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SUMMARY OF MITOSIS AND MEIOSIS

Biologists distinguish two separate events in mitosis and meiosis: karyokinesis, the division of the nucleus, and cytokinesis, the division of the cytoplasm into two distinct cells. In most cells, cytokinesis immediately follows karyokinesis, but there are exceptions. Some cells, such as skeletal muscle cells, undergo mitosis through all the processes of karyokinesis but never divide the cytoplasm. In such cases it is difficult to say where one cell ends and the next begins, but each nucleus appears to control the functions in the cytoplasm near it. Similar situations are found in some plant tissues. Mitosis in the strict sense, then, refers to karyokinesis and does not necessarily involve cytokinesis. Meiosis, on the other hand, seems always to be followed by cytokinesis.

Color titles and illustrations A and B, using light colors.

In *animal cell cytokinesis,* microfilaments draw the cell membrane in at the center and pinch it into two cells. In *plant cell cytokinesis,* the new cells must be separated by a new cell wall as well as by a membrane. A structure called the cell plate is formed in the center of the cell from microtubules and small vesicles, and these assemble a new cell wall with cell membrane on either side of it to separate the original cell into two.

Color the headings Mitosis and Meiosis and titles and structures C and D. The centrioles and spindle apparatus are shown but need not be colored.

The remainder of the plate summarizes the differences between mitosis and meiosis. The two cells by the headings represent cells that were just formed by a previous mitosis and therefore have *chromosomes* that do not consist of two chromatids each as is the case during cell division.

Color structures C^1 and D^1 and titles E and F and their related structures. Use the C color for C^1 and the D color for D^1. The same chromosome is represented in different stages; the superscripts are for identification purposes.

During *interphase,* while the chromosomes are uncoiled into the diffuse chromatin network, each chromosome is *replicated.* That is, an exact copy of it is made, so that by prophase of the next cell division there are two identical structures where there was only one before. The two are still attached and are called chromatids until they separate, but they are in effect each complete chromosomes-to-be. This replication occurs in both mitosis and meiosis, but in meiosis the chromosomes of each pair line up together on the spindle apparatus to form a tetrad, whereas in mitosis they line up independently of each other.

Color title G and the corresponding arrows along with structures C^2 and D^2.

When the actual *division* of the cell occurs, other differences become apparent. In mitosis, the chromatids separate and there is only one division, producing two daughter cells. In meiosis, there is first one division in which the chromatids do not separate, but each chromosome of a homologous pair ends up in a different daughter cell. That division is immediately followed by a second division without any further replication of the chromosomes, so that four daughter cells are produced.

Color structures C^3 and D^3.

The most important difference between mitosis and meiosis is seen in the cells that result. Indeed, all the other differences exist only to produce this final difference: the daughter cells from a mitotic division have a set of chromosomes that is an exact duplicate of the set in the parent cell, while the daughter cells from a meiotic division have only half the number of chromosomes the parent cell had. Moreover, it is not just any half, but exactly one chromosome of each homologous pair. This is referred to as the haploid number of chromosomes.

In animals, the only haploid cells are the gametes, which must meet gametes of the opposite sex and fuse with them in fertilization or else die. Fertilization reestablishes the diploid number of chromosomes. In plants and algae, haploid cells may divide by mitosis for a few or for many generations, depending on the species.

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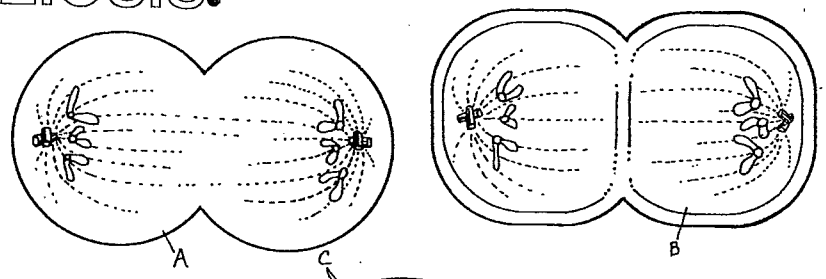
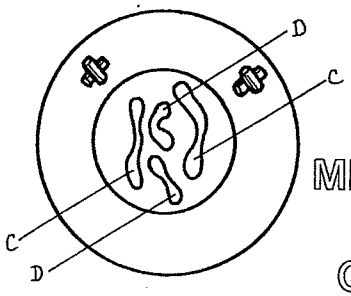
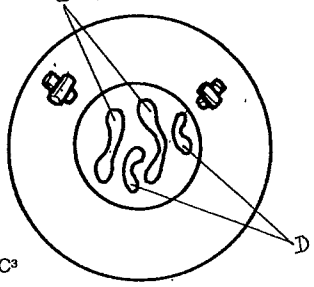
ANIMAL CELL CYTOKINESIS$_A$
PLANT CELL CYTOKINESIS$_B$





MITOSIS★

MEIOSIS★



CHROMOSOME 1$_{C, C^1, C^2, C^3}$
CHROMOSOME 2$_{D, D^1, D^2, D^3}$
INTERPHASE AND REPLICATION$_E$
TETRAD FORMATION$_F$
DIVISION$_G$