

LICHENS

This activity examines lichens, a community of organisms that has significance in food webs and can provide information about air quality.

Objectives for Exam #1:

1. Describe the processes of photosynthesis and respiration in relationship to lichens.
2. Given a lichen specimen, image, or description, classify the lichen and describe its basic structure.
3. Provide examples of basic human uses of lichens.
4. Explain how water and pollutants, including acid rain, impact lichens.

Objective for Portfolio #1:

Identify, draw, and label lichen organisms viewed with a microscope.

Safety:

Microscope slides can break easily. Report any broken glass.

Part I: Lichen Stations

Station A: What is a Lichen?

1. At first lichens may look like a single organism, but they are actually a community of two or more species living together. Different species living in close association over time is called **symbiosis**. In the case of the lichen, the structure we see is a fungus, and living inside the fungus is one or more different species that can photosynthesize. We will cover **photosynthesis** in more detail next week, basically it is a chemical process that uses sunlight energy to convert carbon dioxide into sugars and other organic compounds. **Pigments**, particularly green pigments, are involved in absorbing sunlight. *Thought Question:* Which green organisms do we usually think of when we think of photosynthesis? _____
2. Microscopic species of algae and cyanobacteria can also photosynthesize, these are the organisms living inside of fungi making up the lichen community. Study the lichen at your table. The primary structure you can see is the _____, also called the **mycosymbiont** (meaning “fungus partner”), the greenish color (or blue-green) is from the smaller organisms living inside, which are either _____ or _____, also called the **photosymbionts** (meaning “photosynthetic partners”).

Station B: Photosynthesis and Respiration

1. Using the *Carbon Cycle* poster as a reference, plants and other organisms like algae and cyanobacteria remove carbon dioxide from the atmosphere and use it for the process of _____. Carbon dioxide can leave the atmosphere and enter oceanic waters through the process of _____. Through sedimentation of the remains of organisms, carbon can be stored in _____ rocks (limestone). Over the long term, partially decayed organisms were converted into the fossil fuels: natural gas, oil, and coal. Through drilling and mining, these can be removed from the earth, and the carbon dioxide from these fuels is released into the atmosphere through the process of _____.
2. **All** organisms carry out the process of **respiration**. Respiration is using sugars and oxygen for cellular activity, releasing carbon dioxide, a bit of water, and heat energy. Some organisms can also carry out **photosynthesis**, which is almost the opposite reaction. Photosynthesis requires carbon dioxide and _____ in the presence of sunlight energy to produce sugars and oxygen. Lichens are fungi with photosynthesizing algae or photosynthesizing cyanobacteria living inside. Which of these organisms carry out the process of **respiration**? _____

Station C: Lichens vs. Mosses

1. Lichens are often confused with mosses. Mosses are classified in *Domain Eukaryota* and *Kingdom* _____, lichens are not. Looking at the tree limb covered in mosses and lichens, how can you distinguish mosses from lichens?
2. Lichen communities include a fungus and the smaller photosymbionts algae or cyanobacteria. Fungi are classified in *Domain Eukaryota* and *Kingdom* _____. Algae are classified in *Domain Eukaryota* and *Kingdom* _____, and cyanobacteria are classified in *Domain* _____.

Station D: Lichen Classification

1. Classifying a community of organisms is challenging. Lichens are often classified by the growth form the fungus takes. The three most common growth form categories used are: **crustose**, **foliose**, and **fruticose**. From the lichen display provided, describe what each of these growth forms looks like.

Growth Form	Description
Crustose	
Foliose	
Fruticose	

2. Looking at the photo below (and sample provided), this lichen found on campus can be classified as a _____ growth form.



3. A lichen is a community: fungus with smaller photosynthesizing organisms living inside. Typically the scientific name we give to a lichen refers to the fungal partner. This can be confusing, because the same fungal species in a lichen can have a completely different growth form determined by the type of photosymbiont organisms living inside of them. From the mini-poster provided, the lichen *Sticta felix* has a _____ growth form when it contains green algae, and a _____ growth form when it contains cyanobacteria.

Station E: Significance of Lichens

1. Lichens play an important role in many food webs. From the display provided, list some of the organisms that eat lichens:
2. *Thought Question:* Lichen communities produce almost 1000 chemical substances not produced by other organisms. Some of these chemicals give lichens a unique color or make them toxic. How can color and/or a toxic chemical protect a lichen community?
3. From the material provided describe a few human uses for substances found in lichens.

Station F: Lichen Growth

1. In drought conditions, like summer in Corvallis, the organisms in a lichen community can be relatively inactive. From the data provided, explain what happens to photosynthesis and respiration in a lichen at low water content (approximately 20%) and high water content (approximately 75%).
2. Lichen communities are typically slow growing, some types grow less than 1.0 mm length/year. Lichens grow in three dimensions, but the primary growth for many species is in diameter. A lichen was traced on a piece of acetate. Looking at the acetate, approximately how long ago was this tracing made? _____ Gently lay the acetate over the lichen, lining up the marks on the tree bark with the corresponding marks made on the acetate. Using the provided ruler, approximately how much has the lichen grown in that time period? _____ mm. Has it grown more in one direction than another? _____ Why may a lichen community benefit from growing in a certain direction?

Station G: Air Pollution and Acid Precipitation

1. Many compounds react with water molecules as they move from one part of the water cycle to another. From the poster, sulfur dioxide can react with water to produce _____ and nitrous oxide can react with water to produce _____.
2. Some species of lichens are extremely sensitive to acidic precipitation. One lichen in particular, *Lobaria pulmonaria* ("tree lungwort") is extremely susceptible to acidic conditions, it cannot even grow on acidic barks. From the map provided, *Lobaria* can be found _____. From the *Plants of the Pacific Northwest Coast* book (which includes lichens too), what does *Lobaria pulmonaria* look like (p. 489)? _____ Easy to identify appearance and widespread distribution make *Lobaria* a commonly used **biotic indicator** of acid precipitation in the environment. Biotic indicators are organisms used to detect particular aspects of environmental conditions (like acidity, pollution, climate, etc.).

3. Lichens can be used a biotic indicator species for many air pollutants. The first large-scale air quality monitoring program using lichens was started in the Pacific Northwest, following a protocol developed at OSU. The data is accessible from the U.S Forest Service *National Lichens & Air Quality Database and Clearinghouse* website (<http://gis.nacse.org/lichenair/>). Select Lichen Images from the left column and from the pull-down menu click on Effects of Pollution. How does the bark of red alder trees differ in areas with air pollution?

Part II: Labeled Lichen Microscope Drawing (for Portfolio #1, stamp required)

Skill: Identify, draw, and label lichen organisms viewed with a microscope.

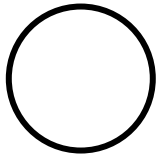
Assignment: In the space provided on the next page, draw and label the “live” lichen you observe under the microscope. Include **both** the mycosymbiont (fungus) and the photosymbionts (algae or cyanobacteria). You may need to search for the smaller organisms, use the handout for guidance. Once you locate the photosymbionts, start to make your drawing. In addition to labeling the organisms, include the magnification used next to the labeled drawing.

Assessment: This assignment is worth 3.0 points: 1.0 point for the drawing (0.5 point for correctly drawing the mycosymbiont, 0.5 point for correctly drawing the photosymbiont); 1.5 point for labeling the organisms (0.5 point for correctly labeling the mycosymbiont, 1.0 point for correctly labeling the photosymbionts); and 0.5 point for the correct magnifications. The microscope drawings need to be completed and stamped in recitation or during GTA office hours weeks 1 or 2 (no later) to receive credit for this assignment.

Procedure:

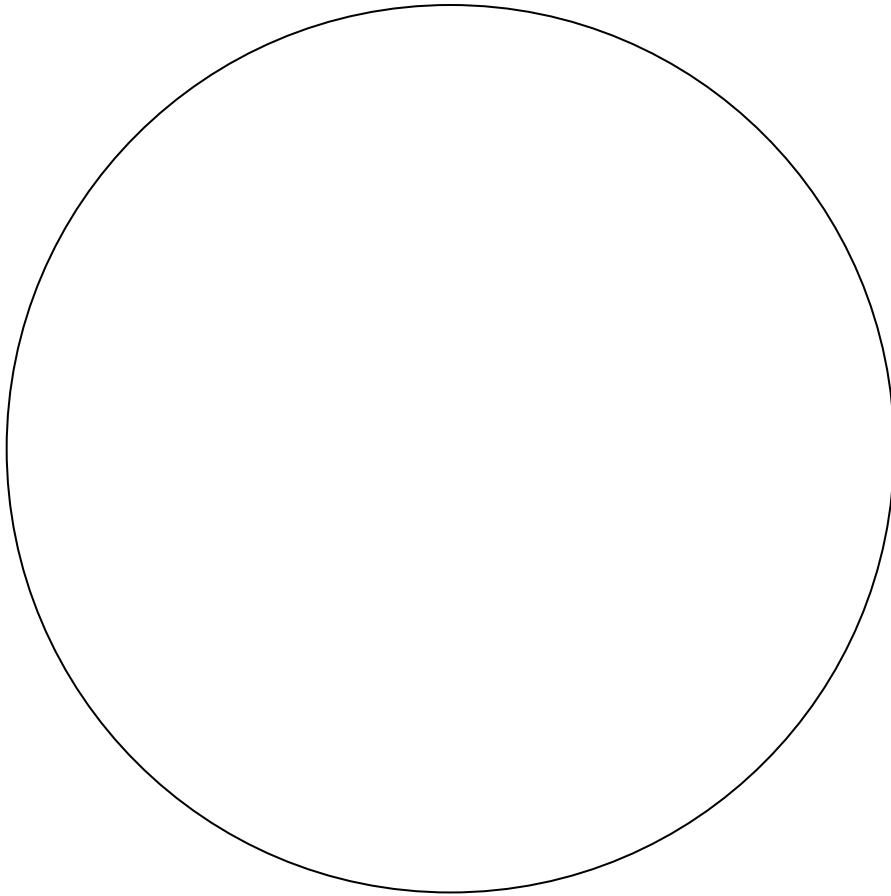
1. Turn on the microscope if the light is not already on (bottom front left switch). Use the focus knobs (back, right and left sides) while looking through the eyepieces to find the specimen.
2. Fungal filaments (hyphae) look like clear threads. The cyanobacteria and algae are small, green, or blue-green, and circular or bead-like. These can be very hard to find, even with a 40X objective. **Find both organisms in the same view before you start your drawing.**
3. Once you find the area you want to draw, determine the total magnification of your specimen. Multiply the power of the *objective lens* by the power of the *eyepieces* (10X). For instance, the “4X” lens gives a total magnification of 40X (4 times 10 = 40X). Write the magnification you are using next to the labeled drawing.
4. Draw and fully label what you see under the under the microscope. Take turns at the microscopes. These are fragile pieces of equipment, remember, ***microscopes are not to be moved, switch places with other students instead.***
5. Everyone should have an opportunity to scan a lichen microscope slide, find his/her own area to draw, and **make a unique labeled drawing.**

The next page will be included in Portfolio #1,



STAMP

Labeled Lichen Microscope Drawing
(Include this stamped page in Portfolio #1)



_____X
(magnification used)

