

Lesson C3–3

Examining Mitosis and Meiosis

Unit C. Basic Principles of Agricultural/Horticultural Science

Problem Area 3. Understanding Cells, Genetics, and Reproduction

Lesson 3. Examining Mitosis and Meiosis

New Mexico Content Standard:

Pathway Strand: Natural Resources and Environmental Systems

Standard: VII: Apply scientific principles to environmental services.

Benchmark: VII-E: Perform common microbiology procedures to examine cell types and conduct tests.

Performance Standard: 1. Identify groups of microorganisms. 2. Analyze factors affecting microbial growth. 3. Explain microbial growth. 4. Describe roles of microorganisms in the environment.

Student Learning Objectives. Instruction in this lesson should result in students achieving the following objectives:

1. Define mitosis and discuss its importance.
2. Explain each step of mitosis.
3. Define meiosis and explain its importance.
4. Explain each step of meiosis.

List of Resources. The following resources may be useful in teaching this lesson:

Recommended Resources. One of the following resources should be selected to accompany the lesson:

Lee, Jasper S. and Diana L. Turner. *AgriScience*, Third Edition. Danville, Illinois: Interstate Publishers, Inc., 2003. (Textbook and Activity Manual, Chapter 15)

Other Resources. The following resources will be useful to students and teachers:

Baker, MeeCee and Robert E. Mikesell. *Animal Science Biology & Technology*. Danville, Illinois: Interstate Publishers, Inc., 1996. (Textbook, Chapter 1)

Biondo, Ronald J. and Jasper S. Lee. *Introduction to Plant and Soil Science and Technology*, Second Edition. Danville, Illinois: Interstate Publishers, Inc., 2003. (Textbook and Activity Manual, Chapter 5)

Mader, Sylvia, S. *Biology*. Dubuque, Iowa: Wm. C. Brown Publishers, 1993, (Textbook, Chapter 5)

List of Equipment, Tools, Supplies, and Facilities

Writing surface
Overhead projector
Transparencies from attached masters

Terms. The following terms are presented in this lesson (shown in bold italics):

Anaphase
Centromere
Diploid number
Gametes
Haploid number
Haploid cells
Homologous
Interphase
Meiosis
Metaphase
Mitosis
Ova
Prophase
Spermatozoa
Telophase

Interest Approach. Use an interest approach that will prepare the students for the lesson. Teachers often develop approaches for their unique class and student situations. A possible approach is included here:

Refer students back to Lesson C3–2 Exploring Genetics, Where they learned that new organisms are formed when the sex cells of two separate plants join to form a gamete. Ask the students if they can explain how half of the new gamete’s traits come from each of the parents. Tell them that in this unit they will learn the process cells go through to grow and to reproduce.

Summary of Content and Teaching Strategies

Objective 1: Define mitosis and discuss its importance.

Anticipated Problem: What is mitosis and why is it important?

- I. **Mitosis** is a sequential process of cell division. At the conclusion of mitosis, what was formerly one cell becomes two. This process is repeated over and over during the life of the organism.
 - A. Mitosis is cell division for growth and repair. This process involves the division of cells that make up the plant body, which consists of the roots, stem, leaves, and flower parts.
 - B. This process is continually occurring. It is extremely important because this is how organisms grow and repair damaged parts. Without mitosis plant growth could not occur.

Use a variety of techniques to help students master this objective. Students should use text materials to help understand the importance of mitosis. Chapter 15 of AgriScience is recommended.

Objective 2: Explain each of the steps of mitosis.

Anticipated Problem: What are the steps of mitosis and what happens in each?

- II. Mitosis is divided into four periods or steps. They are:
 - A. **Prophase** is the stage of chromosome replication. This step follows the period of rest called *interphase*.
 - B. **Metaphase** is the step in which the chromosomes formed in prophase move to the middle of the cell. These chromosomes line up along the equator of the cell.
 - C. The third stage, **anaphase**, is where the chromosomes separate and move to opposite sides of the cell. Shortening spindle fibers separate the chromosomes.
 - D. In **telophase**, the nucleus reforms and a membrane appears between each mass of chromosomes. This newly formed membrane divides the cytoplasm. Once this is completed, the two separate cells repeat the process.

Use a variety of techniques to help students master this objective. Students should use text materials to help understand the process of mitosis. Chapter 15 of AgriScience is recommended. Use TM: C3–3A to aid in reinforcing this objective to students.

Objective 3: Define meiosis and explain its importance.

Anticipated Problem: What is meiosis and why is it important?

- II. *Meiosis* is the division of cells in the reproductive process.
 - A. **Haploid cells** are the cells that are produced as a result of meiosis. These cells have only single chromosomes rather than the **homologous** or matching pair. These cells are known as **gametes**. Male gametes are called **spermatozoa**. Female gametes are known as **ova**.
 - B. Meiosis is also a very important and necessary process. During this process, the sex cells for the organism are produced. Without these sex cells, the organism could not reproduce. If an organism cannot reproduce, that species will become extinct.

Use a variety of techniques to help students master this objective. Students should use text materials to help understand the process of mitosis. Chapter 15 of AgriScience is recommended.

Objective 4: Explain each of the steps of meiosis.

Anticipated Problem: What are the steps of meiosis and what occurs in each?

- IV. Meiosis occurs in two stages, Meiosis I and Meiosis II, with each stage containing four steps.
 - A. Meiosis I is very similar to mitosis. The four steps of meiosis I are:
 - 1. Prophase I is the step in which thread-like fibers form. Homologous chromosome pairs are located together and DNA, which was replicated at the end of interphase, is present.
 - 2. Metaphase I is when the chromosomes align at the equator of the cell with the spindle fibers attached from the **centromere** to the poles of the cell. The centromere is where two chromatids are attached.
 - 3. In anaphase I the centromere does not duplicate. The shortening spindle fibers pull the paired chromosomes to the poles of the cell. This is the stage in which the chromosome number is cut in half.
 - 4. The fourth and final step of Meiosis I is telophase I. In this step, the chromosomes are still joined and contain the **haploid number**, or half the original chromosome number. Two daughter cells are produced when the nucleus reforms.
 - B. After the four steps of Meiosis I, Meiosis II begins. The four steps of Meiosis II are:
 - 1. The first step is prophase II. In this step, spindle fiber formation begins. The main difference between prophase I and prophase II is that DNA does not replicate before prophase II.

2. Prophase II is followed by metaphase II. Here chromatids align at the equator of the cell with spindle fibers attached.
 3. Anaphase II begins when the centromere duplicates. This divides the chromosomes so that each half is pulled to a pole by the spindle fibers.
 4. In telophase II a cell membrane forms between the developing nuclei. Cytokinesis occurs and four daughter cells are formed containing the haploid number of chromosomes.
- C. The cells produced during meiosis, spermatozoa (male) and ova (female) are for sexual reproduction. When the egg and sperm join, a new organism is formed with the **diploid number** of chromosomes.

A variety of techniques can be used to help students master this objective. Students should use text materials to help understand the process of mitosis. Chapter 15 of AgriScience is recommended. Use TM: C3–3B to aid in discussing this objective with your students.

Review/Summary. Use the student learning objectives to summarize the lesson. Have students explain the content associated with each objective. Students' responses can be used in determining which objectives need to be reviewed or retaught using a different teaching strategy. Questions at the end of each chapter in the recommended textbooks may also be used in the review/summary.

Application. Application can involve the following student activity:

Observe Stages of Mitosis – Chapter 15 of the *AgriScience* Activity Manual.

Answers to Sample Test:

Part One: Matching

1=h,2=b,3=e,4=d,5=c,6=j,7=a,8=f,9=g,10=i

Part Two: Completion

11. Prophase I
12. Meiosis
13. Meiosis I, Meiosis II
14. Interphase

Part Three: Short Answer

15. a) Prophase; b) Metaphase; c) Anaphase; d) Telophase

Test

Lesson C3–3: Examining Mitosis and Meiosis

Part One: Matching

Instructions. Match the term with the correct response. Write the letter of the term by the definition.

- | | | |
|------------------|-------------------|----------------|
| a. homologous | e. mitosis | i. spermatozoa |
| b. cell membrane | f. haploid cells | j. ova |
| c. anaphase | g. centromere | |
| d. meiosis | h. haploid number | |

- _____ 1. Half the original chromosome number.
- _____ 2. Outside covering of a cell.
- _____ 3. Cell division in which the daughter cells are exactly like the parent cells.
- _____ 4. Cell division in which the daughter cells contain half the number of chromosomes as the parent cells.
- _____ 5. Where the chromosomes separate and move to opposite sides of the cell.
- _____ 6. Female sex cell.
- _____ 7. Matching pair.
- _____ 8. The cells that are produced as a result of meiosis.
- _____ 9. Point of attachment between two chromatids.
- _____ 10. Male sex cell.

Part Two: Completion

Instructions. Provide the word or words to complete the following statements.

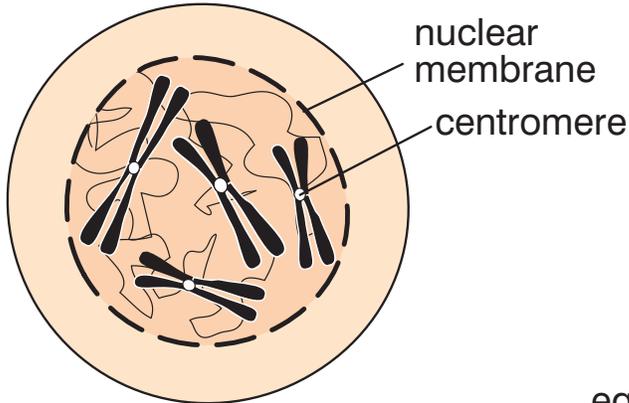
11. _____ is the step in which thread-like fibers form.
12. _____ is the division of cells in the reproductive process.
13. Meiosis occurs in two stages, _____ and _____, with each stage containing four steps.
14. The period of rest is called _____.

Part Three: Short Answer

Instructions. Provide information to answer the following questions.

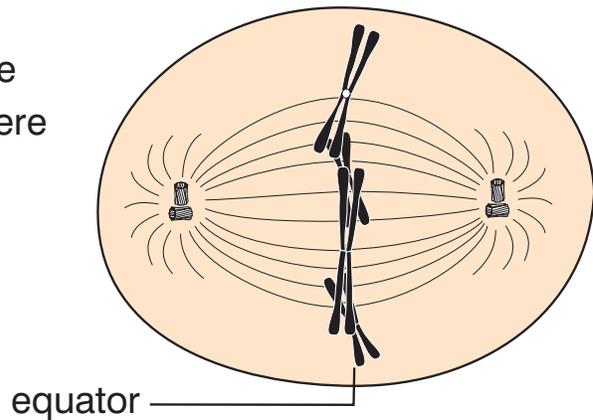
15. List the four stages of Mitosis, in order.
- a.
 - b.
 - c.
 - d.

PROPHASE



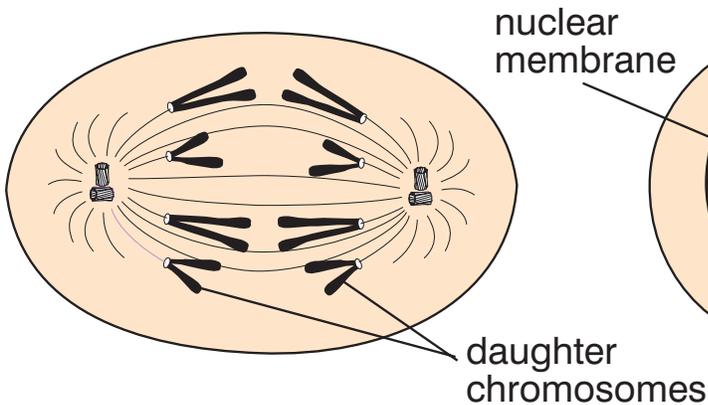
Chromosomes visible.
Nuclear membrane fragments.

METAPHASE



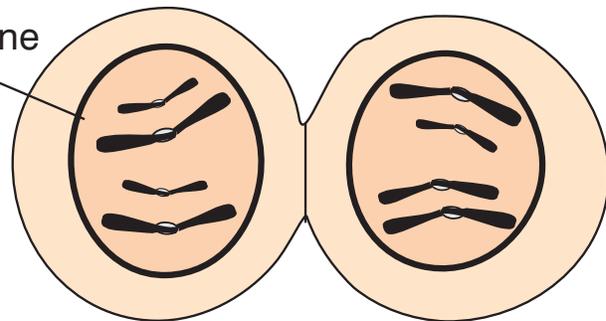
Duplicated chromosomes
are aligned at equator.
One half of each pair of
sister chromatids attach to
spindle fibers.

ANAPHASE



Daughter chromatids separate
and move toward each pole.

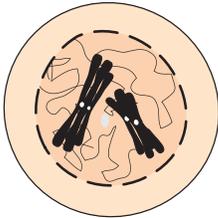
TELOPHASE



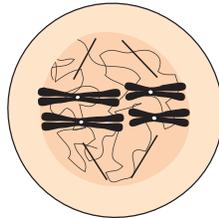
Nuclear membranes reform.
Two new cells are separated.

MEIOSIS I

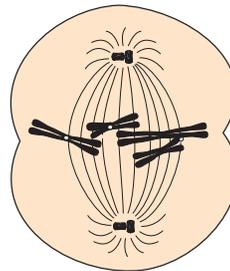
PROPHASE I



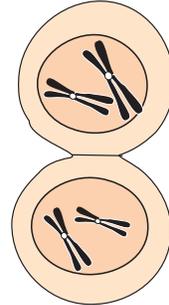
METAPHASE I



ANAPHASE I

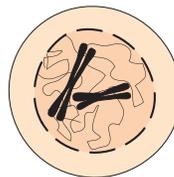


TELOPHASE I



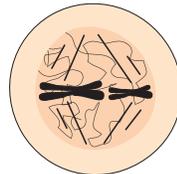
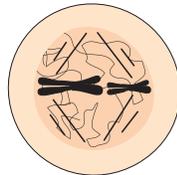
MEIOSIS II

PROPHASE II



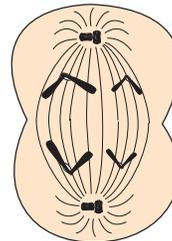
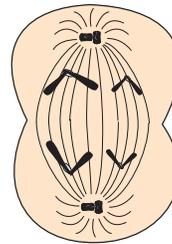
Chromosomes still duplicated.
Nuclear membrane fragments.

METAPHASE II



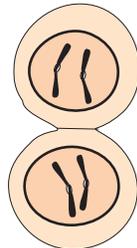
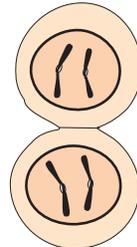
Chromosomes aligned at equator.

ANAPHASE II



Chromatids divide. Chromosomes move toward poles.

TELOPHASE II (gametes)



Nuclear membrane reforms. Meiosis completed.