

Introduction

All cells undergo a process of growth and division called the cell cycle. The cell cycle consists of three major stages: interphase, mitosis, and cytokinesis. During interphase, the cell grows and, at the end, the cell's DNA replicates. Most of a cell's life is spent in interphase. The next phase is mitosis, during which the replicated genetic material separates into two separate nuclei. Mitosis is further divided into four stages: **prophase, metaphase, anaphase, and telophase**. Two identical nuclei result from mitosis. Cytokinesis, the last stage of cell division, is the division of the cell cytoplasm between the two newly forming cells. The completion of the cell cycle results in the formation of two genetically identical daughter cells from the division of a parent cell. In this lab, you will study and compare mitosis in animal and plant cells. You will also identify cells in the different stages of mitosis.

Materials

- prepared slides of onion root tips (longitudinal sections)
- compound light microscope

Mitosis in Plant Cells

Procedure

1. Observe a prepared slide of a longitudinal section of an onion root tip. Use low power to locate the region of actively dividing cells near the end of the root. Then using high power, examine individual cells in the region. Find a cell from each stage of mitosis using the descriptions in the list below. In the space next to each description, draw a cell in that stage as it appears on your slide.

Interphase

This is the phase of normal cell activity. During interphase, individual chromosomes cannot be distinguished. Instead, they appear as a dark mass of material called chromatin. The DNA of each chromosome replicates at the end of this stage. Note the nucleus with one or more dark-stained nucleoli filled with chromatin.

Prophase

In this stage, the chromatin appears as a mass of thick threads. These threads are the replicated chromosomes, which have coiled up and shortened. Each chromosome now consists of a pair of sister chromatids, which are duplicates of the original chromosome. The chromatids are held together by a centromere. In late prophase, the nuclear membrane and nucleoli cannot be seen, but the chromosomes are distinctly visible as pairs of chromatids in the central region of the cell.

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Metaphase

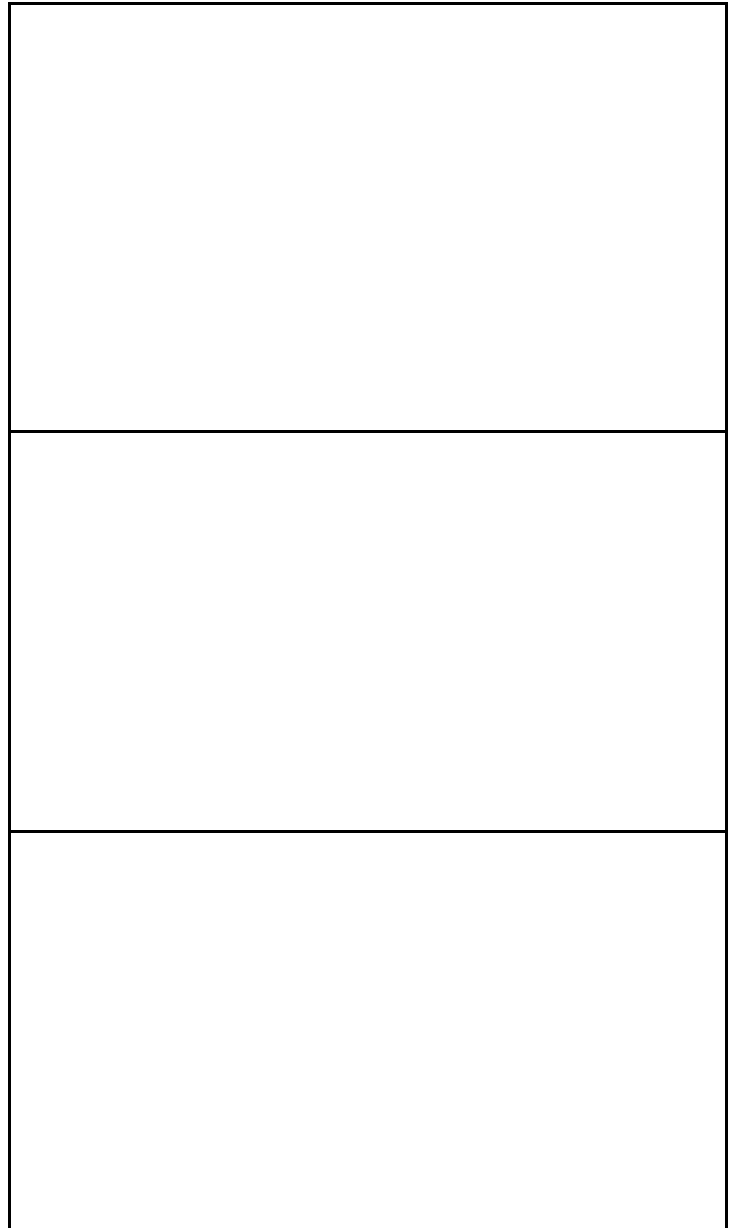
In this stage, the chromosomes line up across the equator of the cell. A mass of fibers called a spindle apparatus has formed between the poles of the cell. Each pole consists of a centrosome, but unlike animals, the centrosome lacks centrioles. A spindle fiber from each pole attaches to each chromosome (pair of chromatids). These fibers are called the kinetochore fibers. Some of the spindle fibers run from pole to pole without attaching to the chromosomes. These fibers are called polar fibers.

Anaphase

In this stage, the centromere that was holding the two sister chromatids together separates. The chromosomes are pulled by the kinetochore fibers toward the poles of the cell. Each sister chromatid is now known as an individual chromosome.

Telophase

In this stage, the chromatids (now called chromosomes) have formed distinctive clumps at each pole. A new nuclear membrane forms around each clump of chromosomes, which uncoil and return to the chromatin networks seen in interphase. The nucleoli reappear. In plants, a cell plate develops to form two new, identical daughter cells. Telophase is often associated with the process called cytokinesis.



Observations

1. What is the basic shape of these plant cells?
2. Describe the shape of the chromosomes as they are pulled to the poles during anaphase.
3. What happens during cytokinesis?

4. How many new cells have formed from the parent cell?
5. At the completion of cytokinesis, the two daughter cells are beginning a new cell cycle of their own. What stage of the cell cycle are they entering? *Hint: G₁, S, G₂, M, or C.*

Analysis and Conclusion

1. How does mitosis, not cytokinesis, differ in plant and animal cells?
2. Which phase of mitosis shows the greatest difference between animal and plant cells? Explain your choice.
3. What role do you think mitosis plays in living things?