

Greatest Discoveries With Bill Nye: Biology

Teacher's Guide

Grade Level: 6–8

Curriculum Focus: Life Sciences

Lesson Duration: One to two class periods

Program Description

The Science of Microbiology – Learn about prokaryotes, eukaryotes, archaea, and the beginnings of microbiology. *The Division of Cells* – Examine the different processes involved in cell division and see how new research on embryonic stem cells may create changes in the future of medical science. *Changing Food to Energy* – Learn about mitochondria and see how your body converts food to useable energy. *Controlling Systems: Hormones and Nerves* – See how chemicals help your nervous system work and learn about naturally occurring hormones in the human body. *Connected Systems: Biodiversity, Ecosystems, and Ecology* – Explore the many connections between the humans, plants, and animals coexisting on planet Earth.

Discussion Questions

- How does the central nervous system work?
 - Describe the three primary kingdoms used to classify life.
 - How does cell division occur? What is unique about meiosis?
 - How do humans affect life on Earth?
 - What is biodiversity?
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Video Index

Segment 1: The Science of Microbiology (9 min.)

Description

For years, scientists assumed there were two primary kingdoms of living organisms, but that changed in the 1970s. Learn about prokaryotes, eukaryotes, and archaea – and about the beginnings of microbiology.

Pre-viewing question

Q: What have you used a microscope?

A: Answers will vary.

Post-viewing question

Q: Why is the discovery of archaea significant?

A: Archaea are single-celled organisms with unique cell walls and a genetic sequence unlike any other that can live anywhere, even in extreme climates. The addition of them as a third category of microbes changed the science of microbiology, which had had been founded on the notion that all microbes either prokaryotes (organisms without a nucleus) or eukaryotes (every other living organism).

Segment 2: Cell Division (11 min.)

Description

Examine the processes involved in cell division. See how new research on embryonic stem cells may alter the future of medical science.

Pre-viewing question

Q: What do you know about stem cell research?

A: Answers will vary.

Post-viewing question

Q: Describe the processes of mitosis and meiosis.

A: In the process of mitosis, a plant or animal cell duplicates itself. A cell divides into two identical cells, called daughter cells. Meiosis is a process of cell division that occurs in organisms that reproduce sexually. The cell nucleus divides into four nuclei, each of which contains half the usual number of chromosomes. Meiosis ensures that when a sperm and ovum join, the chromosomes are not doubled in the next generation of life.

Segment 3: From Food to Energy (6 min.)

Description

Discover how cells convert food into energy. Learn about mitochondria and about how your body uses these “power plants” for respiratory control.

Pre-viewing question

Q: What helps keep your body functioning during physical activity?

A: Answers will vary.

Post-viewing question

Q: What are mitochondria, and how do they function?

A: Mitochondria are tiny, usually round or rod-shaped bodies located inside most cells. They produce ATP, a chemical compound that provides energy to cells. Without this energy, cells could not work and our bodies could not function.

Segment 4: Hormones and Nerves (6 min.)

Description

See how naturally occurring chemicals help the nervous system. Discover the important roles hormones play in the development and functions of the human body.



Pre-viewing question

Q: Name some hormones, and describe how they affect your brain and body.

A: Answers will vary.

Post-viewing question

Q: What role do chemicals play in the functions of the nervous system?

A: Chemicals allow the electrical impulses to jump from one neuron (a cell that transmits electrical impulses through the nervous system) to another, so messages from the brain and central nervous system reach different parts of the body.

Segment 5: Biodiversity and Ecosystems (11 min.)

Description

Earth has a variety of ecosystems, yet all life on our planet is interconnected in some way. Explore the many connections among humans, plants, and animals on planet Earth.

Pre-viewing question

Q: What is photosynthesis?

A: Answers will vary.

Post-viewing question

Q: What do you think would happen to humans if tropical biodiversity disappeared?

A: Answers will vary.

Lesson Plan

Student Objectives

- Describe cell division.
- Identify the stages of mitosis in an onion root.
- Demonstrate an understanding of the differences and similarities between mitosis and meiosis.

Materials

- *Greatest Discoveries With Bill Nye: Biology* program
- Prepared slides of the tip of an onion root, 1 per lab group (the slides should contain a piece of the very bottom of an onion root, about the last ¼ of an inch, stained and dyed)
- Microscope, 1 per lab group
- Science journals or paper
- Crayons, markers, or colored pencils
- Computer with Internet access (optional)



Procedures

1. Use *Greatest Discoveries With Bill Nye: Biology* to introduce the concept of cell division to your class. After watching the program, discuss mitosis and meiosis. How do cells divide? What is the difference between mitosis and meiosis? What kinds of cells divide through meiosis?
2. Describe the stages of mitosis to the class and discuss how to identify the four main stages of mitosis – prophase, metaphase, anaphase, and telophase – as well as interphase, which is still an important part of cell division, although not technically part of mitosis. Ask students some these comprehension questions to make sure they understand the concepts: What happens to cell chromosomes during mitosis? What happens during prophase? During metaphase? How would you identify anaphase and telophase in a cell?
3. Divide students into lab groups of 2 or 3 and explain that they will observe slides of onion root cells under a microscope to identify the different stages of mitosis. Tell students that they will draw diagrams and describe each stage of mitosis based on what they observed.
4. Set up each lab group at a microscope station and give them the prepared slides of the onion roots. Make sure they have their notes on mitosis available to help them identify the stages. Tell the groups to be sure their microscopes are set on high before observing their slides; the stages are difficult to see under lower settings. Once students are ready, give them time to take turns observing the slides.
5. As students examine the slides, walk around the classroom to make sure they can identify the stages of mitosis. The following Web sites identifying the stages of mitosis may provide additional help:
 - http://www.biology.arizona.edu/cell_bio/tutorials/cell_cycle/cells3.html
 - http://www.biology.arizona.edu/cell_bio/activities/cell_cycle/activity_description.html
 - http://biog-101-104.bio.cornell.edu/BioG101_104/tutorials/cell_division/onion_review_fs.html
6. As students observe the slides, ask them to share their observations. Describe prophase. What is happening inside the cell during this stage? Describe the other stages. What is happening in the cell during these stages? How can interphase be identified?
7. Have students draw diagrams of the stages of mitosis in science journals or on a piece of paper, and ask them to write their own description of each stage. Ask volunteers to share their diagrams and descriptions.
8. After the lab work, discuss what students have learned about mitosis. Make sure they have a good grasp of mitosis before discussing the process of meiosis and its unique form of cell division.
9. Discuss meiosis, including its differences and similarities to mitosis. If time permits, have students to examine the following Web site to further explore and compare the processes of mitosis and meiosis:
 - <http://www.accessexcellence.org/RC/VL/GG/comparison.html>



Assessment

Use the following three-point rubric to evaluate students' work during this lesson.

- **3 points:** Students were highly engaged in class discussions; were highly focused and enthusiastically participated in the lab investigation; were able to identify the stages of mitosis under a microscope; drew accurate diagrams of each stage of mitosis; used their own words to write accurate descriptions of each stage of mitosis; and were able to demonstrate a solid understanding of the differences and similarities between mitosis and meiosis.
- **2 points:** Students were somewhat engaged in class discussions; were somewhat focused and generally participated in the lab investigation; were able to identify at least three stages of mitosis under a microscope; drew accurate diagrams of at least three stages of mitosis; used their own words to write somewhat accurate descriptions of each stage of mitosis; and were able to demonstrate a basic understanding of the differences and similarities between mitosis and meiosis.
- **1 point:** Students were unfocused and not engaged in class discussions; minimally participated in the lab investigation; were able to identify two or fewer of the stages of mitosis under a microscope; drew incomplete diagrams of each stage of mitosis or complete diagrams of two or fewer of the stages; wrote inaccurate descriptions of each stage of mitosis or wrote two or fewer accurate descriptions; and were unable to demonstrate an understanding of the differences and similarities between mitosis and meiosis.

Vocabulary

cell biology

Definition: The study of the internal workings of cells at the microscopic and molecular level

Context: Some discoveries in cell biology have led to medical breakthroughs.

chromosome

Definition: A structure in a cell nucleus that consists of genes

Context: Innovations helped science identify chromosomes, structures that carry hereditary characteristics in the nucleus of every cell.

meiosis

Definition: Cell division that produces reproductive cells in sexually reproducing organisms

Context: August Weismann identified meiosis as sex cells that divided and ended with only half of a chromosomal set.

mitosis

Definition: Cell division in which the nucleus divides into nuclei containing the same number of chromosomes

Context: Walther Fleming discovered and named the process of mitosis.



nucleus

Definition: A small flexible sac within a cell that contains the cell's genetic material; the control center of a cell

Context: The nucleus functions as a cell's brain.

Academic Standards

National Academy of Sciences

The National Academy of Sciences provides guidelines for teaching science in grades K–12 to promote scientific literacy. To view the standards, visit this Web site:

<http://books.nap.edu/html/nse/html/overview.html#content>.

This lesson plan addresses the following science standards:

- Science as Inquiry: Understanding about scientific inquiry; Abilities necessary to do scientific inquiry
- Life Science: The cell; Structure and function in living systems; Characteristics of organisms
- Science and Technology: Understanding about science and technology
- History and Nature of Science: History of science; Historical perspectives; Science as a human endeavor

Mid-continent Research for Education and Learning (McREL)

McREL's Content Knowledge: A Compendium of Standards and Benchmarks for K-12 Education addresses 14 content areas. To view the standards and benchmarks, visit

<http://www.mcrel.org/compendium/browse.asp>

This lesson plan addresses the following national standards:

- Science – Life Sciences: Understands the structure and function of cells and organisms
 - Science – Nature of Science: Understands the nature of scientific knowledge; Understands the nature of scientific inquiry
 - Language Arts – Viewing: Uses viewing skills and strategies to understand and interpret visual media
 - Language Arts – Writing: Uses the general skills and strategies of the writing process
 - Technology – Understands the relationships among science, technology, society, and the individual; Understands the nature and uses of different forms of technology
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Support Materials

Develop custom worksheets, educational puzzles, online quizzes, and more with the free teaching tools offered on the Discoveryschool.com Web site. Create and print support materials, or save them to a Custom Classroom account for future use. To learn more, visit

- <http://school.discovery.com/teachingtools/teachingtools.html>
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