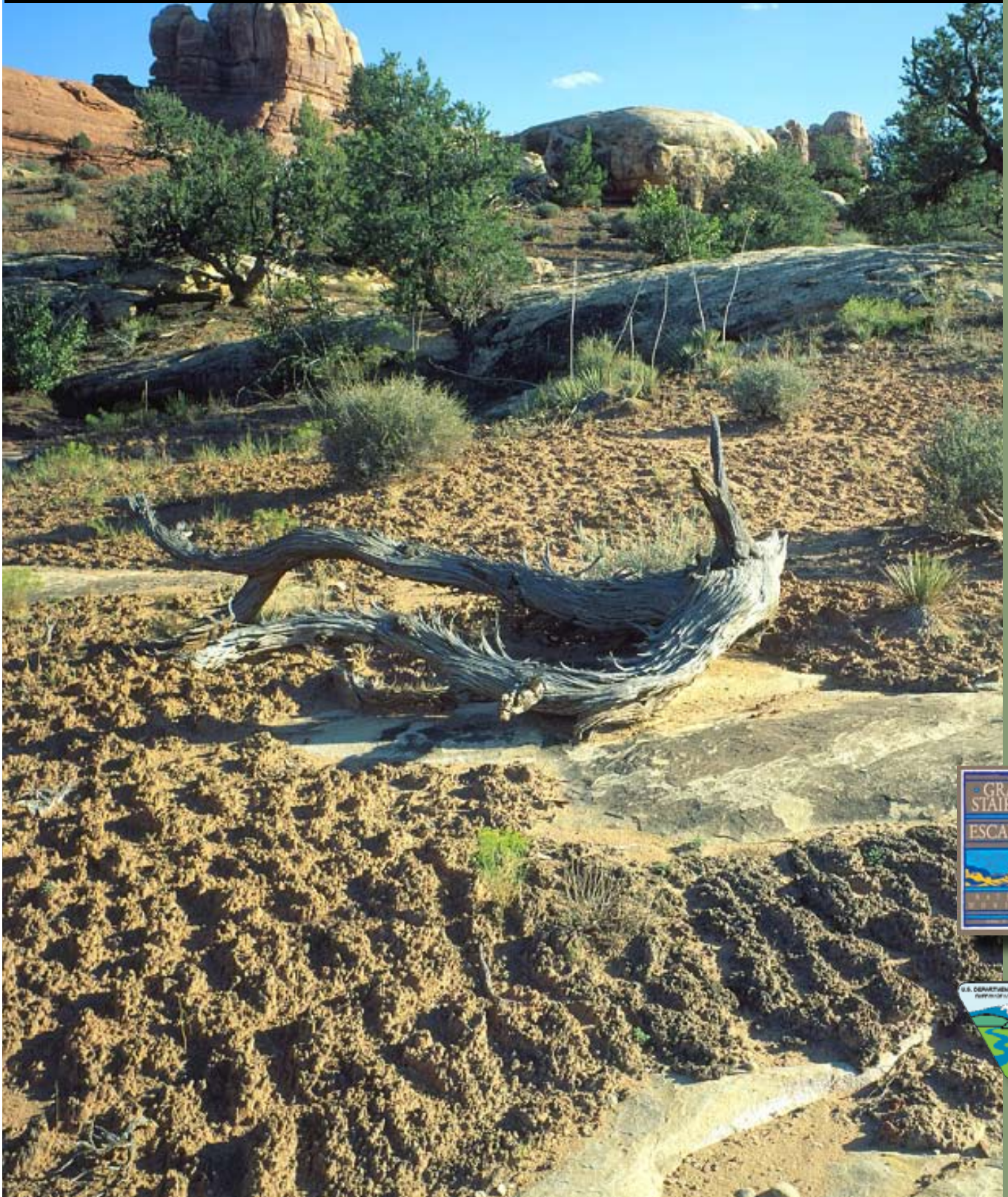


The Secret Life of Cryptobiotic Soil

Teacher Guide

BLM

Grand Staircase-Escalante National Monument



The Secret Life of Cryptobiotic Soil

Grade Level

9-12

Duration

45 Minutes

Description

Using sand, peat moss, water, and “fake snot,” students make a model of cryptobiotic soil and then simulate the effects of wind and water erosion to evaluate its importance in the desert environment.

Goals

- Examine the different organisms that form cryptobiotic soil crusts.
- Evaluate the importance of cryptobiotic soil crusts using models and simulations.

Academic Content Standards

The following standards are drawn from *Content Knowledge*¹.

Life Science Standard 6.

Understands relationships among organisms and their physical environment.

Level IV (Grades 9-12)

Benchmark 1.

Knows how the interrelationships and interdependencies among organisms generate stable ecosystems that fluctuate around a state of rough equilibrium for hundreds or thousands of years (e.g., growth of a population is held in check by environmental factors such as depletion of food or nesting sites, increased loss due to larger numbers, predators, or parasites)

Benchmark 5.

Knows ways in which humans can alter the equilibrium of ecosystems, causing potentially irreversible effects (e.g., human population growth, technology, and consumption; human destruction of habitats through direct harvesting, pollution, and atmospheric changes.)

Nature of Science Standard 11.

Understands the nature of scientific knowledge.

Level IV (Grades 9-12)

Benchmark 3.

Understands how scientific knowledge changes and accumulates over time (e.g., all scientific knowledge is subject to change as new evidence becomes available; some scientific ideas are incomplete and opportunity exists in these

¹ *Content Knowledge: A Compendium of Standards and Benchmarks for K-12 Education: 4th Edition*, Mid-Continent Research for Education and Learning in Aurora, Colorado. <http://www.mcrel.org/standards-benchmarks/>

areas for new advances; theories are continually tested, revised, and occasionally discarded.

Benchmark 4.

Knows that from time to time, major shifts occur in the scientific view of how the world works, but usually the changes that take place in the body of scientific knowledge are small modifications of prior knowledge.

Nature of Science Standard 13.

Understands the scientific enterprise.

Level IV (Grades 9-12)

Benchmark 6.

Knows that creativity, imagination, and a good knowledge base are all required in the work of science and engineering.

Materials

- *The Secret Life of Cryptobiotic Soil – Student Activity*
- 1 gallon bucket of sand
- 1 pound of sphagnum moss (found at most nurseries)
- 1 cup light corn syrup
- 3 packets unflavored gelatin
- 1 gallon of water
- Cookie sheet
- Blow dryer
- Computer with internet access
- Video or DVD *Traces in Time*, produced by GSENM

Objectives

1. Identify the different biological components in cryptobiotic soil crusts.
2. Make a model of a cryptobiotic soil crust.
3. Simulate the effects of erosion on soils with and without cryptobiotic soil crusts.
4. Evaluate the causes for the loss of cryptobiotic soil crusts and the resulting effects to the desert environment.

Procedures

The video or DVD *Traces in Time* is a great way to introduce students to the Grand Staircase-Escalante National Monument.

1. Step 1 - *The Secret Life of Cryptobiotic Soil* (pages 1-2) is an introduction to cryptobiotic soil crusts that students can read on their own.
2. To complete Step 2 - *Experiment: Create a Cryptobiotic Soil Crust Model* (pages 3-4), and Step 3 - *Experiment: Wind and Rain Erosion* (pages 4-5), students can be divided into groups of 3-5 or the activity can be done as a classroom demonstration.

3. To promote classroom discussion in Step 4, *Don't Bust the Crust* (pages 6-8), we recommend teachers review information available on the internet sites below, especially at the USGS Canyonlands Research Station website: <http://www.soilcrust.org/>

4. The technical paper, *Biological Soil Crusts: Ecology and Management, 2001*, is an excellent reference, available as a PDF file at <http://www.blm.gov/nstc/library/techref.htm>

Adaptations:

Internet links are included in the student handout that students can use to learn more about cryptobiotic soil crusts. This will increase the time required for the activity in the classroom, unless students work online at home.

Extensions

Students can expand on this activity by evaluating whether or not the organisms that comprise cryptobiotic soil crusts are symbiotic or not. Recent studies of lichens, frequently used as example symbiotic relationships, have discerned that fungi in the relationship actually “farm” the algae. By using internet sites listed below, students can make their own determination about symbiotic relationships in cryptobiotic soil. There is no right or wrong answer, simply an opportunity for students to do research and analysis.

Assessment

Students should compare their answers to see if they have reached similar conclusions. A class discussion about different types of impacts that damage or destroy cryptobiotic soil crusts could be a good way to end the lesson.

References

Books/ Periodicals

Belnap, Jayne, Roger Rosentreter, Steve Leonard, Julie Hilty Kaltenecker, John Williams and David Eldridge, *Biological Soil Crusts: Ecology and Management*, 2001.
Technical Reference 1730-2. U.S. Department of the Interior, National Science and Technology Center Information and Communications Group, PO Box 25047, Denver, Colorado 80225-0047

Websites

USGS Canyonlands Research Station
<http://www.soilcrust.org/>

BLM NSTC Soil Biological Communities
<http://www.blm.gov/nstc/soil/crusts/>

Natural Resources Conservation Service Soil Quality Information Sheets
<http://soils.usda.gov/sqi/publications/sqis.html>

Capitol Reef National Park
<http://www.nps.gov/care/crypto.htm>

Cryptobiotic Soils – Holding the Place in Place
<http://geochange.er.usgs.gov/sw/impacts/biology/crypto/>

The Microbial World - Cyanobacteria
<http://helios.bto.ed.ac.uk/bto/microbes/cyano.htm>

USGS Canyonlands Research Station
<http://www.soilcrust.org/gallery.htm>

Answer Key

Question 1

Using the blow dryer, begin on low speed and aim the blow dryer at the simulated cryptobiotic soil. Record your observations.

Answers will vary

Question 2

Now aim the blow dryer, on low speed, at the sand. Record you observations.

Answers will vary

Question 3

Turn the blow dryer onto high and aim it toward the sand so that the san wil blow toward the pile of simulated cryptobiotic soil. Record your observations.

Answers will vary

Question 4

Pour $\frac{1}{2}$ the water directly on to the pile of sand. Record your observations.

Answers will vary

Question 5

Now pour the rest of the water directly on the simulated cryptobiotic soil. Record your observations.

Answers will vary

Question 6

Why are cryptobiotic soil crusts important to the desert southwest?

- *Stabilize soil*
- *Decrease erosion*
- *Increase moisture absorption*
- *Provide substrate for seed germination*
- *Increased nitrogen fixing in soils.*

Question 7

How would you explain the importance of cryptobiotic soil crusts to your family and friends?

- *Without cryptobiotic soil crusts desertification increases:*

- *Soil blows with the wind creating hazards and burying vegetation*
- *Water run-off increases*
- *Vegetation dies off due to lack of substrate*
- *With Cryptobiotic soil crusts:*
 - *Soil stays in one place and doesn't blow with the wind.*
 - *Vegetation increases and is more diverse.*
 - *Water is reabsorbed by the ground, replenishing groundwater and aquifers.*

Question 8

How would you suggest dealing with cryptobiotic soil crusts if your family and friends were to come across this type of crusts in the southwest desert?

Try not to walk on them. Walk on rocks, in drainages, or walk around them. If you HAVE to walk on them, walk in single file and try not to create multiple or deep trails that will erode. Also... add water and watch them turn green, almost instantly!

Vocabulary

Abiotic	Not containing or supporting life, non-living.
Allelopathy	When one plant releases a substance that inhibits the growth of another competing plant species.
Bacteria	Single celled microorganisms with circular DNA not enclosed by a nucleus.
Cyanobacteria	Bacteria having photosynthetic pigments, capable of photosynthesis.
Green algae	Mainly aquatic photosynthetic organisms not having true leaves, roots, or stems.
Inoculum	Material used to initiate a microbial culture.
Lichens	Complex organism consisting of fungi and algae growing together.
Mosses	Simple non-flowering plants with short stems and scale-like leaves.
Microfungi	Microscopic, single or multi-celled organism lacking chlorophyll that reproduces from spores and obtains nutrients by decomposing organic matter.
OHV	Off Highway Vehicle