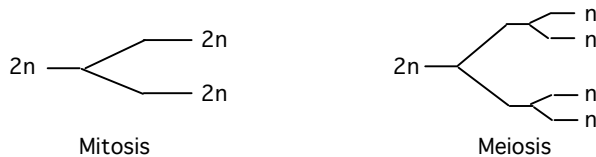


**BIOLOGY 100**  
**SOLUTIONS TO PROBLEMS**

**MITOSIS AND MEIOSIS**

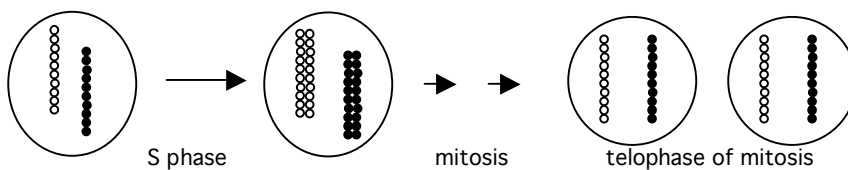
1. If an organism has 15 pairs of homologous chromosomes, how many chromosomes will each daughter cell have after telophase of mitosis? In this same organism, how many chromosomes will each daughter cell have after telophase II of meiosis?



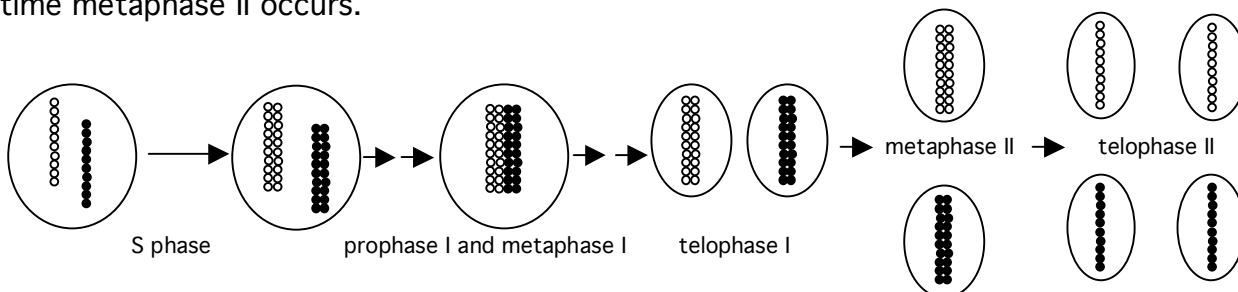
If a cell has 15 pairs of chromosomes ( $n = 15$ ), it has 30 chromosomes ( $2n = 30$ ). At the end of mitosis, the two daughter cells will be exact copies of the original cell. Each daughter cell will have 30 chromosomes. At the end of meiosis II, each cell (i.e., gamete) would have half the original number of chromosomes, that is, 15 chromosomes.

2. How many DNA molecules are present in a chromosome of a cell in metaphase of mitosis? How many DNA molecules are present in a chromosome of a cell at metaphase II of meiosis?

A chromosome in G1 of the cell cycle is composed of a very long molecule of double stranded DNA. Recall that DNA is replicated during the S phase of the cell cycle. Thus during metaphase of mitosis, each chromosome (i.e., each chromatid pair) will contain two molecules of double stranded DNA (one molecule per sister chromatid). The following diagram depicts the behavior of one homologous pair of chromosomes during mitosis. In a real cell, chromosomes would not be visible during interphase of the cell cycle.

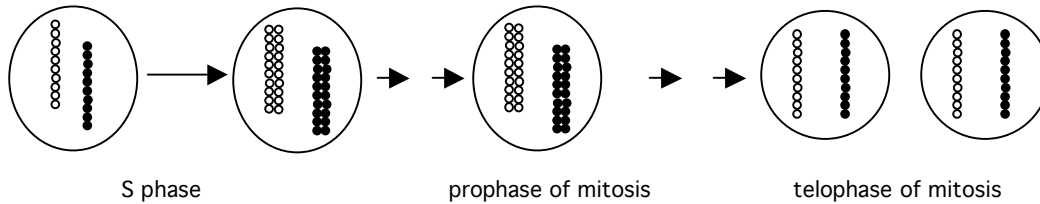


During prophase I and metaphase I of meiosis, a chromosome consists of a tetrad (4 chromatids or 4 DNA molecules) and is reduced to two chromatids (2 DNA molecules) by the time metaphase II occurs.



3. In a eukaryotic cell undergoing mitosis, how does the amount of DNA in a prophase nucleus compare with the amount of DNA in a telophase nucleus?

DNA is duplicated during the S phase of interphase. A cell in prophase has 2x the DNA of the starting cell (as it is in G1 of the cell cycle). The forming daughter cell nuclei in the telophase cells will each have the same amount of DNA as the starting cell.



4. If an organism has three pairs of homologous chromosomes, how many different kinds of gametes can this organism produce based on different chromosomal arrangements? Assume that the members of each pair are not identical.

A gamete for this organism will have three chromosomes. Each chromosome is one of two possibilities. Thus, there will be  $2 \times 2 \times 2 = 8$  possible arrangements (or  $(2)^3 = 8$ ).

5. Humans have 23 pairs of homologous chromosomes. How many different kinds of sperm cells can a man produce based on different chromosomal arrangements? Again, assume that the members of each pair are not identical.

A sperm cell contains 23 chromosomes with two possibilities for each chromosome. The possible number of sperm cells based on different chromosome combinations is  $(2)^{23} = 8,388,608$ .