
Lichen Air Quality



Purpose:

- This activity allows students to conduct a survey of the lichens at a study site to determine the air quality at the site. Students will then discuss the causes of air pollution and propose actions that would improve the air quality at their site.

Objectives:

- Students will conduct a survey of the lichens in an area, working in groups and using lichen ID cards to record which species they find.
- Students will compile class data to analyze the air quality at their site.
- Students will describe the likely causes of the observed air quality at their site through think-pair-share discussion.
- Students will propose three actions that they and their community can take to improve or maintain good air quality.

Time Required: 1 hour

Appropriate grades: 6th-9th

NGSS and Common Core Standards:

MS-LS2-4: Construct an argument supported by empirical evidence that changes to physical or biological components of an ecosystem affect populations.

MS-ESS3-3: Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment.

Materials:

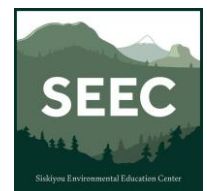
- Lichen specimens – 8 (provided)
- Local lichen ID cards – 4 sets with 8 cards each (provided)
- Common Lichens of the Rogue Valley PowerPoint - located on kit flash drive (provided)
- Whiteboard or butcher paper (not provided)

Activity:

Introduction	Set out lichen specimens for students to look at. Have students observe them closely,
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	<p>and ask them what they think they might be. Compile a list of ideas on the board. Explain that students are looking at lichens – a composite organism created by a fungus and a photosynthetic partner – green algae or cyanobacteria (sometimes both!).</p>
<p>Body</p>	<p>Use the “Common Lichens of the Rogue Valley” PowerPoint to introduce students to the variety of lichens they might see in this area. Highlight the variety of colors and growth forms that lichens exhibit.</p> <ul style="list-style-type: none"> ● <i>Note:</i> lichen genera will be used in lieu of species, as many lichens are difficult to identify to species (lichenologists use chemical tests and microscopic analysis to determine the species for many lichens). <p>Ask students to brainstorm what lichens might need to survive. Make a list of suggestions on the board. If the class needs help, ask them to think about what plants need – lichens need the same things (sunlight, water, and mineral nutrients from the soil).</p> <p>Now ask students to brainstorm how lichens obtain these things.</p> <ul style="list-style-type: none"> ● Lichens obtain and utilize sunlight just as plants do. ● Unlike plants, lichens do not have roots to absorb water and nutrients from soil. Instead, they absorb water and minerals through the air across their entire body surface. <p>Students can imagine lichens to be like sponges, soaking up everything carried in the air. Ask students if they think it is a good thing to absorb everything that is carried in the air? Highlight the potential for air pollution to harm lichens.</p> <p>It turns out that some lichens are more sensitive than others when it comes to air pollution like excess nitrogen or harmful metals. Throughout the world, lichenologists are using lichens as indicators of air quality. The presence or absence of certain genera or species can indicate different levels of air pollution.</p> <p>Field Study – Lichen Air Quality Survey</p> <p>Divide students into small groups for the lichen field study. Provide each group with a set of local lichen ID cards. These cards contain pictures of common lichens along with their sensitivity to air pollution.</p> <ul style="list-style-type: none"> ● <i>Note:</i> the lichen ID cards do not include crustose species. These species can be very hard to identify, and are thus excluded for the purposes of this activity. <p>Each group must formulate a hypothesis before their survey. (Do they expect to find highly sensitive lichens, indicative of good air quality? Do they expect to find only tolerant species, indicative of poor air quality?)</p> <p>Assign each group to a different portion of the survey site. Groups are tasked with</p>



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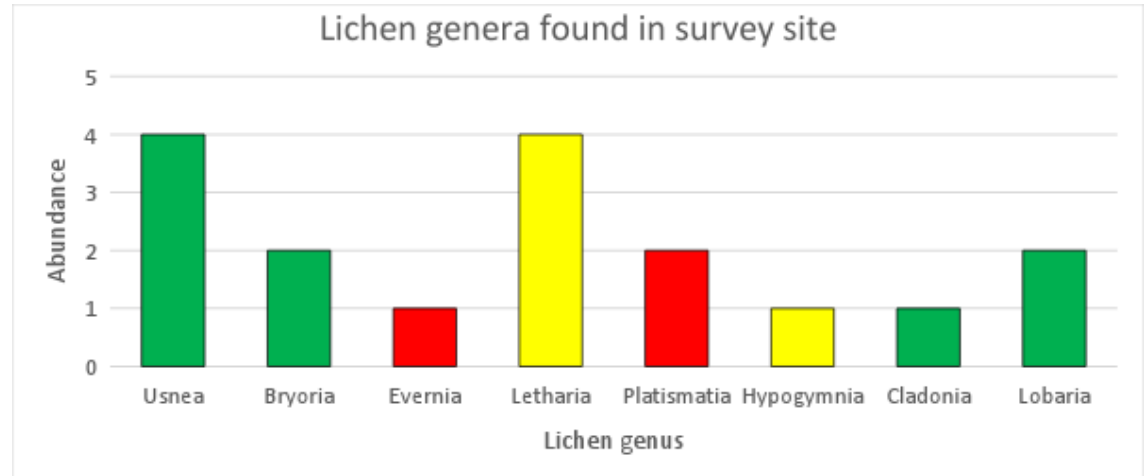
identifying each lichen they find using the local lichen ID cards (i.e. 5 *Usnea*, 4 *Lobaria*, etc.). Have at least one group member record the group's findings in a notebook.

- Encourage students to look closely, and be aware that many different lichens may be present on a single twig or rock.

Provide groups with 15 minutes to survey their portion of the site.

Once the groups have completed their surveys, have them compile the class data in a table (using a whiteboard or butcher paper).

Have each group create a bar graph using the class data. They may choose to use a different color for lichens that are sensitive, intermediate, and tolerant of air pollution. See example below.



Use think-pair-share to discuss the results of the lichen survey with the class.

Discussion questions include:

- Were certain lichen genera more abundant than others?
- What lichens are most common at the site?
- Did our survey support or reject your hypothesis?
- What does our survey indicate about air quality in our community?
- What factors may affect the air quality in our area (near the interstate, near the forest, near farms etc.)?

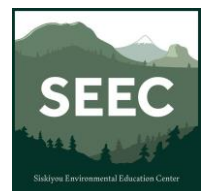
Ask each student to propose three actions that could be taken to improve or maintain good air quality at the site. These can be actions for the student, the school, or the community at large to undertake.

Closure

Conclude by encouraging students to fulfill the actions that they proposed, if possible. There are things we can all do to reduce air pollution. Clean air is in everyone's best interest – including lichens!



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Modifications:

- **Upper High School:**

- Rather than propose three actions that would improve air quality, have high school students work in groups to design a solution for reducing the impacts of air pollution on the study site. Students will summarize their solution in a presentation.
- Have high school students perform lichen surveys at multiple sites. Students can compare findings from different areas, discussing sources of air pollution and how these differ at different sites.



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