[redacted]ZATION OF THE BODY
[redacted]SION / MITOSIS

See 3

[redacted] Plate 3 for cell [redacted], nucleolus, and cen- [redacted] this plate, even though the previous letter labels may be different. Use contrasting colors for E–E² and F–F², and gray for D–D* to distinguish the latter from those with the contrasting colors. (1) Begin with the cell in interphase, reading the related text and completing each cell before going on to the next. (2) Color gray the name of each stage and its appropriate arrow of progression. *Note that in interphase, the chromatin material* within the nuclear membrane is in a thread-like state; color over the entire area with the appropriate color. Note that the starting chromatin (D* in interphase) is colored differently in the daughter cells (E², F²); it is the same chromatin.

CELL MEMBRANE A yellow/peach
NUCLEAR MEMBRANE B white
NUCLEOLUS C white
CHROMATIN D*/CHROMOSOME D' green
CHROMATID E/CHROMOSOME E' blue
CHROMATIN E².
CHROMATID F/CHROMOSOME F' red
CHROMATIN F².
CENTROMERE G black
CENTRIOLE H brown
[redacted] I
SPINDLE J orange

The ability to reproduce its kind is a characteristic of living things. Cells reproduce in a process of duplication and division called mitosis. Epithelial and connective cells reproduce frequently; mature muscle cells not so frequently; mature nerve cells rarely if at all. Overactive mitoses may result in the formation of an encapsulated tumor; uncontrolled mitoses, associated with invasiveness and metastases, is called cancer.

As the main cellular changes during mitosis occur in the nucleus and surrounding area, only these parts of the cell are illustrated here. We are showing here how the nuclear chromatin (diffuse network of DNA and related protein), once duplicated, transforms into 46 chromosomes which divide into paired subunits (92 chromatids), and how those chromatids separate and move into opposite ends of the dividing cell, forming the 46 chromosomes of each of the newly formed daughter cells. For clarity, we show only 4 pairs of chromatids and chromosomes. The phases of the observed nuclear changes during mitosis are:

Interphase: the longest period of the reproductive cycle; the phase between successive divisions. Duplication of DNA (in chromatin) occurs during this phase. The dispersed chromatin (D*) here is a network of fine fibrils, not visible as discrete entities in the nucleoplasm. The cell membrane, nucleus, and nucleolus are intact. The centrioles are paired and adjacent to one another at one pole of the cell.

Prophase: the dispersed chromatin (D*) thickens, shortens, and coils to form condensed chromatin or chromosomes (D'*). Each chromosome consists of 2 chromatids (E and F) connected by a centromere (G). Each chromatid has the equivalent amount of DNA of a chromosome. In the latter part of this phase, the nuclear membrane breaks up and dissolves, as does the nucleolus. The centrioles, having duplicated during interphase, separate, each pair going to opposite poles of the cell. They project microtubules called asters.

Metaphase: strands of spindle fibers project across the cell center from paired centrioles. The chromatids attach to the spindle fibers at the centromere, and line up in the center, half (46) on one side, half (46) on the other.

Anaphase: the centromeres divide, each daughter centromere attached to one chromatid. Each centromere is drawn to the ipsilateral pole of the cell, along the track of the spindle fiber, and taking its chromatid with it. The separated chromatids now constitute chromosomes. Anaphase ends when the daughter chromosomes arrive at their respective poles (46 on each side).

Telophase: here the cell pinches off in the center, forming 2 daughter cells, each identical to the mother cell. The cytoplasm and organelles had duplicated earlier and are segregated each into their respective newly-forming cells. As the nucleus is reconstituted, and the nuclear membrane and nucleolus reappear in each new cell, the chromosomes fade into dispersed chromatin and the centromere disappears. Complete cleavage of the parent cell into daughter cells terminates the mitotic process. Each daughter cell enters interphase to start the process anew. The process of cell division serves to increase cell numbers, not change cellular content.