



uBEATS Teacher's Guide:

Cell Division: Mitosis and Meiosis (Grades 9-10)

This teacher guide is a supplementary text to support the use of the uBEATS “Cell Division: Mitosis and Meiosis” module for grades (9-10).

To help students develop the knowledge necessary for an incredible future in health care, we created UNMC Building Excellence in Academics Through STEM (uBEATS), an online health science resource for Nebraska students.

UNMC uBEATS modules are short (15 minutes or less), interactive online health science modules to supplement curriculum taught in grades 6 – 12. These do not replace curriculum but are a supplement for teachers and students incorporating evidence-based information and UNMC expert guided material. Each module is chunked into sections with formative and summative assessments with immediate feedback provided.

Tips on how to utilize uBEATS modules:

- Internet access is required to view uBEATS modules.
- For those who have access to one-to-one technology, modules can be used in or outside of the classroom as a topic introduction, extension, or review.
- For classrooms without individual student devices modules can be used in whole group instruction. Formative assessment questions can use the teacher's preferred call and response method and summative assessment questions can be displayed on the board and answered individually by students or printed and distributed to students after viewing the module.

Objectives

- Describe the process of mitosis as a part of cell division.
 - Explain the importance of meiosis in helping to increase species diversity (including recombination and random assortment of chromosomes).
 - Compare and contrast mitosis vs. meiosis.
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Introduction

How do organisms grow and develop?

“Ontogeny recapitulates Phylogeny.” Old professors would often repeat this phrase. In this module you will learn about the cell cycle and the replication of cells through mitosis and meiosis. By understanding the simplicity of mitosis, and the intricacy that meiosis brings to species diversity, a person will begin to understand that phrase.

Prior Knowledge

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Before beginning this module, the student should understand the Grade Band Endpoints for LS3.A. [A Framework for K-12 Science Education.](#)

- **By the end of grade 8.** Organisms reproduce, either sexually or asexually, and transfer their genetic information to their offspring. Animals engage in characteristic behaviors that increase the odds of reproduction. Plants reproduce in a variety of ways, sometimes depending on animal behavior and specialized features (such as attractively colored flowers) for reproduction. Plant growth can continue throughout the plant's life through production of plant matter in photosynthesis. Genetic factors as well as local conditions affect the size of the adult plant. The growth of an animal is controlled by genetic factors, food intake, and interactions with other organisms, and each species has a typical adult size range.

Key Terms/Vocabulary

Ontogeny, phylogeny, recapitulation, cell cycle, cell division, nuclear membrane, chromosome, gene, chromatid, sister chromatid, mitotic spindle, centrosome, microtubule, interphase, G₀ gap phase (resting phase), G₁ gap phase (growth phase), S phase (synthesis phase), proteins, organelles, DNA replication, G₂ gap phase, mitosis, prophase, prometaphase, metaphase, metaphase plate, spindle pole, anaphase, telophase, cytoplasm, cytokinesis, mother cell, daughter cell, apoptosis, meiosis I, meiosis II, gamete, sperm, egg, diploid, haploid, reduction division, homologous, recombination,



Science Standards

Nebraska's College and Career Ready Standards for Science 2017

- Structure and Function in Living Things: SC.HS.6.1.D [Nebraska Science Standards](#)

Next Generation Science Standards (NGSS) featuring [Three-Dimensional Learning](#)

Core Idea LS1.B: Growth and Development of Organisms [A Framework for K-12 Education](#)

- In multicellular organisms individual cells grow and then divide via a process called mitosis, thereby allowing the organism to grow. The organism begins as a single cell (fertilized egg) that divides successively to produce many cells, with each parent cell passing identical genetic material (two variants of each chromosome pair) to both daughter cells. As successive subdivisions of an embryo's cells occur, programmed genetic instructions and small differences in their immediate environments activate or inactivate different genes, which cause the cells to develop differently—a process called differentiation. Cellular division and differentiation produce and maintain a complex organism, composed of systems of tissues and organs that work together to meet the needs of the whole organism.
- In sexual reproduction, a specialized type of cell division called meiosis occurs that results in the production of sex cells, such as gametes in animals (sperm and eggs), which contain only one member from each chromosome pair in the parent cell.

Extensions of the lesson

- To help students become more familiar with the Key Terms of this module, the teacher can use the vocabulary list for a classroom Word Wall or integrate the vocabulary into classroom word games during review sessions.
- As student misconceptions become apparent, the teacher may need to reinforce these important concepts:
 - Ontogeny is the development of an individual organism from fertilization to final maturity. On the other hand, phylogeny is the evolutionary history of a species. During the nineteenth century, as biologists became engrossed in the exciting study of embryonic development, similarities between both processes were identified. While modern researchers no longer believe that a developing individual successively mirrors all of the adult forms of its evolutionary ancestors, we are now captivated by the fact that mitosis and meiosis provide the mechanisms for both sameness and diversity, as cells replicate during the development of new individuals (ontogeny) as well as during the evolution of new species (phylogeny).
 - Mitosis is the cell division that makes new cells and ensures that those new cells have the same DNA as the original cell.
 - During an individual's ontogeny, even though all new cells throughout the body have the same DNA as the original fertilized egg, different kinds of cells develop by way of cell differentiation, during which the genes within the DNA are turned on or off as needed for each kind of cell.



- Meiosis, the other kind of cell division, does not occur all over the body—it only happens in the reproductive glands. Meiosis does not produce new cells having identical DNA—meiosis guarantees that none of the unique resulting cells can have the same identical DNA as the original cell.
- Mitosis and meiosis cause each generation to have the same kinds of developmental characteristics as their parents, but over many, many generations, new branches develop on the phylogenetic tree.

Enrichment

- For information about health-related career opportunities, see UNMC's [Careers in Healthcare](#).
- For information about careers in microbiology, look at <https://collegegrad.com/careers/microbiologists>.
- Students should be watchful in current events for recent news about reproductive technology, birth defects, family relationships, and considerations of race.
- To make connections in your community, contact local universities, hospitals, healthcare clinics, nurses, doctors, zoo.
- To see a simple comparison of meiosis and mitosis, see [Amoeba Sisters](#).
- To view a 5-minute animation of meiosis, see [Meiosis](#).
- To view a 5-minute animation of mitosis, see [Mitosis](#).
- Biology Crash Course #12 explains the process of mitosis: [Splitting Up is Complicated](#).
- For a lab activity viewing stages of mitosis, try [Biology Junction Mitosis](#).