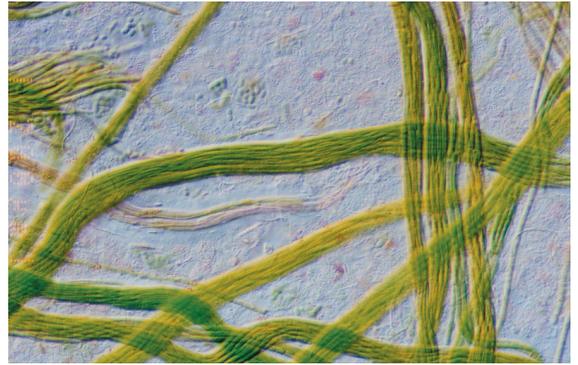


Science Lesson Plan: Day One Microscope Activity

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Background

Living systems at all levels of organization demonstrate the complementary nature of structure and function. Different kinds of microbes in microbial mats look different under the microscope. Scientists refer to the overall shape of the organisms as their “morphology”. Bacteria cell structures differ from other organisms because they do not contain nuclei. Because bacteria are so small, it is difficult to observe cell structure without a high-powered microscope. Cyanobacteria, however, which are present in most photosynthetic microbial mats, are relatively large bacteria. Students may view the general shape of bacteria, including cyanobacteria, under a school microscope and subsequently refer to pictures provided in the image gallery to gain an understanding of cell structure.



A compound microscope view of microorganisms in a microbial mat. Photo credit: Leslie Profert-Bebout

Main Concept

There is a great deal of diversity in the morphology of bacteria, especially cyanobacteria, in a microbial mat varies by organism. Bacteria cell structures differ from other organisms.

Scientific Question

What is the morphology of cyanobacteria living in microbial mats and how do their cell structures differ from other organisms?

Objectives

- 1 The student will use a microscope to observe cyanobacteria.
- 2 The student will identify cyanobacteria that can be found in a microbial mat.

Abstract of Lesson

Using cyanobacteria ordered from a biological supply store, students will observe cyanobacteria under the microscope and draw the organisms. Pictures of organisms in the mat are included. If microscopes are not available for student use, pictures of cyanobacteria, diatoms, purple sulfur bacteria, and colorless sulfur bacteria are included for observation. Detailed pictures of cyanobacteria cell structure are also available.

Prerequisite Concepts

1. Students should be familiar with proper microscope usage procedures.

Major Concepts

1. Bacteria structure “morphology” varies by organism.
2. Bacteria cell structure is different from other organisms since they do not have nuclei.

Misconceptions

1. Cyanobacteria are plants or algae because they contain chloroplasts. Cyanobacteria do not contain chloroplasts, rather they have loose thylakoid membranes inside their cell wall. Plants received chloroplasts as a result of an endosymbiotic event in which cyanobacteria were engulfed by an organism ancestral to plants. In this way, cyanobacteria actually *became* the chloroplast we find in plants today.

National Education Standards

Fully Met	Partially Met	Addressed
	NSES C4(5-8): Structure and Function in Living Systems a, b	
	2061: 5A(6-8) #1, #3 2061: 5C(6-8) #1	

California Science Standards

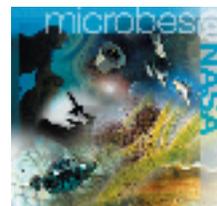
Fully Met	Partially Met	Addressed
		Grade 7:Cell Biology #1a, b

Reading on Topic Related to Study

A book that can be purchased is: Margulis, Lynn and Dorion Sagan, *The Microcosmos Coloring Book*, New York: Harcourt Brace Jovanovich, Publishers, 1988.

Materials List

1. Microscopes (100X) for students to view internal structures, otherwise view bacteria using microscopes at 20X to 40X magnification (enough for student lab groups) and show cell structure using pictures.
2. Pictures of bacteria and organisms titled “Life in a Microbial Mat” from the Microbial Mat Investigations lesson plans.
3. Pictures of cyanobacteria cell structure from the image gallery on the Microbes @ NASA website <http://microbes.arc.nasa.gov/>
4. Cyanobacteria cultures ordered in advance from a biological supply company:
 - *Gloecapsa*
 - *Lyngbya*
 - *Oscillatoria*
 - *Phormidium*
 - *Spirulina*
5. Diatoms ordered from a biological supply company
6. Media to keep cultures alive ordered from a biological supply company
7. Microscope slides
8. Cover slips
9. Pipettes
10. White paper for drawing
11. Colored pencils
12. Access to micro*scope from the Image Gallery of the Microbes@NASA Web Page <http://microbes.arc.nasa.gov>



Preparation

1. Order cyanobacteria and diatoms in advance so that they arrive several days before classroom observation.
2. Arrange microscopes, slides, cover slips, and pipettes for lab use.
3. Review microscope use procedures with the class.

Note: The cyanobacteria ordered for this activity are freshwater, except for *Spirulina*. The microbial mats studied in the unit are marine, however; the freshwater bacteria ordered also have marine varieties that are present in mats. Not all of the cyanobacteria in the mats are available for purchase. Therefore, pictures of *Microcoleus*, purple sulfur bacteria, sulfur bacteria and colorless sulfur bacteria are available to display. micro*scope at the Marine Biological Laboratory in Woods Hole, Massachusetts is preparing pictures of organisms found in microbial mats. Check the link to this page at <http://microscope.mbl.edu/>, to see if the file is available.

Procedure

1. Introduce cyanobacteria bacteria to the students. Highlight that bacteria cells differ from other cell structures, because they do not have a nucleus. Because of this, genetic material is loose in the cell in the gel-like cytoplasm. Except for the protein-producing ribosomes, bacteria do not have organelles (specialized cell structures that have specific functions). However, bacteria do have cell walls and cell membranes. Cyanobacteria harvest the energy contained in sunlight and turn it into food (sugars) using the same process of photosynthesis found in higher plants. Cyanobacteria take the hydrogen atoms of water to reduce carbon dioxide and oxygen is produced.
2. Assign each student lab group one drawing of cyanobacteria morphology to prepare in large scale (8 X 10 inches) for class tomorrow. The drawing should be labeled with the name or category of bacteria it represents. Student lab groups should prepare pictures of *Microcoleus*, *Gleocapsa*, *Oscillatoria*, *Spirulina*, *Phormidium*, diatoms, colorless sulfur bacteria, purple sulfur bacteria, sulfate reducing bacteria, and fermenters for the interactive biogeochemical activity the next day. Note that some of these drawings will have to be made from pictures that the teacher obtains from the microbial mat education page.
3. Have students observe cyanobacteria and diatoms under the microscopes. If magnification is not enough to view cell structure, display pictures to supplement what students view through the microscope.
Items to note:
 - *Gleocapsa* have groups of cells held together by a sticky, gelatin-like polymer called a glycocalyx.
 - *Lyngbya* are a collection of single cells enclosed in a sheath.
 - *Oscillatoria* is a filamentous cyanobacteria with tapering trichomes. They, and many other types of cyanobacteria move using a kind of movement called “gliding motility” move by wave movements of tiny fibers.
 - *Spirulina* look like a slinky and move in a corkscrew type fashion.
 - Diatoms have several cell structures. Using a science book, have students label the nucleus and other visible cell structures. Compare these structures to bacteria cell structures.
4. During observation, the teacher should circulate around the room, checking for accuracy of drawings, assisting with microscope usage, etc.
5. Conclude by collecting drawings for each class period. They will be used in the interactive activity in the next lesson.

Credits

Lesson Plan:

Art, Graphic Design & Layout: C. Triano & T. Esposito, TopSpin Design Works