomes. During metaphase of the first meiotic division, the chromosome pairs (**tetrads**) line up at the metaphase (equatorial) plate so that at anaphase I, one chromosome of a homologous pair moves toward one pole of the spindle, and the other chromosome moves toward the opposite pole. This represents one of the principal differences between a meiotic and mitotic division. In a mitotic anaphase, the centromere between the sister chromatids of each chromosome splits after the chromosomes have lined up at the metaphase plate, and one chromatid from each chromosome migrates to each pole of the mitotic spindle. This activity results in genetically equal daughter cells after a mitotic division, whereas the daughter cells are genetically unequal after the first meiotic division. Each daughter cell of the first meiotic division contains the haploid (1n) number of chromosomes, but each

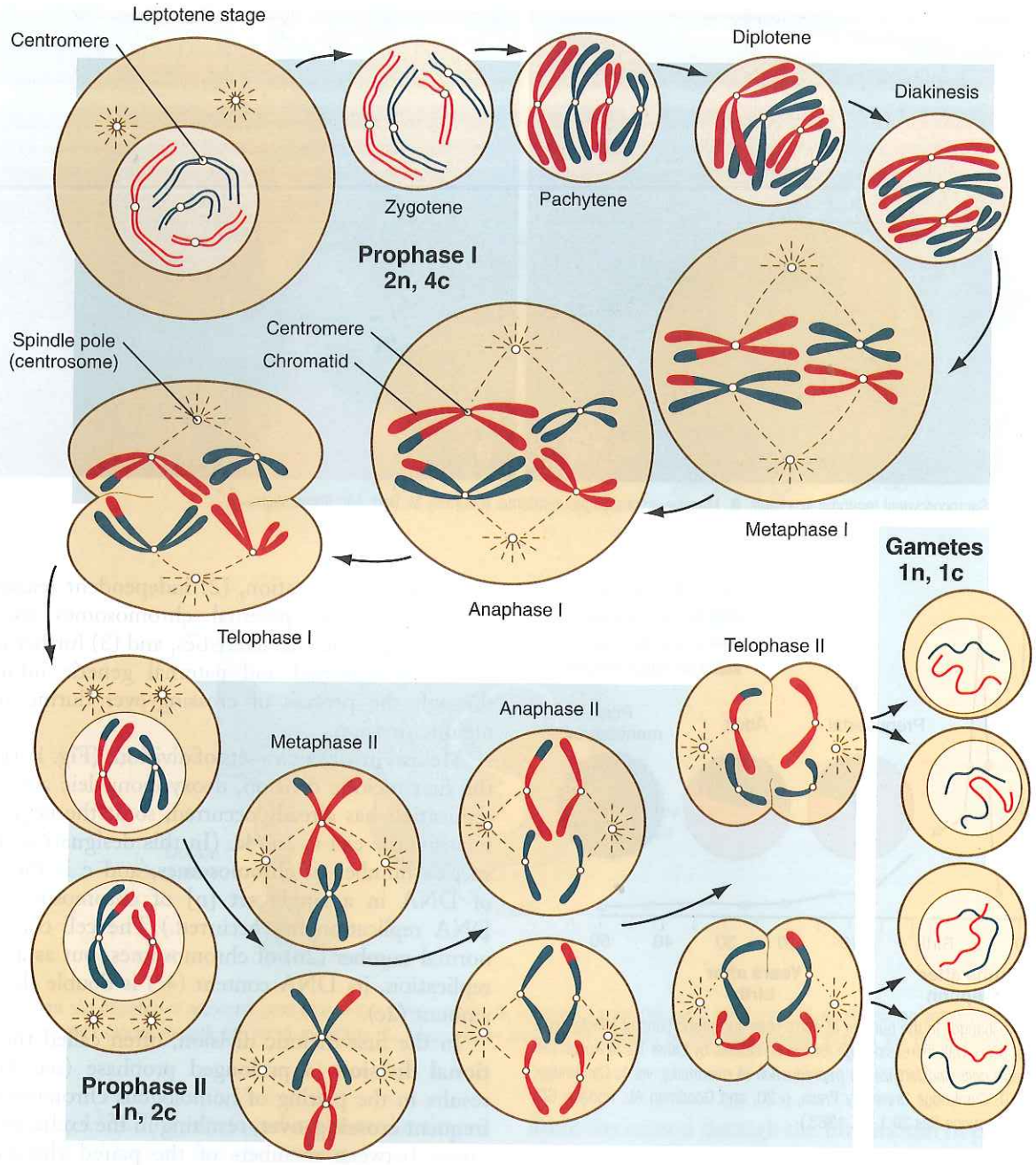

FIGURE 1-4. Summary of the major stages of meiosis in a generalized germ cell.

chromosome still consists of two chromatids (2c) connected by a centromere. No new duplication of chromosomal DNA is required between the first and second meiotic divisions because each haploid daughter cell resulting from the first meiotic division already contains chromosomes in the replicated state.

The second meiotic division, called the **equational division**, is similar to an ordinary mitotic division except that before division the cell is haploid (1n, 2c). When the chromosomes line up along the equatorial plate at metaphase II, the centromeres between sister chromatids divide, allowing the sister chromatids of each chromosome to migrate to opposite poles of the spindle apparatus during anaphase II. Each daughter cell of the second meiotic division is truly haploid (1n, 1c).

Meiosis in Females

The period of meiosis involves other cellular activities in addition to the redistribution of chromosomal material. As the oogonia enter the first meiotic division late in the fetal period, they are called **primary oocytes**.

Meiosis in the human female is a very leisurely process. As the primary oocytes enter the diplotene stage of the first meiotic division in the early months after birth, the first of two blocks in the meiotic process occurs (Fig. 1-5). The suspended diplotene phase of meiosis is the period when the primary oocyte prepares for the needs of the embryo. In oocytes of amphibians and other lower vertebrates, which must develop outside the mother's body and often in a hostile environment, it is highly advantageous