

DON'T TAKE A "LICHEN" FOR POLLUTION*



OBJECTIVES

The student will do the following:

1. Recognize three different kinds of lichens.
2. Measure lichen coverage using grids.
3. Predict air quality based on types and amounts of lichens present.

SUBJECT:

Science

TIME:

1-2 class periods

MATERIALS:

small marking flags (10 of 1 color for each student group, numbered 1-10)
envelopes to store flags
masking tape
erasable felt-tip markers
lichen grid transparencies (master included)
pencils with erasers
graph paper (1 per group of 2)
clipboards (optional)
student sheets (included)

BACKGROUND INFORMATION

Lichens (pronounced *likens*) look like plants but are really two types of plants, fungi and algae, growing so closely together that they look like single organisms. Scientists still do not fully understand the relationship between the fungi and algae that make up lichens. They are often considered symbiotic organisms—mutually beneficial to each other. The photosynthesizing algae provide food for both, while the fungi appear to provide moisture, minerals, and support. However, lichen fungi cannot live without their algae partners, while most of the algae can live by themselves. This may mean that the fungi are parasites, using the algae to obtain food and giving little to the algae in return.

Whatever the relationship between the algae and fungi, it is a highly successful one. Lichens often grow in locations where most other plants cannot—bare rocks, tree trunks, bare soil. In some of these locations they play an important role helping soil formation. By interacting with the bare rocks to help break them down chemically and by trapping dust and organic matter from the air, lichens often start to create and enrich soil where other plants can eventually grow. Every natural habitat from deserts to rain forests has lichens. They are able to survive extreme conditions of heat, cold, and drought. However, few species of lichens can survive air pollution, particularly acid air pollution.

Lichens come in a variety of sizes, shapes, colors, and textures. Lichens are often divided into three classifications—crusty, leaflike, or shrubby. Crusty lichens usually grow flat on rocks and tree trunks and may be embedded in these surfaces. Crusty rock lichens are colorful and range from oranges and yellows to greens, browns, grays, and blacks. Leaflike lichens have lobed surfaces that are only partially attached to other surfaces. Shrubby lichens are branched and either stand upright or hang from other surfaces. Leaflike and shrubby lichens are usually some shade of green. Lichens are often confused with moss, but

* This activity is adapted, with permission, from the activity "Lichen Looking" found in the Outdoor Biological Instructional Series (OBIS), developed by the Lawrence Hall of Science, University of California, Berkeley, California.

real mosses are tiny plants with leaves and stems. Because lichens were once mistakenly classified with mosses, some common lichens were named Reindeer moss, Oak moss, and Iceland moss.

Lichens are extremely sensitive to air pollution and sometimes can be used as indicators of air quality. Scientists study both the type of lichens present and the size of the lichens. Shrubby and leaflike lichens can only survive in clean air. Lichens are relatively rare in large cities and in areas of very heavy air pollution, there are no lichens of any type. The size of the lichens present is also important. Larger individual lichens generally mean better air quality. In 1971 an air quality map of the British Isles was made based on an evaluation of lichen presence and growth.

Lichens are also valuable for evaluating air quality in another way. Lichens accumulate metals and other elements from rainwater and dust. By analyzing lichens that live near emission sources for chemicals which indicate pollution, scientists can determine how far the pollution has spread.

PROCEDURE

I. Setting the Stage

- A. Share the background information with the students and explain to the students that they are going to be looking at lichens. Hand out copies of the student sheet "KINDS OF LICHENS" (included). Point out the three different classes of lichens.
- B. Explain why lichens are used as air quality indicators. Distribute copies of the student sheet "LICHENS AS POLLUTION INDICATORS" (included). Explain how the types and amounts of lichens present are used to measure air quality.
- C. Distribute transparencies of the "LICHEN GRID" (included). There should be one transparency distributed for every 2-3 lichens the students are going to check for size. Demonstrate how to trace a lichen onto the grid and how to count the number of square centimeters the lichen covers. NOTE: Count partially covered squares as 0.1-0.9. Have the students hold the grid over a lichen (without touching it) and draw the outline on the grid. Erasable felt-tip marker can be wiped off later and the transparencies can be reused.
- D. Distribute copies of the student sheet "MEASURING AIR QUALITY WITH LICHENS" (included).

II. Activity

- A. Transport the class to a field location where lichens are present and describe the boundaries of the activity site. Make sure to take the handouts, "LICHEN GRIDS," and felt-tip markers to the field location. CAUTION: Remind students to watch out for poison ivy. Describe it to them if necessary.
 1. Challenge the students to locate all the places where lichens live at the site. Divide the students into pairs or teams. CAUTION: Warn students not to touch the lichens or disturb them in any way because any damage to them would be long lasting.
 2. Give each team an envelope with 10 flags and some masking tape. Have teams mark where they found lichens with the flags by poking the flags into the ground near the lichens or by taping flags next to rock lichens. Give them 10 minutes to do this.
 3. Have the students map the area on a piece of graph paper and mark locations of the flags. Allow 10 minutes for this. NOTE: To reduce confusion and/or to get more consistent results, you may draw a map of the study area ahead of time and copy it for the students. It should be as simple as possible, outlining the area and indicating major features such as tree trunks (represented as circles), rocks, logs, and other possible sites for lichens.

4. Have students write on the map, under each of their own lichen locations, the number and the type of lichen(s) found.
 5. Give each team 2 or 3 transparencies of the student sheet "LICHEN GRID" (included) and have them trace several different lichens onto each transparency with a felt-tip marker. Make sure the students record the location number for each lichen. Allow 5 minutes for each tracing. NOTE: Ideally all lichens the students have identified (10 per student group) will be measured. After the students have measured 1 or 2, the rest will go faster. The students should measure at least 3 each. (See the note in I.C. for more information.)
 6. Be sure to remove flags before you leave the site.
- B. After finding, mapping, and measuring the lichens, the students should complete the following tasks. These should be done at the study site or in the classroom.
1. Have the students count how many square centimeters in size their lichens are. Have the students place the sizes of the lichens beside the appropriate sites on their maps.
 2. Student groups should enter information about their lichens (location, kind, and size) on a master map so that the whole class can see the pattern of lichen growth on the study site. NOTE: You may want to duplicate this master map for all the students before the class discusses it.
- C. Discuss the results with the students.
1. What kinds of lichens are found at the study site? Using the student sheet "LICHENS AS POLLUTION INDICATORS," assess air quality using the lichen type.
 2. What size are the lichens? Using the student sheet "MEASURING AIR QUALITY WITH LICHENS," assess air quality based on size.
- D. Ask the students to draw conclusions based on the lichen study. Have them answer the following questions.
1. Are the results the same using both methods?
 2. Look at the site map. Describe where you found the biggest and smallest lichens and why.
 3. Do you think air quality is affecting lichens at this site? Why or why not?

III. Follow-Up

Remove one of the lichens from the study site. Take it to a biology department at a local college or university and have them chemically analyze it for metals. Is there any evidence of pollution? If so, ask them where they think it is coming from and what could be done to prevent the problem.

IV. Extension

Select several sites at various distances from a known air pollutant source and conduct this activity at each site. Compare the results. Can you see a measurable decrease in lichen populations as you move toward the air pollution source?

KINDS OF LICHENS



Crusty



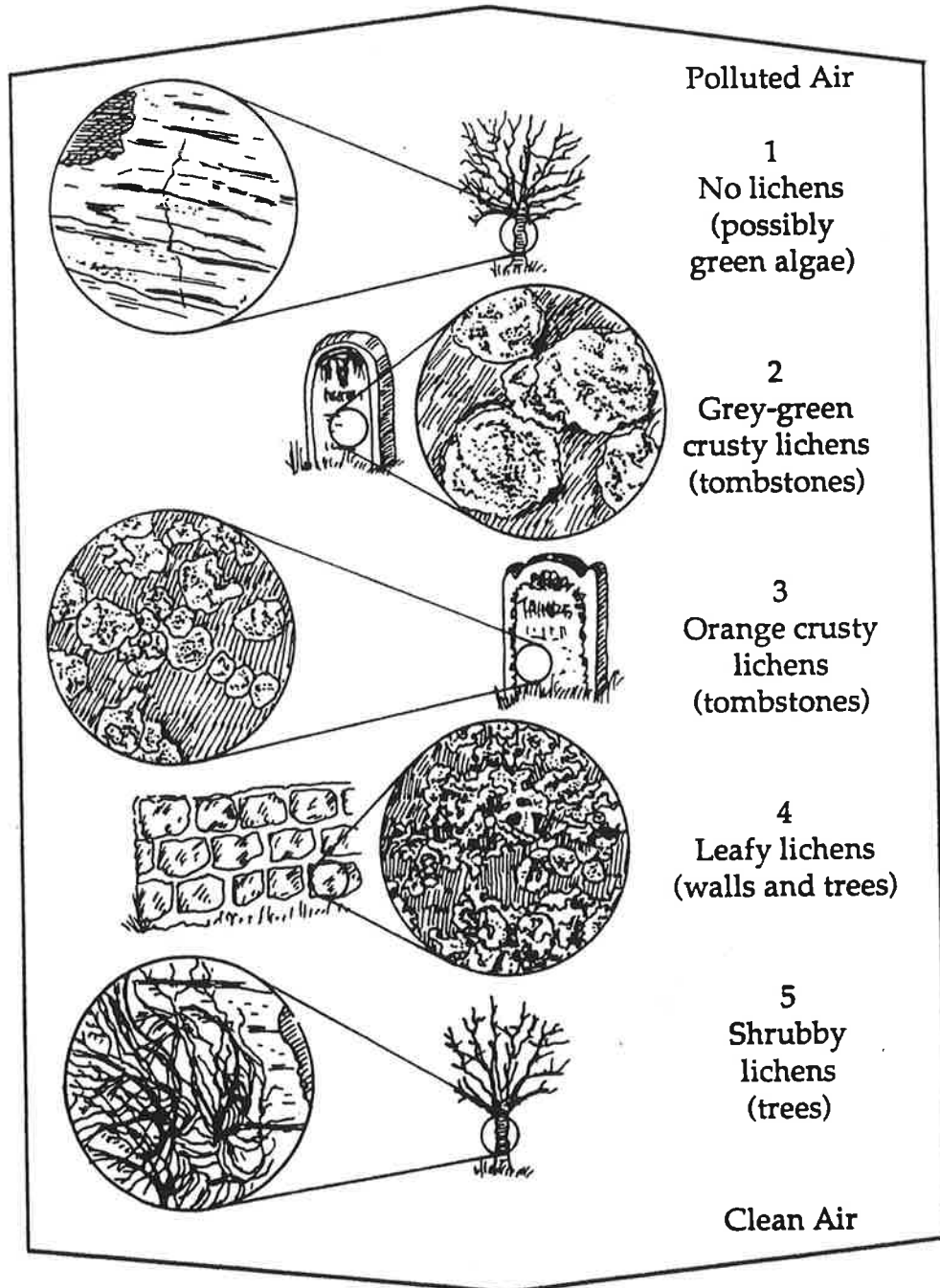
Leaflike



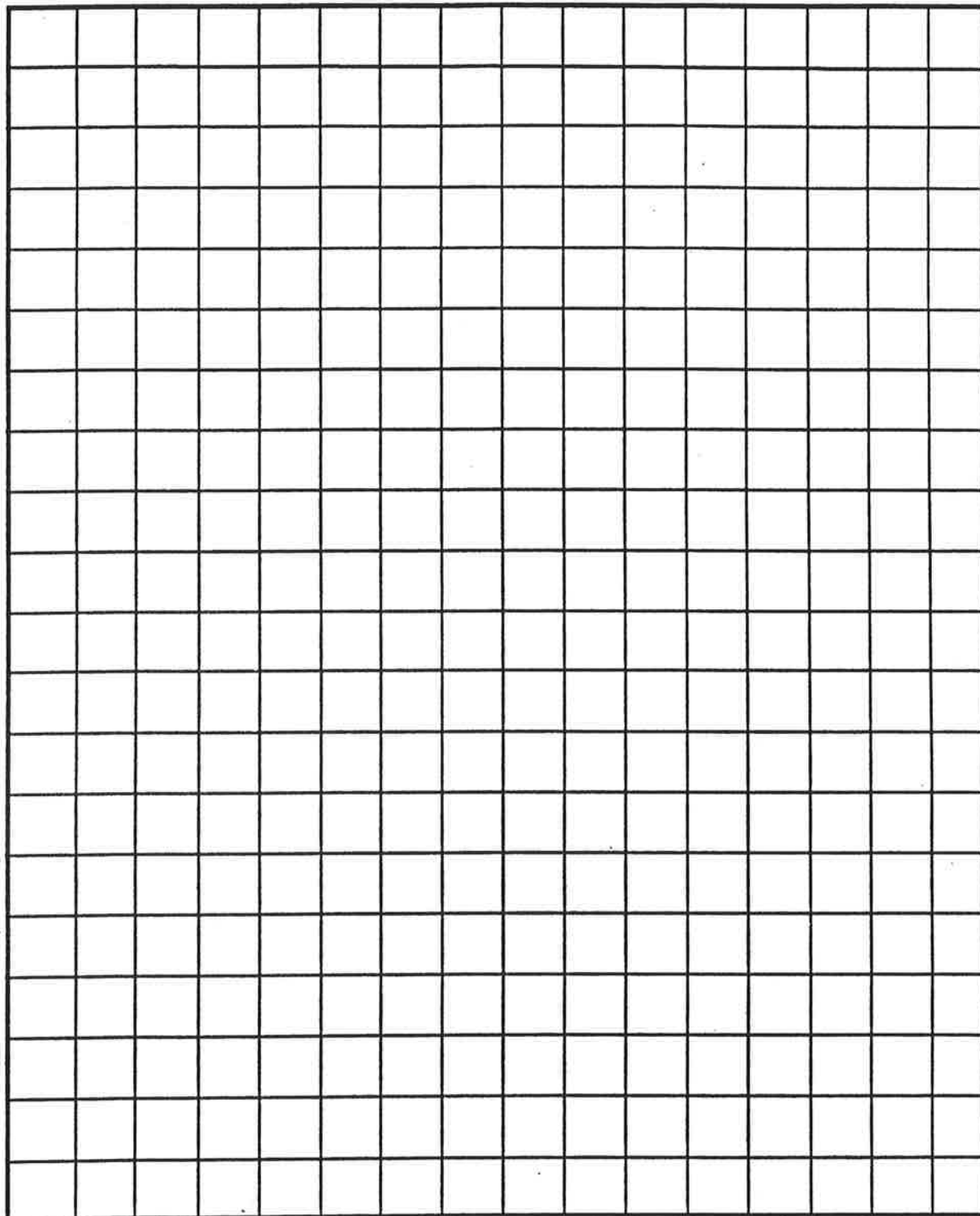
Shrubby

LICHENS AS POLLUTION INDICATORS

Plants called lichens are sensitive to air pollution, especially the air's acidity. So, you can use their presence or absence to see how clean the air is. Shrubby and leafy lichens only survive in clean air. In the most polluted areas there are none at all. Look for lichens on walls, stones, and trees, and use this scale to rate the air quality. NOTE: Different lichen types can be found in the same area. To use this scale, decide which lichen type is most common in the study area.



LICHEN GRID



MEASURING AIR QUALITY USING LICHEN SIZE

SIZE (Square Centimeters)	AIR QUALITY
10-12	Excellent
7-9	Good
4-6	Fair
0-3	Poor

Don't Take a "Lichen" for Pollution

This is a story about Franny Fungus and Al Alga. Now Franny was an excellent carpenter. She took great pride in building wonderful and sturdy structures. And Al Alga – well, Al was a world-class chef. He enjoyed cooking all kinds of dishes.

One day, Al and Franny met each other and took an immediate "lichen" to each other. They decided to spend the rest of their lives together. So, Franny built and maintained their home while Al spent his time preparing their meals.