
CRUSTOSE


FOLIOSE


FRUITICOSE

NAME:_____
DATE:_____PERIOD:_____

FIELD STUDY: Lichens, Primary Succession and the Development of Soil in Terrestrial Ecosystems

Introduction.

ECOLOGICAL SUCCESSION refers to stages of natural changes in the biotic and abiotic structure of an environment over time. PRIMARY SUCCESSION begins with the formation of soil from solid rock, and ends with the establishment of a mature forest. This process occurs over long periods of time(1000's of years). If a mature forest is cut down, if a fire or natural disaster (storms,volcanic eruptions, etc.) destroys the forest, the bare soil in the area will again develop through time to a mature forest. This type of succession takes place over shorter periods of time(150-200 yrs.), and is called SECONDARY SUCCESSION.

PRIMARY ECOLOGICAL SUCCESSION begins with the breakdown of solid rock to form the mineral particles of soil. The process responsible for this breakdown is called WEATHERING. PHYSICAL WEATHERING involves the expansion and contraction of the rock surface by daily heating by the sun, and cooling at night. During winter conditions, daily freezing and thawing(FROST WEDGING) of water and ice splits open the tiny cracks in the rock surface. Wind, rain, sleet, etc. also contribute to the process. BIOLOGICAL WEATHERING involves the splitting of the rock surface by the roots of plants imbedded in the crevices.

Another type of process combines BIOLOGICAL and CHEMICAL WEATHERING. This takes place in LICHEN colonies that inhabit the rock surfaces. Lichens are patchy growths of ALGAE and FUNGI, existing together as "one organism" in a SYMBIOTIC relationship known as MUTUALISM. It is for this reason that lichens do not require soil to grow on bare rock surfaces. The algae portion of the lichen carries on the process of PHOTOSYNTHESIS, using sunlight, water(H_2O), and carbon dioxide (CO_2) to produce food($C_6H_{12}O_6$) and oxygen(O_2) The algae then use the food and oxygen in the process of RESPIRATION to obtain energy for growth. Carbon dioxide and water are released during this process. When the algae cells die, they are consumed as food for energy and growth by the fungi portion of the lichen colony. During this DECOMPOSITION(respiration) process, the fungi use oxygen produced by the algae, and release carbon dioxide and water. Other niches of the fungi are to retain water, and anchor the lichen colony to the rock surface.

Some of the carbon dioxide, produced during respiration by both the fungi and the algae, combines with moisture in the lichen colony to form carbonic acid. The acid dissolves the rock to form INORGANIC MINERAL PARTICLES. The chemical equation for this reaction is as follows:

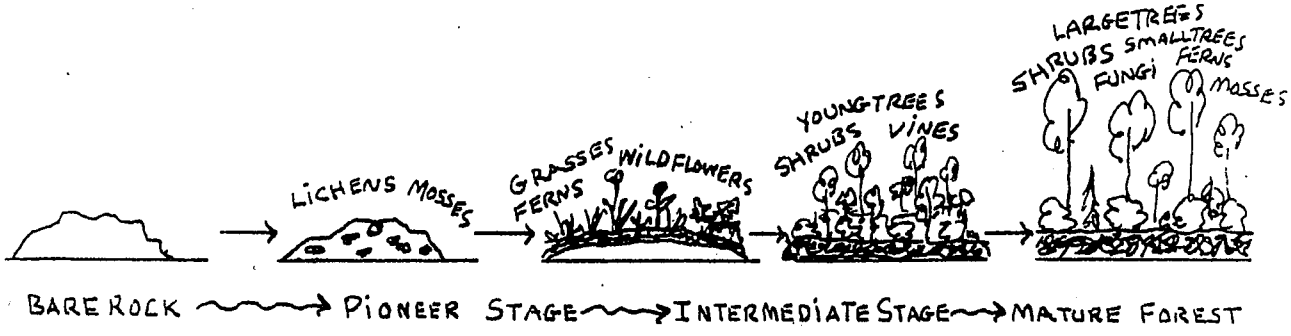
carbon dioxide (CO_2) + water (H_2O) ⟶ carbonic acid (H_2CO_3)

This physical, chemical and biological weathering of rock is the beginning of soil formation.

Lichen colonies also act as a trap for dust particles from the air, as well as provide shelter in rock cavities for small insects, crustaceans, worms, etc. These live animals inside the lichen produce waste products, and some die. The dust particles, the dead algae, fungi and animals, and the live animal waste products all add ORGANIC MATTER to the inorganic mineral particles. Together they form soil.

SOIL = INORGANIC MINERAL PARTICLES (sand/silt/clay) + ORGANIC MATTER

Primary Succession can now continue as spores of mosses and ferns, and seeds of grasses and wildflowers take hold in the newly formed soil. As the soil layer continues to thicken, shrubs and trees become established in the developing terrestrial ecosystem. Eventually, the ecological succession process leads to a mature forest community, and a habitat for forest animals.



Purpose.

(1) To observe lichens in their natural environment, and collect samples for microscopic examination.
(2) To understand the role lichens play during the process of Primary Succession.

Materials.

DAY 1/OUTSIDE	DAY2/INSIDE
*Small Vial(for lichen sample)	*microscope
*metric ruler	*glass slide
*plastic spoon	*cover slip
*needle probe	*dropping pipette
*clipboard w. copy of field study	*needle probe

Instructions. DO STEPS (1) thru (4) ON DAY 1

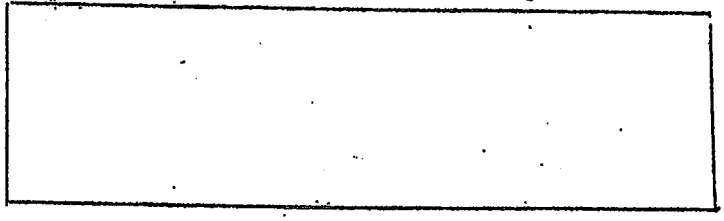
(1) The HABITAT of a living organism describes the type of environment in which it lives. Describe the habitat of the lichen colonies observed at your study site.

_____

_____

_____

(2) Make a sketch of a lichen colony on the rock surface.



(3) Measure the diameter(in centimeters) of 10 randomly-selected lichen colonies. Calculate their average size.

_____cm.	_____cm.	TOTAL OF THE
_____cm.	_____cm.	10 MEASUREMENTS = _____cm.
_____cm.	_____cm.	
_____cm.	_____cm.	AVERAGE SIZE OF
_____cm.	_____cm.	A LICHEN COLONY = _____cm.

What might be the value of measuring the lichen colony sizes every year?_____

_____

DAY 1(cont.)

(4) Lichens are grouped into 3 types, in terms of differences in their physical structure, or MORPHOLOGY.

A. CRUSTOSE - a fine, "crusty", almost powdery growth tightly attached to the rock surface.

B. FOLIOSE - a leafy, thick-textured growth with deep crevices.

C. FRUITICOSE - a thick-textured growth with vertical structures protruding upward from the colony.

Which of the 3 types of lichens inhabit the rocks at your study sight?_____

*Collect a sample of lichens from the rock surface by scraping off some of the growth into a small vial. Collect enough to fill the vial to a depth of about 5 millimeters(.5 cm.) Return the sample to the lab for microscopic examination. BE SURE TO LABEL YOUR VIAL WITH THE LETTER OF YOUR LAB GROUP, and CLASS PERIOD.(Example: A1, F3, D4, etc.)

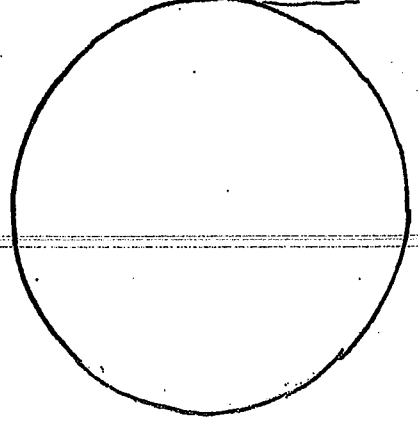
DAY 2/INSIDE LAB

(1) Place a few peices, about the size of a pin head, on a glass microscope slide. Using a dropping pipette, add 1 drop of spring water to the lichen sample. Place a cover slip on the specimen, and allow it to sit for 2-3 minutes. Holding the slide in one hand, GENTLY press down on the cover slip with the forefinger of the other hand, and using a circular motion, crush the specimen in the water on the slide until you observe a cloudy mass.

(2) Place the slide on the microscope stage, with the cloudy mass in the center of the stage opening. Clamp the sides of the slide to hold it in place. Using the COURSE ADJUSTMENT KNOB, focus on the edges of the cloudy mass at LOW POWER magnification. Move the slide around while observing thru the lens and find a clear image.

(3) Switch to HIGH POWER magnification, and using the FINE ADJUSTMENT KNOB, focus on the image. Look for broken strands(hyphae) of fungi, and circular green cells of algae. Make a sketch of the lichens at HIGH POWER. Label the ALGAE and the FUNGI on your sketch.

SKETCH OF LICHENS AT HIGH POWER MAGNIFICATION



DAY 2(cont.)

(4) The ecological NICHE of an organism is the functionit performs in its habitat. Answer the following about some of the important functions(niches) of lichens:

A. What biological processes take place in the algae and fungi cells making up a lichen colony? What does each use and produce during these processes, in terms of O_2, CO_2, H_2O, food(glucose), sunlight, and energy? COMPLETE THE BLANKS BELOW TO ANSWER THESE QUESTIONS:

	BIOLOGICAL PROSESS	USES	PRODUCES
ALGAE:	_____	1 sunlight 2 _____ 3 _____	1 _____ 2 oxygen
	respiration	1 glucose 2 _____	1 energy 2 _____ 3 _____
FUNGI:	_____	1 _____ 2 oxygen	1 _____ 2 _____ 3 water

B. Besides respiration/decomposition, what two other functions(niches) do fungi perform in the lichen colony?

(1)_____
(2)_____

C. How do lichens play and important role in the development of the following two major components of soil?:

(1)MINERAL PARTICLES:_____
_____

(2)ORGANIC MATTER:_____
_____
_____

D. Would a lichen be considered a producer, comsumer or decomposer? Explain your answer._____
_____
_____

E. In terms of SYMBIOSIS, explain why soil is NOT necessary for lichens to grow on solid rock surfaces.
_____
_____
_____
_____