



Lichens

Grade Span	3 - 5 Grades
Time Span	Walk school ground/trail around school to locate and identify lichens before class-have examples of the three different types if available.
Standards	2-LS4-1 Make observations of plants and animals to compare the diversity of life in different habitats
Focus Question	Why do birds migrate? 2. What about birds that make it easier for them to migrate better than other animals?
Overview	Lichens are a complex life form that is a symbiotic partnership of two separate organisms, a fungus and an alga. The dominant partner is the fungus, which gives the lichen the majority of its characteristics, from its thallus shape to its fruiting bodies. The alga can be either a green alga or a blue-green alga, otherwise known as cyanobacteria. Many lichens will have both types of algae.
Objectives	Students will learn about the symbiotic relationship between fungus and alga. Students will also learn to identify some of the more common lichen and their key characteristics.
Materials Needed	Appropriate outdoor gear for the season Small magnifying glasses per group or student Pencil and Paper for sketching Lichen guide book-available on Amazon.com if not in local stores Lichen Key found at the bottom of this lesson plan

Outdoor Classroom Lesson Plan

National Park Service
U.S. Department of the Interior
Acadia National Park, Maine



Vocabulary	<p>Algae - Algae are in another kingdom (Protista) separate from plants and fungi. There are several types of algae: green, brown, red, gold. They can survive in salt water and in freshwater on their own, and in any environment when part of a lichen relationship.</p> <p>Lichen - a simple slow-growing plant that typically forms a low crusty, leaflike, or branching growth on rocks, walls, and trees.</p> <p>Fungus - Fungi are a diverse group of organisms that are in their own kingdom (Fungi), separate from plants. Fungi do not contain chlorophyll or any other means of producing their own food so they rely on other organisms for nutrition. Fungi are widely known for their role in the decomposition of organic matter. They are also necessary for the survival of the ecosystem around them, such as partnering with plants and trees for nutrients and survival.</p> <p>Crustose - Crust-like; growing tight against the substrate</p> <p>Foliose - Leaf-like; with flat sheets of tissue not tightly bound</p> <p>Fruticose - shrubby; free-standing branching tubes</p> <p>Symbiosis - an interaction between two different organisms living in close physical association, typically to the advantage of both.</p>
Teacher Prep	Walk school ground/trail around school to locate and identify lichens before class-have examples of the three different types if available.



Background

Types of Lichens

Crustose: Crust-like; growing tight against the substrate

Foliose-Leaf-like; with flat sheets of tissue not tightly bound

Fruticose-shrubby; free-standing branching tubes

What is Symbiosis?

Interaction between two different organisms living in close physical association, typically to the advantage of both.

What are Fungi?

Fungi are a diverse group of organisms that are in their own kingdom (Fungi), separate from plants. Fungi do not contain chlorophyll or any other means of producing their own food so they rely on other organisms for nutrition. Fungi are widely known for their role in the decomposition of organic matter. They are also necessary for the survival of the ecosystem around them, such as partnering with plants and trees for nutrients and survival.

Lichens are another such partnership for fungi to gain nutrients from another organism. The algal partner photosynthesizes and provides food for the fungus, so it can grow and spread.

What is Algae?

Algae are in another kingdom (Protista) separate from plants and fungi. There are several types of algae: green, brown, red, gold. They can survive in salt water and in freshwater on their own, and in any environment when part of a lichen relationship.

Although cyanobacteria are called blue-green algae, they are actually bacteria, and are part of the bacteria kingdom, Monera. The "blue" in the common name refers to the fact that they need to live in water, and "green algae" refers to their photosynthetic abilities, like green algae.

Ecological Importance of Lichens:

Lichens have been used for many things by both animals and humans. They provide forage, shelter, and building materials for elk, deer, birds, and insects. In fact, some insects have adapted their appearance to look like lichens, which are a large part of their habitat. Some insects change their appearance through evolution while others simply use lichens as a disguise.

Humans use lichens for dyes, clothing, and decoration, but did you know that people also eat lichens? *Bryoria* is a common genus of lichen across the United States. In times of hardship, some Native American tribes would eat this lichen while other tribes sought it out. Some lichens were fed to pets during hard times as well.

Be careful though, not all lichens are edible, and in fact, some can be poisonous. For example, the wolf lichen got its name because it was used in Europe to poison wolves. Other lichens, like *Usnea*, are researched for their antibiotic properties for use in the development of drugs, and a variety of other products use lichen in their ingredient lists today. For example, lichens are used in deodorant, toothpaste, salves, extracts, and perfumes. In Japan, they use lichens in paint for its anti-mildew properties. Be careful, though, in what you use; a few people have been known to have allergic reactions to lichens, resulting in skin disorders.

Lichens and Air Quality



Some sensitive lichen species develop structural changes in response to air pollution including reduced photosynthesis and bleaching. Pollution can also cause the death of the lichen algae, discoloration and reduced growth of the lichen fungus, or kill a lichen completely. Over time, sensitive species may be replaced by pollution-tolerant species. Hence the species of lichens present in a location and the concentration of pollutants measured in those lichens can tell us a lot about air quality.

“What are Lichens?” USDA Forest Service

Rangeland Management & Vegetation Ecology - Botany Program

<https://www.fs.fed.us/wildflowers/beauty/lichens/whatare.shtml>

“Lichens and Air Quality”

US National Park Service

<https://www.nps.gov/articles/lichens-and-air-quality.htm>

“Lichen Exploration”-Beetles Project

<http://beetlesproject.org/cms/wp-content/uploads/2015/12/Lichen-Exploration.pdf>



Procedure

Engage:

Exploring Lichens-Part 1

1. Pairs observe, describe, and compare lichens up close and see how many different kinds that they can find. Students explore in pairs. Tell them when they see different kinds of organisms that they should compare them and describe to their partner.

Say: "There are over 10,000 different kinds of this organism. Let's see how many different kinds we can find here and what we notice about them."

Say: "Describe them out loud and make comparisons between different kinds that you see"

2. Students explore the organisms in this area. Give them 10-20 minutes to explore and find as many different kinds as they can. Emphasize that they should not remove or harm the organism but to observe it where it is growing. If lichen is growing on a portable stick or rock, they may be brought back to the group to share.

3. Teacher checks in with students and asks what they notice:

Ask them to compare the different organisms they find: color, texture, size, ect.

Explore:

Part 2-Can be done right after the above, next day, or a different time all together.

Sharing Lichen Observations 10-20 min

1. Group Chat: What did you find?

Gather students in a circle. If they collected sticks or rocks, have them put them in the middle of the circle. Listen as they describe their findings and ask follow up questions:

What did you notice?

How many different kinds did you find?

How are they similar or different from each other?

How would you describe the most interesting ones to your friends or family?

What does that look like to you?

How does it look different in your hand lens?

2. Introduce the name "lichen".

Tell the students this organism is called a lichen. Write the name out for them so that they can see it.

3. Group Chat-So what is a lichen exactly?

Ask the following questions and listen to their ideas. Help them make connections to their prior knowledge.

Let's talk about lichens and what kind of organism they are.

What do you know about plants?

Do you see any evidence that lichen is a plant?



What do you know about fungi?
Any evidence that lichen is a fungus?

4. “Freddy Fungus and Andy Algae took a likin’ to each other.”

After students have shared their ideas, explain to them that lichens are actually two organisms, a fungus and an alga, that often depend on each other. The fungus collects water and nutrients, attaches to a surface and protects the algae from the environment. By using photosynthesis, the algae makes food (same process as plants) that provides the energy that both the fungus and algae need to grow and survive.

Introduce the word -Symbiosis-Explain that the close relationship between two organisms like the algae and fungus is called a symbiotic relationship. Other examples of symbiotic relationships: bees/flowers, clownfish/sea anemone, ant/aphid, humans/gut bacteria, plant roots/fungi.

Activity 3

Part 3: Can be done right after, next day, or a different time all together
Using the Lichen Key-Attached to lesson below (20-60 minutes)

1. Have students share with a student that they were not exploring with.
2. Introduce the key with the three different types of lichens with pictures: crusty, leafy, and shrubby.
3. Show the key and tell students that even though there are thousands of different kinds of lichens, most can be grouped into one of three main types:
Crustose: Crust-like; growing tight against the substrate
Foliose-Leaf-like; with flat sheets of tissue not tightly bound
Fruticose-shrubby; free-standing branching tubes
If possible show students the key while holding up examples of real organisms that they collected or walk around the grounds to point them out.
Add verbal descriptors:
Crusty is like paint that is closely attached to the surface everywhere.
Leafy is like a leaf that is only attached at one point.
Shrubby lichens look like a bush or a beard
Explain that the real ones will not look exactly like the ones in the pictures. These are just examples.
4. Have students explore and identify lichen types with the key (make copies) and look for patterns of where they grow. Give them 10-20 minutes to explore the different types of lichens
Give some examples of patterns to look for:
Look for what surface it grows on and what it doesn’t grow on. Rocks? Wood? Under rocks. Low on trees? High on trees? Where do you not find lichens?



Students can also look for where the different types of lichens grow. What kind grow on rocks? What kinds do you see up in a tree?

Are there any unnatural places where lichens grow? I have seen them on an iron fence? How do they grow there?

After students have explored for 10-20 minutes-this time with a different group than the first have them all meet back for a group chat and discuss the following:

Where did you find or not find lichens?

Did you find all three types?

What did you see more of?

Did you notice any patterns for the surfaces that they grow on?

Did you find the different types of lichens growing on the same surfaces or near each other?

Was there anything else growing near, around, or under the lichen?

Ask students to make a possible explanation for why they grow on those surfaces. Remind them what lichens need to survive.

5. After students have shared and discussed their possible explanations discuss the following:

Explain that each type of lichen has specific environmental conditions where it survives best. This is true for all organisms.

Explain that all organisms slightly change the environment that it lives in while it grows. Over time this could change the environment for other organisms that live in that area.

Ex: Lichens can trap soil which can add surfaces for other organisms to grow on.

Explain that lichens typically grow on surfaces in this order: crusty, leafy, shrubby, and followed by mosses and other plants. Crusty lichens grow on bare rock, then leafy grows on top of the crusty, which will die beneath the leafy. Then shrubby lichens will grow on top of the leaf. After that then mosses will grow and possibly trees.

6. Give students 5-10 minutes to explore to see if they can find this pattern of growth.

Explanation: Now it's time to codify and formalize the students' observations. The following videos can help you elucidate and demonstrate the basic concepts underlying the discoveries students made as they explored.

Extension:

Additional lesson-Lichens and Air Quality

1. Explain to the students that lots of leafy and shrubby lichens in an area mean that the air is very clean. Crusty lichens can survive when the air quality is poor, but



	<p>the leafy and shrubby lichens are more sensitive to pollutants. It does not indicate bad air quality in the absence of leafy and shrubby lichens.</p> <ol style="list-style-type: none">2. Ask students if there is anything that they can conclude about the quality of air in the area that you are observing lichens.3. Students may research this more for an additional assignment
Wrap-Up	<p>Evaluate:</p> <p>Formative Assessment:</p> <p>Where did you find or not find lichens? Did you find all three types? What did you see more of? Did you notice any patterns for the surfaces that they grow on? Did you find the different types of lichens growing on the same surfaces or near each other? Was there anything else growing near, around, or under the lichen? Ask students to make a possible explanation for why they grow on those surfaces. Remind them what lichens need to survive.</p>



Lichen Key

Decide if your lichen resembles one of these three kinds:

Crusty: Crustose

crust-like, growing tight against the rock, wood, or other substrate. Paint-like.



Leaf-like: Foliose

with flat sheets of tissue that are not tightly bound. Usually attached to rock or wood in just one place.



Shrubby-Fruticose

free-standing branching tubes.

Often like a beard, hangs down. Looks like a small bush



Images from pexels.com