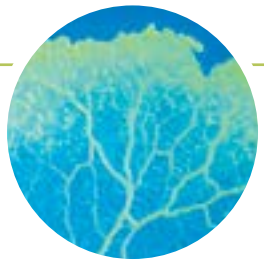
Decomposition by *Physarum polycephalum*

A Carolina Essentials™ Activity



TIME REQUIREMENTS

PREP	ACTIVITY
1.5 hr	1.25 hr

Teacher Prep: 90 min for plate preparation and 24 hrs for incubation

Student Activity: 45 min on day 1 and 10 min per day for days 2 to 4

SAFETY REQUIREMENTS

MATERIALS

Culture plates of plasmodial *Physarum polycephalum* (each pair or group of students will need an active culture)

2% agar plate, non-nutritive and sterile (per pair or group of students)

Old-fashioned oatmeal (not instant or quick cooking)

Disposable scalpel, sterile

Forceps, sterile

Stereomicroscope (per pair or group of students)

Digital balance

China marker or waterproof marker

Tape

HELPFUL LINKS

Exploring the Mysteries of Slime Molds

Physarum Polycephalum Care Guide

Techniques for Studying Bacteria and Fungi Manual

REFERENCE KITS

Physarum Culture Kit

Introduction to *Physarum* Kit

Living *Physarum* Review Set

Slime Mold Growing Kit

Chemotaxis in *Physarum Polycephalum* Kit

Overview

This observational microbiology activity introduces students to a slime mold from the genus *Physarum*, a decomposer found in cool, humid, dark places like the forest floor. *Physarum* is an intriguing organism that can be used to introduce or discuss multiple subjects: trophic levels, life cycles, mitosis, meiosis, sexual and asexual reproduction, cytoplasmic streaming, chemotaxis, basic navigation, simple decision-making, mechanisms for survival in stressful environments, cell structure, and developmental biology.

Students will observe the phenomenon of the plasmodial form of *Physarum polycephalum* as it streams in search of a food source. Decomposers play a critical role in every ecosystem, transferring energy and cycling matter through the food web. *Physarum polycephalum* feeds on microorganisms found on dead leaf matter, such as bacteria, fungi, and yeasts, continuing the cycle of decomposition.

Life Science, Earth and Space Science
Grades: 9–12

Essential Question

What role do decomposers play in an ecosystem?

Activity Objectives

1. Observe the phenomenon of periodic streaming in *Physarum polycephalum*.
2. Explain why *Physarum polycephalum* is considered a decomposer.
3. Explain *Physarum's* role in the terrestrial carbon cycle.

Next Generation Science Standards* (NGSS)

PE MS-LS2-3. Develop a model to describe the cycling of matter and flow of energy among living and nonliving parts of an ecosystem.

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Developing and Using Models • Develop a model based on evidence to illustrate the relationships between systems or between components of a system.	**Ecosystems: Interactions, Energy, and Dynamics** • Cycling of matter and flow of energy through terrestrial food webs.	**Energy and Matter** • Energy drives the cycling of matter within and between systems.

Safety Procedures and Precautions

Use this activity only in accordance with established laboratory safety practices, including appropriate personal protective equipment (PPE) such as gloves, chemical splash goggles, and lab coats or aprons. Ensure that students understand and adhere to these practices. Know and follow all federal, state, and local regulations, as well as school district guidelines, for the disposal of laboratory wastes. Students should not eat, drink, or chew gum in the lab and should wash their hands after entering and before exiting the lab. *Physarum polycephalum* is not pathogenic under normal circumstances. However, treat all microorganisms as potential pathogens.

Continued on the next page.

Decomposition by *Physarum polycephalum*

A Carolina Essentials™ Activity

Teacher Preparation and Disposal

Preparation of student plates

A *Physarum* plate culture comes ready to use or subculture for additional group samples. When the culture arrives, immediately open the shipping container and remove and inspect the culture. The plasmodium is a yellow growth on the surface of the agar. Ensure that the plates are not cracked and the lids are securely taped. To subculture, use a sterile scalpel to remove a pea-size piece of plasmodium with agar from the plate culture and relocate it to the center of a sterile 2% agar plate with the plasmodium side facing down. As soon as you complete the transfer, place 3 to 4 oat flakes on and about the plasmodium to feed the *Physarum*. You can create multiple plate cultures from one plate using this method. Place the new plates in a plastic bag with the lid side up and store in a dark location. Use within 24 to 48 hours.

Disposal

Sterilize any used plates and other materials that have come in contact with the *Physarum* by autoclaving for 40 minutes at 121° C and 15 pounds per square inch of pressure. You can also disinfect the plates by covering them in a 10% chlorine bleach solution (1 part bleach to 9 parts water) and soaking them for 2 hours. Disinfect all work surfaces and wash hands before and after working with the organism. Dispose of disinfected plates and agar in the trash.

Student Procedure

1. Write your name or group number on the bottom of the petri dish. Set your microscope up to view the petri dish containing the plasmodial form of *Physarum polycephalum*. Light the plate from the underside.
2. Begin with the 10× lens and observe the entire plasmodium. Sketch and describe what you observe.
3. Locate an area of plasmodium in which streaming is taking place. Switch to the 40× lens and observe this area for 3 to 4 minutes. Sketch and describe what you observe. Using a china marker, outline the plasmodium area on the petri dish top.
4. After observing the *Physarum*, place 3 to 4 oat flakes in different locations in the petri dish and seal the dish with tape.
5. Weigh the petri dish and contents.
6. After 24 hours, examine the *Physarum* again. Outline the plasmodium area again.
7. Weigh the petri dish after 24 hours of growth.

Teacher Preparation and Tips

1. *Remind students to begin with the 10× lens and to make sure the petri dish is illuminated from below.*
2. *Remind students to keep the petri dish closed to minimize contamination.*
3. *Demonstrate the setup for viewing the petri dish.*
4. *You may want to project an online timer to help students keep track of observations.*
5. *Walk around the room and check student sketches for adequate detail. Students can use a marker instead of the china marker for outlining the plasmodium.*
6. *Make sure students place the new oat flakes in different locations. Close to the edge of the dish, near the leading edge of the plasmodium, or forming a triangle are good suggestions.*
7. *Check to ensure students are sealing the petri dish with tape.*
8. *Remind students of the definition of conservation and the law of conservation of mass and energy. Mass should remain the same if the plates were sealed properly.*

Continued on the next page.

Decomposition by *Physarum polycephalum*

A Carolina Essentials™ Activity

Data and Observations

Student answers will vary but should include observations of streaming and the plasmodium moving toward the food supply, possibly on several fronts. Over 24 hours, the plasmodium should increase in area, and mass will probably remain unchanged.

Observation	Sketch	Description
Day 1 10×		
Day 1 40×		
Day 2 40×		

Day	Weight (g)
1	
2	

Continued on the next page.

Decomposition by *Physarum polycephalum*

A Carolina Essentials™ Activity

Analysis and Discussion

1. Using the correct scientific vocabulary, describe the structure of *Physarum polycephalum.*

   Physarum *is a single large cell with multiple nuclei. We observed it in the plasmodial state. Numerous fan-like structures with central veins moved forward and then retreated.*

2. Compare the changes in area covered by the *Physarum* plasmodium after 24 hours. Was the growth in a particular direction? What could explain the direction of growth?

   The area covered by the plasmodium should increase. Growth should be toward the oat flakes/food source. Physarum *is ingesting food and increasing its area as it streams toward new food sources.*

3. Diagram a model deciduous forest food web with *Physarum* as a decomposer and indicate the flow of energy within the food web. Include 2 producers and 5 consumers on at least 3 tropic levels.

   Student answers will vary. They must include a producer and at least one consumer. Physarum *should be shown as a decomposer. Students should remember that only 10% of energy is transferred up from one trophic level to the next.*

4. Using the data for the weight of *Physarum,* oat flakes, and the petri dish, explain a decomposer's role in conservation of matter or cycling of energy and matter, especially carbon.

   The total weight of Physarum, *oak flakes, and petri dish should remain constant. Students should notice that* Physarum *flows over the oat flakes and that the size of the oat flakes may diminish. The observation of* Physarum *increasing in size while the food source decreases in size and the total weight remains constant provides a mathematical model of energy and matter cycling within an ecosystem.*

TEACHER NOTES