The *nucleus* of eucaryotic cells contains *chromosomes* as nuclear material (DNA molecules with some closely associated small proteins), surrounded by a membrane. The nuclear membrane consists of a pair of concentric and porous membranes. The nucleolus is an area in the nucleus that stains differently and is the site of ribosome synthesis. However, many chromosomes contain small amounts of RNA and basic proteins called *histones* attached to the DNA. Each chromosome contains a single linear DNA molecule on which the histones are attached.

Cell division (asexual) in eucaryotes involves several major steps, such as DNA synthesis, nuclear division, cell division, and cell separation. Sexual reproduction in eucaryotic cells involves the conjugation of two cells called *gametes* (egg and sperm cells). The single cell formed from the conjugation of gametes is called a *zygote*. The zygote has twice as many chromosomes as does the gamete. Gametes are *haploid* cells, while zygotes are *diploid*. For humans, a haploid cell contains 23 chromosomes, and diploid cells have 46. The cell-division cycle (asexual reproduction) in a eucaryotic cell is depicted in Fig. 2.4.

The cell-division cycle is divided into four phases. The M phase consists of *mitosis* where the nucleous divides, and *cytokinesis* where the cell splits into separate daughter cells. All of the phases between one M phase and the next are known collectively as the *interphase*. The interphase is divided into three phases: G_1, S, and G_2. The cell increases in size during the interphase period. In the S phase the cell replicates its nuclear DNA. There are key checkpoints in the cycle when the cell machinery must commit to entry to the next phase. Checkpoints exist for entry into the S and M phases and exit from M phase. Cells may also be in a G_0 state, which is a resting state where there is no growth.

The *mitochondria* are the powerhouses of a eucaryotic cell, where respiration and oxidative phosphorylation take place. Mitochondria have a nearly cylindrical shape 1 μm in diameter and 2 to 3 μm in length. The typical structure of a mitochondrion is shown in

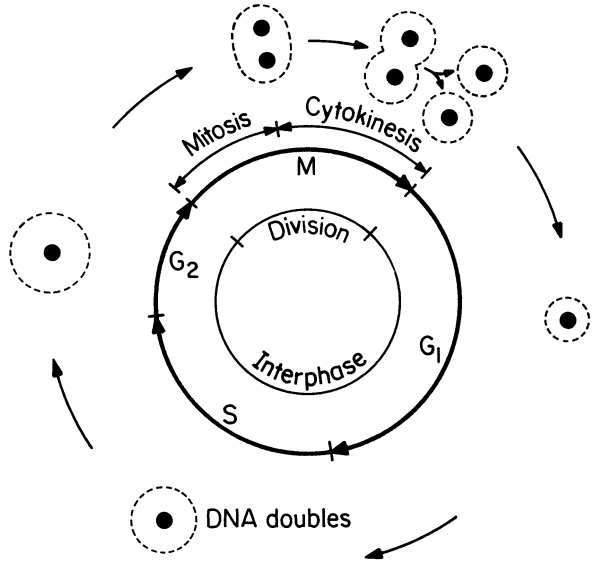

Figure 2.4. Schematic of cell division cycle in an eucaryote. (See text for details.)