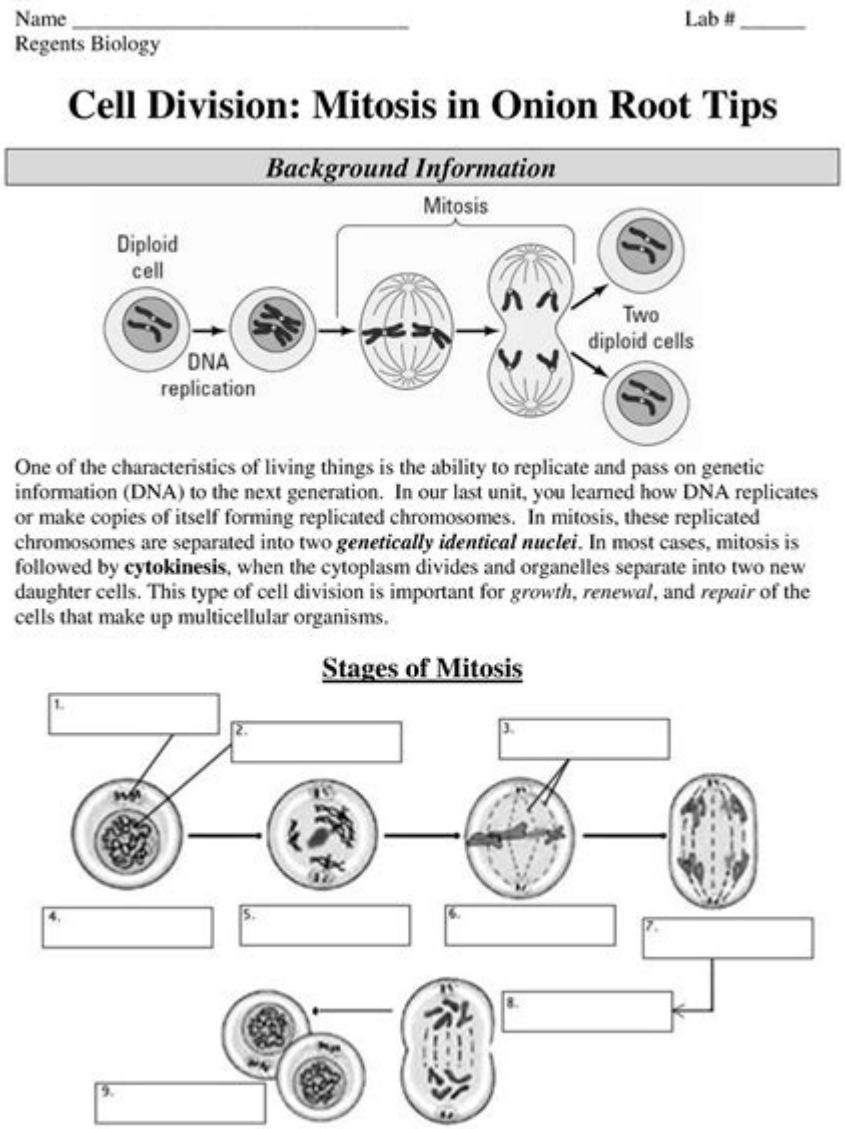
Mitosis In An Onion Root Answer Key



Name _____ Lab # _____
Regents Biology

Cell Division: Mitosis in Onion Root Tips

Background Information

Mitosis
Diploid cell
DNA replication
Two diploid cells

One of the characteristics of living things is the ability to replicate and pass on genetic information (DNA) to the next generation. In our last unit, you learned how DNA replicates or make copies of itself forming replicated chromosomes. In mitosis, these replicated chromosomes are separated into two ***genetically identical nuclei***. In most cases, mitosis is followed by **cytokinesis**, when the cytoplasm divides and organelles separate into two new daughter cells. This type of cell division is important for *growth*, *renewal*, and *repair* of the cells that make up multicellular organisms.

Stages of Mitosis

Mitosis in an onion root answer key is a crucial topic in the study of cell biology, particularly in understanding how cells divide and proliferate. Mitosis is a process of nuclear division that results in two genetically identical daughter cells, each having the same number of chromosomes as the parent cell. This process plays a vital role in growth, development, and tissue repair in multicellular organisms. The onion (Allium cepa) root tip is a commonly used specimen for observing mitosis due to its rapid cell division and well-defined growth zones.

Understanding Mitosis

Mitosis is the process by which a single cell divides to produce two new cells. This division is essential for growth, tissue repair, and asexual reproduction in some organisms. The stages of mitosis can be broadly

categorized into several key phases:

The Stages of Mitosis

1. Prophase:
- Chromatin condenses into visible chromosomes, each consisting of two sister chromatids.
- The nuclear envelope begins to break down.
- The mitotic spindle starts to form from centrosomes.

2. Metaphase:
- Chromosomes align along the metaphase plate (the cell's equatorial plane).
- Spindle fibers attach to the centromeres of the chromosomes.

3. Anaphase:
- Sister chromatids are pulled apart toward opposite poles of the cell.
- The cell begins to elongate as the chromatids are separated.

4. Telophase:
- Chromosomes reach the poles and begin to de-condense back into chromatin.
- The nuclear envelope re-forms around each set of chromosomes.
- The mitotic spindle disintegrates.

5. Cytokinesis:
- This is not a phase of mitosis itself but occurs concurrently with telophase.
- The cytoplasm divides, resulting in two separate daughter cells.

Why Use Onion Roots for Observing Mitosis?

Onion root tips are an ideal model for studying mitosis for several reasons:

- Rapid Growth: Onion roots grow quickly, leading to a high frequency of cell division.
- Well-Defined Zones: The root tip contains a region called the meristem, where active cell division occurs, making it easier to find cells in various stages of mitosis.
- Large Cells: Onion cells are large and easy to manipulate under a microscope.

Preparing Onion Root Samples for Microscopic Observation

To observe mitosis in onion roots, specific steps must be followed to prepare the samples:

1. Collecting Onion Root Tips:
- Obtain healthy onion bulbs.
- Use a scalpel or scissors to cut off the root tips, approximately 1 cm in length.

2. Fixation:

- Place the root tips in a fixative solution (such as ethanol-acetic acid) for several hours or overnight to preserve the cellular structures.

3. Staining:
- After fixation, rinse the root tips in water.
- Stain the root tips with a dye (e.g., methylene blue or iodine) to enhance visibility of the chromosomes.

4. Sectioning:
- Cut thin cross-sections of the stained root tips using a microtome or razor blade.

5. Mounting:
- Place the sections on a microscope slide, add a cover slip, and observe under a light microscope.

Identifying Stages of Mitosis in Onion Root Cells

When observing the prepared onion root tip slides under a microscope, you can identify the various stages of mitosis. Here's how to recognize each stage:

Prophase

- Chromosomes appear as distinct structures.
- The nuclear envelope becomes fragmented.
- Spindle fibers start to form.

Metaphase

- Chromosomes are lined up along the metaphase plate.
- Spindle fibers are clearly visible, attached to the centromeres of the chromosomes.

Anaphase

- Sister chromatids are moving apart toward opposite ends of the cell.
- The cell elongates as the chromatids are pulled apart.

Telophase

- Chromosomes begin to de-condense and become less distinct.
- The nuclear envelope re-forms around each set of chromosomes.

Cytokinesis

- The cell membrane pinches inwards, leading to the formation of two separate daughter cells.

Analyzing Mitosis in Onion Root Cells

When analyzing the stages of mitosis in onion root cells, several key observations can be made:

- Frequency of Stages: Count the number of cells in each stage of mitosis to determine the mitotic index, which is the ratio of dividing cells to non-dividing cells.
- Duration of Stages: Some stages may take longer than others; for example, prophase is often longer than anaphase.
- Cellular Characteristics: Examine the structural characteristics of cells in each phase, such as the appearance of chromosomes and the condition of the nuclear envelope.

Importance of Mitosis in Biology

Mitosis is fundamental to life for several reasons:

- Growth and Development: Mitosis allows for the growth of tissues and organs in multicellular organisms.
- Regeneration: Many organisms can regenerate lost parts through mitotic cell division.
- Asexual Reproduction: Some organisms reproduce asexually through mitosis, leading to offspring that are genetically identical to the parent.

Conclusion

In summary, studying mitosis in an onion root provides a clear and practical understanding of the cell division process. By preparing onion root samples and observing them under a microscope, students can identify the distinct stages of mitosis and appreciate the importance of this process in growth, development, and cellular repair. As a model organism, the onion root serves as an excellent educational tool for both students and researchers in the field of biology. Understanding mitosis is essential for grasping broader biological concepts, including genetics, evolution, and the functioning of living organisms.

Frequently Asked Questions

What is mitosis and why is it important in onion root cells?

Mitosis is the process of cell division that results in two genetically

identical daughter cells. It is important in onion root cells for growth and development, allowing the plant to increase its root mass and absorb more nutrients.

How can you observe mitosis in onion root tips?

Mitosis can be observed in onion root tips by preparing a slide with a thin slice of the root, staining it with a dye like methylene blue, and then using a microscope to visualize the stages of mitosis.

What are the main stages of mitosis observed in onion root cells?

The main stages of mitosis observed in onion root cells are prophase, metaphase, anaphase, and telophase, followed by cytokinesis.

How does the duration of mitosis in onion root cells compare to other cell types?

The duration of mitosis in onion root cells is relatively quick, typically taking about 30 minutes, but this can vary depending on the specific cell type and environmental conditions.

What role does the onion root cap play during mitosis?

The onion root cap protects the growing tip of the root as it pushes through the soil. While it doesn’t directly participate in mitosis, it is essential for the growth and protection of the dividing cells behind it.

Why is the onion root tip often used in biology labs to study mitosis?

The onion root tip is often used in biology labs to study mitosis because it has a high rate of cell division, making it easier to observe the various stages of mitosis under a microscope.

What is the significance of using a stain like acetocarmine when observing mitosis in onion root tips?

Using a stain like acetocarmine enhances the contrast of the chromosomes, making them more visible under the microscope, which is crucial for identifying the stages of mitosis.

Can mitosis in onion root cells be affected by environmental factors?

Yes, environmental factors such as temperature, light, and nutrient availability can affect the rate of mitosis in onion root cells, influencing growth and development.

What is cytokinesis and how does it relate to mitosis

in onion root cells?

Cytokinesis is the final step of cell division where the cytoplasm divides, resulting in two separate cells. It follows mitosis in onion root cells, ensuring that each daughter cell contains the necessary organelles and cytoplasmic components.

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