

# Lichens



Making the  
**Invisible** Visible

**An Air Pollution Survey**

# HOW THIS SURVEY CAN HELP YOU, YOUR COMMUNITY AND THE ENVIRONMENT

There is no right or wrong way of conducting this survey.

**JUST GET STUCK IN, HAVE A GO**

and see what you discover.  
It's the process of exploration that counts!

## Invisible air pollution

☉ Unlike air pollution of the past that was hard to ignore, because it was smelly and visible as smog, today air pollution is almost invisible. This means we often forget about it. We can overlook the negative impacts it has on our health and the health of the environment.

☉ The air quality in Scotland is generally very good, however in our cities there are 'hotspots' of heavily polluted air. Sometimes the air we breathe can be of very poor quality.

☉ Poor quality air in our cities is mainly caused by cars, trucks and other motorised vehicles burning fossil fuels. Fumes from road traffic contain dangerous gases such as carbon monoxide, oxides of nitrogen, hydrocarbons and particulates.

☉ These pollutants can cause great harm to people who breathe them. They can also react with other gases to create further toxins that are harmful to humans, animals and plants.

**TAKE PART** in this simple lichen survey as an individual or as a group. **IT HELPS YOU** get an idea of the air quality in your local area. **EXPLORE** where you live; your neighbourhood; your place of work or school. **DISCOVER** a range of things that can affect the quality of air. **BE EMPOWERED** to take individual or group action to improve air quality.



# Making the invisible visible

## LICHENS ARE EXTRAORDINARY ORGANISMS!

Easily overlooked, they colonize trees and many other surfaces including soil, stone or rocks and even cut-wood, metal, plastic, cloth and glass.

Most lichens are very sensitive to air pollution

and are used as indicators for environmental health.

**We can look for lichens growing in our local area and the species we find can tell us something about the quality of the air we breathe.**

Lichens are made up of two or more different organisms, living together

in a relationship where each partner benefits the other:

**FUNGI** provide the protective 'home' or body of the lichen.

**ALGAE** make food using energy from the sun, combined with air and water (photosynthesis).

**Together they support each other to live.**



## Lichen identification

Lichens come in many different shapes, sizes and colours. Which lichen is which? Let's take a closer look at the ones to look out for ...



### BLUE-GREY LEAFY (Foliose)

- ☉ Flat leaf-like parts often growing in layers that you can get your nail underneath.
- ☉ Distinct upper and lower surface.
- ☉ Can be whitish or blue-grey in colour.
- ☉ May have peg-like or powdery areas in cracks on the surface.

### CAMOUFLAGED GREEN-BROWN LEAFY (Foliose)

- ☉ Flat leaf-like parts often growing in layers.
- ☉ Often growing very close to the bark and hard to spot – so a very close look is needed to see these.



### FRILLY/BUSHY (Fruticose)

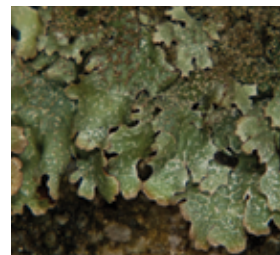
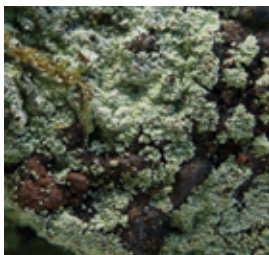
- ☉ Shrubby, bushy or hair-like.
- ☉ No distinct upper and lower surfaces.
- ☉ Attached by, and branching out from a single point.
- ☉ Sticks out or hangs down from the tree trunk or branch.

### Some CRUSTY (Crustose) lichens have 'fruits' which look like JAM TARTS!

- ☉ These lichens form a kind of stain on the surface of the bark or twig.
- ☉ They grow very closely attached to the bark, and can't be peeled off without collecting the bark as well.



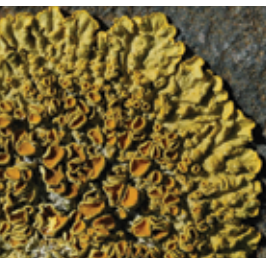
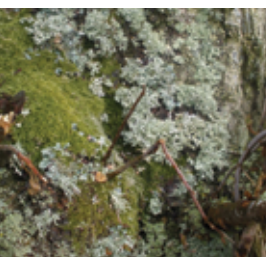
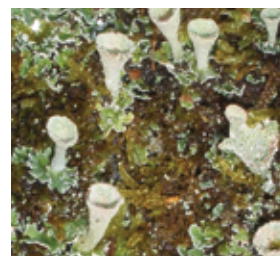




**LOOK CLOSELY**  
for the amazing  
variety of lichen  
shapes, sizes, colours  
and combinations!

Try iSpot to help  
with identifying the  
lichens you find:  
[www.ispotnature.org](http://www.ispotnature.org)

**iSpot**  
share nature





# HOW CLEAN IS THE AIR WHERE YOU LIVE?

## SURVEY PART 1 I am what I breathe

### TO COMPLETE THIS SURVEY YOU WILL NEED:

- ☉ This survey sheet
- ☉ A compass (optional)
- ☉ One piece of plain paper per person
- ☉ A pen or pencil and coloured pencils (optional)

### CHOOSE AN AREA YOU WANT TO SURVEY

This could be where you live, your school and surrounds, or a local park.

Take a moment to stand still in your survey area, close your eyes and take some deep breaths in and out (1-2 minutes).

While you do this see if you can feel the air come in through your mouth, pass down your throat (trace its journey with your hand if you like), and feel the air filling all parts of your lungs ...

Now imagine the air passing through your lungs and into your blood, through your arteries, travelling all the way down to the tips of your toes, along to the tips of your fingers, and right up to the top of your head.

**DOESN'T IT FEEL GOOD!**

## CLEAN AIR

**IS ESSENTIAL** to our daily lives, supplying our blood with oxygen, and maintaining our health.

We breathe approximately 20,000 litres of air into our bodies every day! That's a lot of air isn't it!

Toxins found in microscopic dirt in the air can penetrate our lung tissue and blood stream, and can make us ill.

So we need the air we breathe to be as clean as possible.

# LET'S EXPLORE YOUR LOCAL AREA AND MAP WHAT YOU FIND ...

## SURVEY PART **2a** A sense of place



### HOW DOES THE ENVIRONMENT AROUND YOU AFFECT THE QUALITY OF THE AIR YOU BREATHE?

Roads, tall buildings, local factories, airports, wind direction, the number and type of trees, etc., can all affect the level of air pollution and in turn the lichens that you will find.

#### SUGGESTIONS FOR MAPPING YOUR SURVEY AREA

1. Sketch out a map of your chosen survey area. (You could use the blank page in this booklet).
2. Or print out a simple map of the area you are going to survey.
3. Or find an Ordnance Survey map of the area you want to survey.

#### START EXPLORING

☉ Take a walk around your survey area. Note down the different features you can see from the ground up to the sky (such as paths, open space, individual trees or woodland; hedges or walls; buildings, factories, nearby roads and traffic junctions), and sketch these onto your map.

☉ Now stand in the centre of your survey area, close your eyes and use your senses to experience the world in a different way – be curious.. What can you hear, smell or feel, far away and nearby? Can you feel the wind? Where is it coming from? Does it rush down your street? Can you feel the sun or is it shady? Fumes from passing cars or lorries? Turn to face another direction, do you experience different noises, smells?

☉ Remember to sketch the sources of air pollution onto your map, and note down your thoughts and observations.

# TAKE A MOMENT TO REVIEW YOUR MAP ... IS THERE ANYTHING YOU'VE FORGOTTEN?

## SURVEY PART **2b** A sense of place

### LOOK AROUND YOUR SURVEY AREA USE THE QUESTIONS BELOW AS A CHECKLIST

**1. Which of these best describes the location you are surveying?  
Choose as many of the following that fit:**

- ☐ Street ☐ Rural ☐ Industrial area ☐ Open space ☐ City
- ☐ Playing field or park ☐ Edge of woodland ☐ Residential area
- ☐ Town ☐ Churchyard ☐ Farmland ☐ Garden ☐ Wasteland ☐ Upland

**2. Where are the roads? What type of roads are they?**

- ☐ Busy ☐ Quiet ☐ Ring-road ☐ Dead-end ☐ Busy at certain times of the day?

**3. Is it a very shaded place? Is it a very windy place?**

**4. Is the area built up? Are there lots of tall buildings?**

**5. Is it mainly buildings, roads and pavements? Or is it mainly single storey houses, grassy areas and open views?**

### NOW THINK ABOUT YOUR SURVEY AREA AS A WHOLE, REFLECTING ON THE INFORMATION YOU'VE FOUND

**How might the structure of your area affect the level of air pollution in it?**

Research shows that different features in a landscape/survey area might affect the quality of the air. Hotspots of high pollution have been shown to occur near busy roads and at busy road junctions. Trees can help absorb some air pollutants, whilst tall buildings can make air pollution worse by reducing air flow and trapping polluted air.





**DRAW A MAP OF YOUR SURVEY AREA ...**



# IT'S TIME TO LOOK MORE CLOSELY AT THE TREES AND LICHENS IN YOUR SURVEY AREA

## SURVEY PART 3 Taking a closer look

Mark trees onto your map if you haven't already.  
Now read the questions below carefully.  
Look at the tree trunks and circle the answer that fits best (A, B or C) for each. If the trees are very small, look at the whole tree. Use the descriptions and images of the different types of lichens in this booklet to help you.

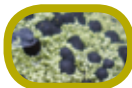
- 1 Find the **ONE TREE** in your survey area that has **THE MOST BUSHY** lichens on the **SOUTH SIDE** of the tree trunk (use your compass or the sun to find the south side). Now count how many of these **BUSHY** lichens you can see. Are there ...

- A None
- B One to several
- C Covering more than a quarter of the south side of the tree



- 2 Now find the **ONE TREE** in your survey area that has the most lichens of **ANY SORT** on it. **FOR ALL SIDES OF THE TREE** together – north, south, east and west. Count how many **DIFFERENT TYPES** of lichen can you spot. Are there ...

- A None
- B One to ten
- C More than ten



- 3 For the next three questions explore between 4 and 10 trees in your survey area. Count how many of these trees have **BLUE-GREY LEAFY** lichens on them. Are there ...

- A None
- B Some, but fewer than half of the trees examined
- C More than half of the trees



- 4 Now looking very closely again at the same 4-10 tree trunks, count how many have **CAMOUFLAGED GREEN-BROWN LEAFY** lichens on them. Are there ...

- A None
- B Some, but fewer than half of the trees examined
- C More than half of the trees



- 5 Looking even closer, count how many of the 4-10 tree trunks have tiny '**JAM-TART**' lichens on them. Are there ...

- A None
- B Some, but fewer than half of the trees examined
- C More than half of the trees



# WHAT THE LICHENS YOU'VE IDENTIFIED TELL YOU ABOUT YOUR LOCAL AIR QUALITY

## SURVEY PART 4 The results

What do the results mean for you, your community and the environment? Add up the number of answers that were A's, B's and C's.

### MOSTLY A'S

Uh-oh, don't breathe too deeply. The air quality is probably not very good here.

Can you think of any reasons why this is? Look around you and at your map and think about the main source of pollution. Are you next to a very **busy road**? Is this made worse because you are surrounded by **high buildings**?



### MOSTLY B'S

Well not bad, but could be better. The air quality may be intermediate.

Do you think that the air quality may be improving or getting worse? Look around you and at your map and think about the balance between the healthy or polluted aspects of your survey area.

### MOSTLY C'S

Good for lichens and for you! The air quality in your area seems to be good.

Why this might be? Look around you and at your map for clues.

### EXPLORING THE ACCURACY OF YOUR RESULT

Does the result make sense? In science there are always limitations to results. The results you get (in this case mostly A's, B's or C's) cannot be seen as THE FINAL ANSWER – but they can be an important clue, and a spur to asking more questions. Research shows that there are many factors that can affect the number and type of lichens growing in your survey area, such as the amount of light and shade, or different tree species. For example, trees that don't drop their leaves (evergreens) or trees with very dense leaf cover (like beech), can create too much shade for lichens to grow. Historic pollution may also still be stopping lichen growth.

You might get a different result if you choose different trees in your survey area. Why not have another go and see if your result changes! If the result is the same, you can have more confidence in your answer.



# POSITIVE ACTION FOR CLEANER AIR

**sustrans**  
JOIN THE MOVEMENT

**www.sustrans.org.uk**

A UK charity enabling people to travel by foot, bike or public transport for more of their daily journeys.

## JOHN MUIR AWARD

Why not do this survey as part of your JOHN MUIR AWARD

[www.johnmuirtrust.org/john-muir-award](http://www.johnmuirtrust.org/john-muir-award)

## FIND OUT MORE ABOUT YOUR LOCAL ENVIRONMENT AND AIR QUALITY

- ☉ [www.environment.scotland.gov.uk/air-quality/](http://www.environment.scotland.gov.uk/air-quality/)
- ☉ [www.environment.scotland.gov.uk/get-interactive/](http://www.environment.scotland.gov.uk/get-interactive/)

## AIR QUALITY AWARENESS INDOORS AND OUT

- ☉ [www.cleanerairbetterhealth.eu/en/](http://www.cleanerairbetterhealth.eu/en/)
- ☉ CITI-SENSE Social networking platform [co.citi-sense.eu/](http://co.citi-sense.eu/)

## NEXT STEPS

- ☉ OPAL Air Survey  
[www.opalexplornature.org/AirSurvey](http://www.opalexplornature.org/AirSurvey)
- ☉ CEH Lichen-App  
[www.apis.ac.uk/nitrogen-lichen-field-manual](http://www.apis.ac.uk/nitrogen-lichen-field-manual)

## SHARE YOUR DISCOVERIES

Make a display of your survey map and photos for your friends and family.



**YOU CAN HELP MAKE  
THE AIR IN YOUR LOCAL  
AREA CLEANER BY**  
reducing short car journeys...



... TRY  
walking,  
cycling or  
scooting.  
**IT CAN  
REALLY  
COUNT!**



# RESOURCES, ACTIVITIES, LINKS



## LEARNING RESOURCES FOR ENTRY TO SENIOR LEVEL

- © **Scottish Government** [www.scottishairquality.co.uk/education/](http://www.scottishairquality.co.uk/education/)
- © **Scottish Environment** [www.environment.scotland.gov.uk/get-learning/air/](http://www.environment.scotland.gov.uk/get-learning/air/)
- © **OPAL** [www.opalexplornature.org/survey-curriculum-links](http://www.opalexplornature.org/survey-curriculum-links)
- © **SEPA and North Lanarkshire Council** [www.learnaboutair.com/](http://www.learnaboutair.com/)
- © **UK Air Pollution Information System (APIS)** [www.apis.ac.uk/](http://www.apis.ac.uk/)



## FIND OUT MORE ABOUT LICHENS

- © **Royal Botanic Garden Edinburgh** [www.rbge.org.uk/the-gardens/edinburgh/garden-features/lichens](http://www.rbge.org.uk/the-gardens/edinburgh/garden-features/lichens)
- © **Scottish Natural Heritage** [www.snh.gov.uk/about-scotland-nature/species/lichens/](http://www.snh.gov.uk/about-scotland-nature/species/lichens/)
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- © **The British Lichen Society** [britishlichensociety.org.uk/](http://britishlichensociety.org.uk/)



Royal  
Botanic Garden  
Edinburgh



edinburgh  
LIVING LANDSCAPE



Esmée  
Fairbairn  
FOUNDATION

## HOW AND WHY THIS SURVEY CAME ABOUT

The survey is based on research about Lichens as Air Quality Indicators, as part of the Edinburgh Living Landscape initiative. It seeks to empower local communities through air quality monitoring, making links between biodiversity, environmental and human health.

**Photo credits:** Front cover and other images - Mike Sutcliffe@britishlichens.co.uk. Orange peel fungus - H. Krisp (own work) [upload.wikimedia.org/wikipedia/commons/8/86/Aleuria\\_aurantia\\_fungus\\_orange\\_peel\\_%28second\\_view%29.jpg](http://upload.wikimedia.org/wikipedia/commons/8/86/Aleuria_aurantia_fungus_orange_peel_%28second_view%29.jpg). Algae - F. Iamiot (own work) [upload.wikimedia.org/wikipedia/commons/5/59/EutrophicationEutrophisationEutrophierung.jpg](http://upload.wikimedia.org/wikipedia/commons/5/59/EutrophicationEutrophisationEutrophierung.jpg). *Parmelia sulcata* - James Lindsey at Ecology of Commanster [upload.wikimedia.org/wikipedia/commons/3/30/Parmelia\\_sulcata\\_-\\_Lindsey.jpg](http://upload.wikimedia.org/wikipedia/commons/3/30/Parmelia_sulcata_-_Lindsey.jpg). *Melanelixia fuliginosa* - Jerzy Opióła (own work) [upload.wikimedia.org/wikipedia/commons/4/42/Melanelixia\\_fuliginosa\\_BP2\\_%282%29.JPG](http://upload.wikimedia.org/wikipedia/commons/4/42/Melanelixia_fuliginosa_BP2_%282%29.JPG). Chandra-Prasad/Sustrans - youngster cycling along traffic free path. North Edinburgh traffic free cycle way. Other images: OPAL Air Survey, TCV Scotland, Natural History Museum University of Oslo.