



Lichens as Biomonitors

Terrestrial Ecology Extension Activity

Chris Lundberg, Program Coordinator, Mathematics & Science Center

Adapted from “Biomonitoring,” DuPont Air Quality Simulation at the Mathematics & Science Center, 1996 and developed with funding from the Mathematics & Science Center

Question

Living organisms, such as lichens, can be used as an indicator of air quality. These organisms that tell us about the health of an environment are termed “biomonitors.” The type of lichens that you may find around your home or school can tell you a lot about the health of the air around you. This is an activity designed for your students to use their observation and measuring skills to analyze air quality in a specific area.

Background

Did you know that plants and animals can tell us about the health of our environment? Living things CAN monitor the health of an environment, and we call these organisms “**biomonitors.**” In this activity you will be using a unique living organism called lichens (a combination of a plant and a fungus) in order to determine the quality of the air you breathe.

Lichens are small plants that look somewhat like a moss. Actually, lichens are a combination of a fungus and an alga (plant) growing together in a relationship called **symbiosis**. Symbiosis means that each member benefits from the other. In this case, the alga makes the food, and the fungus collects water. Lichens tolerate extremes of both temperature and lack of water and they often thrive in places where you would not expect to find living things, such as growing on bare rock.

Since lichens have no roots, they absorb much of their raw materials directly from the air and moisture around them. This makes them very sensitive to air pollution and acid rain. And, since lichens have no way to excrete the pollutants they absorb, these materials stay inside of their cells. Since pollutants build up inside them, lichens can be used to monitor long-term accumulation of pollutants such as lead from rainwater and dust. Scientists collect and analyze lichens near sources of pollution to determine how far the pollution has spread.

Safety Remember to follow your regular classroom rules for lab safety.




Materials 3 different lichen samples (or any samples that you can collect)
[Lichen Grid Transparency](#)
Transparency marking pen
Handout

Procedure Obtain your transparency and your lichen samples. Review the information below and use it as a basis for conducting your analysis of your lichen samples.

Observing Lichens

Lichens are categorized in three basic types: crusty, leaf-like, and shrubby. Since shrubby and leaf-like lichens only survive in clean air, a scale can be created to rate air quality by the types of lichens found in an area. In strongly polluted areas, there are no lichens of any type.

Observe the common kinds of lichens found in Virginia in Table 1. See if you can identify your samples based on this information.

Table 1: Common Kinds of Lichens in Virginia		
 <p>Crusty</p>	 <p>Leaflike</p>	 <p>Shrubby</p>

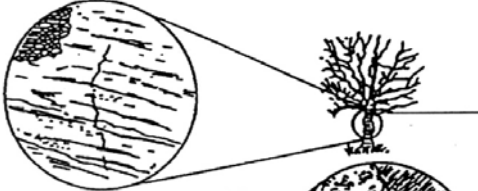


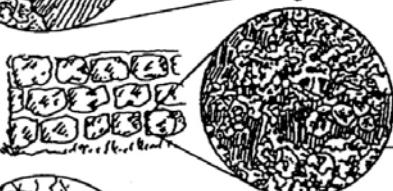

Sizing-up Lichens

The size of lichens is a good indicator of air quality. Other factors, such as age and amount of sunlight, can affect their size. But assuming standard conditions for growth, the next table shown can be used to use lichen size to determine air quality.

Table 2: Lichen Size and Air Quality	
Size (Square Centimeters)	Air Quality Rating
0 – 3 cm.	Poor
4 – 6 cm.	Fair
7 – 9 cm.	Good
10 – 12 cm.	Excellent

Examining the Type of Lichens

Finally, an examination of the type of lichens found will indicate the relative air quality. Review Table 3 to see which types of lichens you can expect to be found in various levels of air quality.

Table 3: Lichen Types and Air Quality	
	Poor Air No Lichen
	Fair Air Gray-Green Crusty Lichens
	Fair Air Orange Crusty Lichens
	Good Air Leafy Lichens
	Excellent Air Shrubby Lichens

Now, continue to use the information from this handout and the lichens that you have collected to perform the following investigation.

Directions for Lichens Activity

1. Use the [Lichen Grid Transparency](#) with your three lichen samples and the information from Tables 1, 2 and 3 to conduct this investigation.
2. Label your samples: Sample #1, Sample #2, and Sample #3.
3. Hold the grid over each of the lichen samples and trace the outside shape of each lichen on a separate part of the transparency.
4. Count the number of squares inside the traced area. Each square represents one square centimeter and will give you the approximate area of the lichen sample.
5. Observe the color and determine the type of lichen for each sample.
6. Using the sizes you calculated and information from Tables 2 & 3, assign an air quality rating to each lichen sample.
7. Record your measurements and observations on the table below. Then answer the questions.

Data

Data Table: Lichens as Air Quality Biomonitors				
Sample	Color	Lichens Type	Size (cm²)	Air Quality Rating
# 1				
# 2				
# 3				

Questions / Conclusions

1. Which of the samples was the largest? _____
2. Which type of lichen could come from an area of high air quality?

3. Which type of lichen might indicate air of moderately poor quality?

4. Do any of the samples indicate very polluted air? _____
5. Are there other organisms that can serve as indicators (monitors) of air quality? Name a few.
6. Lichens, because of their unique characteristics, also play an important role in ecological succession of a particular area (for example, the restoration of an area burned by a forest fire). Explain how lichens would be important in such a situation.

Extensions

Learn even more about methods of determining the quality of the air you breathe. Check out the DEQ – the Virginia Department of Environmental Quality at their website: <http://www.deq.state.va.us>