

Cleaner Air 4 Primary Schools Toolkit



Transport
for London

MAYOR OF LONDON



LSx

London Sustainability Exchange

About London Sustainability Exchange

London Sustainability Exchange (LSx) works to support London to become a sustainable world city. It provides businesses, government, communities and people with the motivation, knowledge and connections they need to put sustainability into practice.

With the backing of influential partners and members LSx plays a central role in making London an exemplar sustainable world city by:

- Increasing sustainability literacy in London
- Developing and influencing policy and practice across London
- Learning from and broadcast good practice everywhere

For more information on the work done by LSx on air quality and citizen science, visit:

http://www.lsx.org.uk/whatwedo/CleanAir4Schools_page3504.aspx

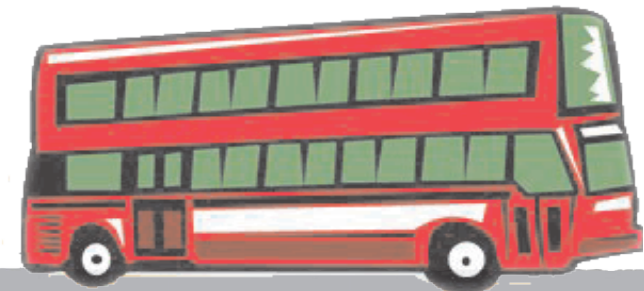
http://www.lsx.org.uk/resources/CaseStudyPepys_page3194.aspx

London Sustainability Exchange
84 Long Lane
London
SE1 4AU

Tel: +44(0)20 7234 9400
Fax: +44(0)20 7234 9419
Email: info@lsx.org.uk
Web: www.lsx.org.uk



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Section 1: Introduction



For: Teachers
Governors and support staff
Maintenance team

Welcome to the Cleaner Air 4 Primary Schools Toolkit!

Air pollution can have extremely negative impacts on health and well-being, leading to serious health problems. These impacts are often most severely felt by vulnerable people such as children, older people and those with existing heart and lung conditions.

People living in areas near major roads - which are often some of the most deprived parts of London - are exposed to particularly high levels of pollution.

This toolkit:

- Provides tools to identify areas of poor air quality around your school
- Promotes pupil understanding of the causes and impacts of air pollution
- Gives ideas for engaging staff, pupils and parents/carers in improving air quality
- Offers tips to maximise the air quality benefits of school travel plans and energy efficiency programmes
- Sets out a 12 week timeline of activities to maximise its benefits
- Help you reduce children's exposure to air pollutants, within the school and through their travel

Who's it for?

The kit is designed for staff:

	Section 1: About Air Quality	Section 2: Links with National Curriculum	Section 3: Citizen Science Activities	Section 4: Travel Plan Advice	Section 5: Reducing School Building Emissions	Section 6: Reducing Exposure to Pollution
Teachers	✓	✓	✓	✓		
Governors and support staff	✓			✓	✓	✓
Maintenance team	✓				✓	

How do I use it?

This toolkit is designed for you to take what you need from it. Each section contains a summary on how to complete activities, and includes helpful links and further resources, top tips and ideas for other activities to support this work.

About Air Quality

Air quality is about how healthy the air that we breathe is. Air is made up of “good” gases like oxygen that we need to breathe, “bad” gases like nitrogen dioxide that affect our health, and tiny particles like “dust”.

London, like many other European cities, has not yet reduced air pollution to healthy levels. However, London’s air quality is much better than it used to be. In 1952, 4,000 people died in London during “the great smog” because there were no laws about air quality to protect people’s health. Today, the London Mayor has a legal responsibility to improve air quality and make it healthier for Londoners to breathe.

Most air pollution in London comes from cars, vans and trucks, and heating our homes and buildings. This means that the way we travel and heat our buildings affects the quality of air we breathe. Some pollution in London is also blown in from outside the city (estimated at around 40%)¹.

What are the main air pollutants in London?

To find what our air quality is like, we need to measure the concentration of pollutants (harmful gases and dust) in the air. Air quality is measured by monitoring stations across London, and the results can be viewed online at londonair.org.uk.

Two pollutants are a particular problem in London:

Nitrogen Dioxide (NO₂)

Nitrogen dioxide is a harmful gas produced by burning fossil fuels. Petrol used in car engines is one of the biggest sources of NO₂, so levels are highest near roads. Other sources include burning coal and gas in power stations to produce electricity and gas boilers used for heating.

NO₂ can make it harder to breathe and can damage people’s lungs if they are exposed to it for a long time. NO₂ particularly affects children, and people who already have breathing problems such as asthma².

Particulate Matter (PM)

Microscopic materials suspended in water vapour or gases in the air. The main source of particulate matter is burning fossil fuels – particularly from petrol or diesel used in cars, vans and trucks, and from the wearing down of tyres and brakes.



The most dangerous particulate matter is very small – those which are 10 micrometers or smaller are known as PM10, and those which are 2.5 micrometers or smaller are known as PM2.5. These particles are equivalent to 2.5-10 millionths of a meter – at least 10 times smaller than the width of a human hair. Because of their small size, they can easily be breathed in, causing both short and long term breathing and heart problems.³

Levels of NO₂ and PM have decreased a great deal since the 1950's when environmental protection legislation was first introduced in the UK. However, since about 2002 London has struggled to reduce pollution levels further⁴.



Air Quality and Climate Change

Climate change is caused by rising levels of greenhouse gases in the earth's atmosphere. These include water vapour, Carbon Dioxide (CO₂), Methane, and Nitrous Oxide (N₂O). Emissions from burning fossil fuels will include gases that affect climate change and gases and particles that affect local air quality. This toolkit is primarily aimed at understanding air quality in your neighbourhood.

[Air Pollution Lesson Sheet on page 42](#)

[About Air Quality: Helpful Links and Further Resources on page 77](#)



Section 2: Linking Cleaner Air 4 Schools to the National Curriculum



For: Teachers

Our toolkit uses citizen science activities to bring air quality to life.

What is Citizen Science?

Citizen science is a fun and interesting way of getting people involved in understanding and tackling environmental issues. By collecting scientific data we can better understand an issue like poor air quality.

We have developed a citizen science programme for primary schools to raise awareness of air quality issues and encourage pupils and their parents and school staff to do their bit to reduce air pollution. We have combined this with social marketing activities to help pupils spread the word.



How to deliver the Cleaner Air 4 Primary Schools Programme

This toolkit includes a number of different citizen science and social marketing activities and experiments for your school to carry out as part of an air quality project. These can be integrated into a lesson, or completed as part of an extracurricular activity with an environment club, Green Team or Eco-committee. The full programme could be extended across a year group, or even as a whole school initiative with different classes and year groups carrying out different activities as part of a themed term or year.

Citizen Science and air quality activities can be of particular benefit to school children, because of their links to the National Curriculum. The following programme of activities can be used together or individually to introduce issues of air pollution to children, and to better understand the causes of pollution and how to affect change.

Key Stage 2 Scheme of Work

This is a suggestion of how the Citizen Science and Social Marketing activities described in this Toolkit could be incorporated into a Scheme of Work. You can select sections appropriate to your school and to the time available.

National Curriculum links

This Toolkit develops key concepts and skills which are fundamental to curriculum subjects, including:

- Science: planning and carrying out scientific investigations; gathering, analysing and evaluating evidence; generating and testing theories; and communicating scientific information.
- PSHE/Citizenship: recognising that individual choices and behaviour can affect issues and political and social institutions; researching, debating, talking and writing about their own and others' viewpoints on issues that affect themselves and society; and playing an active role as citizens, making real choices, participating in decision making and leading a healthier, safer lifestyle.
- English: developing skills of speaking, listening, reading and writing for a purpose, investigating, planning, predicting, debating, and communicating to the wider community in the context of an issue which is real, relevant and motivating.
- Geography: undertaking a geographical enquiry, asking geographical questions, collecting and recording evidence, recognising how people can improve or damage the environment, explaining their views on a geographical issue, identifying opportunities for their own involvement in managing environments sustainably and communicating in ways appropriate to the task and audience.
- ICT: developing research skills, preparing and interpreting information using ICT, presenting information via desk-top publishing or multi-media presentations, sharing information via the internet.

Government Review of the Curriculum

The Government's Curriculum Review, which is being conducted at the time of writing, is intending to slim down the curriculum to give teachers more freedom 'to design a wider school curriculum that best meets the needs of their pupils'. This should allow additional space for developing essential skills in science, PSHE, Geography, ICT and English through a topic such as air pollution which impacts on children's health and daily lives. As the existing National Curriculum requirements remain in force until the revised curriculum is introduced, specific curriculum links are given in the activities below.

Cleaner Air 4 Primary Schools Timeline

Week	0	1	2	3	4	5	6	7	8	9	10	11	12		
Lessons	Teacher Preparation	Introduce Air Quality & Plan an Investigation	Investigating Air Quality			Analysing Data			Action Planning	Taking Action	Evaluating Success				
Citizen Science Activities			Diffusion Tubes Put Out Collect	Ghost Wipes Poster 1st wipe 2nd wipe		Analyse Results									
			Surface wipes	Ozone Badges	Lichen Study										
Social Marketing Activities												Badges Competition Manufacture			
												Moth pledges			
									Other Activities (Coffee morning, Poster & Story competitions, Letters to MP etc)						
Optional Surveys		Hands-up travel survey Idling survey										2 nd survey			
Evaluation												2 nd survey			
Present Findings												Evaluate Results			
													Assembly		

The timeline above illustrates how this toolkit can be used as part of a 12 week programme investigating air quality. This shows how it is possible to carry out the programme over the course of a single term, but some schools may find it beneficial to spread the activities over a full academic year. This would also have the added benefit of continually reinforcing messages about air pollution and sustainable travel, encouraging more staff and parents to take up sustainable travel over time.

Part 1: Introducing Air Quality and Planning an investigation

Objectives

Pupils will learn how to:

- Make predictions
- Ask scientific questions
- Plan how to answer their questions
- Decide what kind of evidence to collect
- Use large-scale maps
- Research and discuss topical issues

National Curriculum links

Science SC1: 1b, 2a, b,

Geography 1a, 2c, 6a, e

PSHE/Citizenship 1a, c, 2a, 3a,

English Speaking and Listening 2a, b, e, 3a, b, c, d, f, 10b

Resources needed

- Info sheet (see [“Air Pollution Lesson Sheet”](#) on page 42)
- A big large-scale map of the area around the school (e.g. projector showing a Google Maps with a radius of approximately 500m around your school)
- Copies of large scale A4 maps showing the same area around the school (eg. printouts from Google maps) – one for each group of 4-5 pupils
- Red and green sticky dots for each group
- You will need to decide in advance which of the Citizen Science methods of data-gathering you will be using in the next session and, if necessary, order the equipment (see [“Section 3: Citizen Science Activities”](#) on page 21)

Introduction

Tell the class that they will be investigating air quality. Explain what this means. Explore types of pollution, causes and health effects.

Ask pupils

- how they think air quality might be different on a busy road and in a quiet area away from traffic
- to turn their predictions into a scientific question that can be investigated
- how they think they could find an answer to their question

Tell them some of the ways that air quality can be measured (relating them to their suggestions) and the method they will be using in the next session.



Group activity

Ask pupils to work in groups of 4-5. (If time is limited you can do this as a class activity and miss out the feedback stage below)

Give each group a large-scale A4 map of the area around the school and some red and green stickers. Ask them to discuss in their groups where they think the air will be most polluted and why. They should mark these places on the map with a red dot.

They should then discuss where they think the air will be cleanest and mark these on the map with a green dot.

Class discussion

Ask one group to tell the class one of the places where they thought the air would be most polluted and why. Did the other groups agree? Mark this place with a red dot on a large map displayed at the front of the class. Then ask the next group to say a different place and repeat the process until all the most polluted places have been marked.

Now do the same with the least polluted places. Mark these with green dots.



As a class, choose 6-8 places near to the school for investigation during the next session. Make sure these include a range of sites eg. busy and quiet roads, inside school grounds away from roads, next to traffic lights, at school gates, in car park (or identify sites as suggested in the instructions for the chosen method of data-gathering).

Give each site a name or number so that data can be easily referenced back to the map.

Part 2: Investigating air quality

Objectives

Pupils will learn to:

- Collect scientific evidence
- Use scientific equipment
- Carry out fieldwork investigations
- Make a labelled field sketch

National Curriculum links

Science SC1: 1b, 2e, f

Geography 1b, 2b, 7c

Resources needed:

- Activity sheets and worksheets for your chosen method of data-gathering (see [“Appendix 1: Classroom Activity Sheets & Citizen Science Resources”](#) on page 41)

Class/group activity

Carry out your chosen method of data-gathering as advised in the relevant Toolkit Resources

Ask pupils to do a labelled field sketch of the place or places where they carry out their data gathering.

Some of the data-gathering methods will need two sessions – see instructions for each method.



Part 3: Analysing the data

Objectives

Pupils will learn to:

- Draw conclusions from scientific data
- Recognise patterns
- Communicate data appropriately
- Recognise how people can improve or damage their environment
- Make informed choices
- Identify problems and suggest solutions

National Curriculum links

Science SC1: 1b, 2h, i, j, k, l,

Geography 1c, 2e, f, g, 3e, 5a, b, 6a, e

PSHE/Citizenship 1a, c, 2a, 3a, e,

English Speaking and Listening 2a, b, e, 3a, b, c, d, f, 10c

ICT 1a, b, c

Resources needed

- Data gathered in previous session or analysis from lab (as appropriate)
- Equipment for chosen method of presenting data, eg. plain and graph paper, computers
- Scrap paper and pencils for group note-taking
- Large sheet of paper

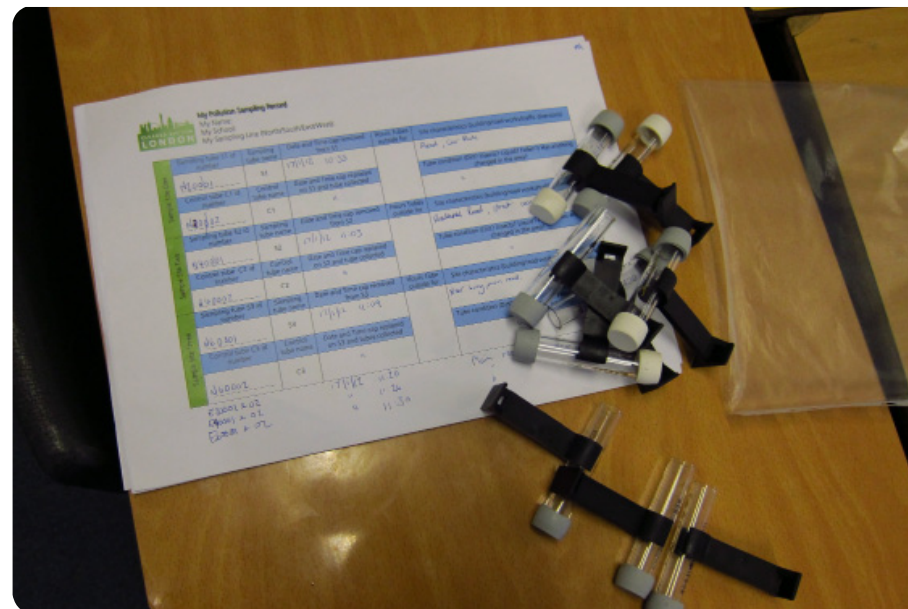
Introduction

Present the data analysis to the class, or ask groups to present their data, depending on data-gathering method used in Part 2.

Class discussion

Discuss the results:

- What did pupils notice?
- In what kinds of places is the air most polluted?
- Did the evidence confirm or disprove their predictions?
- Did anything surprise them?



- What do they think happens when people breathe in air in the most polluted places?
- What could be done to reduce the amount of pollution in the air?
- What could they do to limit their exposure to air pollution?

The class should decide on the most appropriate way of presenting the data, eg. displayed around their 'prediction' map, on a sketch map of the area, in a graph or spreadsheet - this could then be done as a class, group or individual activity.

Group activity

In groups of 4 or 5, ask pupils to make a list of recommendations based on their findings. These could include

- long term (eg. reduce traffic, redesign engines to use less petrol, promote electric cars),
- medium term (eg. campaign to reduce idling outside school gates, develop a school travel plan)
- short term (eg. take a different route to school).



The groups should also think about who would be responsible for carrying out each of their recommendations (eg. government, car manufacturers, the school, parents, children).

Take feedback from the groups and write up a class list of recommendations on a large sheet of paper. This should be kept for the next session.

Extensions

1. Pupils could gather more evidence before finalising their recommendations, eg:
 - carry out traffic surveys;
 - survey and time engines left idling in particular places;
 - interview passers-by for their opinions on the issue of air pollution.
2. Pupils could investigate air quality on the internet, eg:
 - compare their data to air quality information for other parts of London on <http://www.londonair.org.uk>
 - view a 3 minute video on the impacts of air pollution on <http://www.londonair.org.uk/LondonAir/guide/Soundslides/HealthEffects/HealthEffectsVideo.aspx>
 - compare their data to air quality throughout Europe on <http://watch.eyearth.org/> and contribute their own data to the site

Part 4: Action planning

Objectives

Pupils will learn:

- How decisions and actions can affect the quality of people's lives
- Different ways in which people can improve their environment
- How to present a persuasive argument
- To make real choices and decisions

National Curriculum links

Geography 4g, 5a, b, 6a, e

PSHE/Citizenship 1a, c, 2a, b, 3a, e, 5a, d

English Speaking and Listening 1b, c, 2a, b, e, 3a, b, c, d, f,

Resources needed

- Class list of recommendations from previous session
- Scrap paper and pencils – one per group

Introduction

Display the list of recommendations from the previous session and read them through together.

Group activity

Ask pupils to work in groups of 4 or 5. They should discuss the four points below and one person in each group should note down the group's decisions.

1. Decide on one recommendation that they would like to take action on.

2. Discuss what would be the best way to take action: for example:

- influence someone in a position of power (eg. by writing a letter or inviting them into school to respond to questions);
- influence their parents or local people (eg. by designing a leaflet, putting on a play, sharing their findings in the school newsletter);
- take action as a school (eg. by developing a school travel plan, a campaign, a walking bus);
- inform other pupils (eg. through an assembly presentation, designing posters, talking to them in the playground, publicising quieter walking or cycling routes)

The poster is titled 'Have you heard of Cleaner Air 4 Schools?' and is divided into several sections. At the top left, 'What is it?' explains the project's goal to improve air quality in London. Below this, 'What do we want to achieve?' lists goals like improving confidence and skills of parents and teachers. The middle left section, 'What has your child has been doing?', features 'Citizen Science Activities' (like using Diffusion Tubes) and 'Art Activities' (like creating a 'Poisoned Marsh'). The middle right section, 'What have we discovered?', includes a map of London and photos of children. The bottom right section, 'What can I do to improve air quality?', lists actions like 'Travel to school' (walking, cycling, public transport), 'Promote sustainable travel' (encouraging others), and 'If you must drive' (checking engine, carpooling, etc.). A red box on the right says 'If you want to know more, LSX will be at our school assembly on Monday 19th March 9am!'. Logos for Transport for London, Mayor of London, and LSX are at the bottom.

3. Think about the most effective way to influence, inform or encourage others by:
- deciding on the message they want to get across
 - deciding who they want to share their message with
 - thinking about what will appeal to this group of people (eg. Should their message seem 'cool', fun, important, interesting ...? Would this audience respond best to facts, stories, pictures ...?)

4. Decide how they would know whether their action had been successful.

Class activity

Ask each group to briefly present their ideas.

Collect in the notes made by each group. They will be needed for Part 5 and 6.

Either: Vote on which action the class would like to carry forward together.

Or: Each group could develop its own plan.



Part 5: Taking action

Objectives

Pupils will learn how to:

- Explain their views on issues that affect them and others
- Communicate in ways appropriate to the task and audience
- Take responsibility for taking action to improve their health and environment

National Curriculum links

Science SC1: 1b, 2b, g, m

Geography 1d, e, 2a

PSHE/Citizenship 1a, c, 5a, d

English Speaking and Listening 1b, c, d, e, 10c, Writing 1a, c, e, 2a, b, c, d, e, f, 9a, b, c, 11

ICT 2a, 3a, b

Resources needed

- Notes from Part 4
- Other resources will depend on the actions and methods pupils have chosen.

Individual, group and/ or class activity

Write the letters, design the posters or leaflets and decide how and where to distribute or display them, plan and deliver the presentation or campaign ...

Pupils could research further information to inform their actions, eg. about air pollution and its impacts (see links for Activity 3) or about safe and clean air walking or cycling routes through [Walkit](#), [TFL](#) or [Sustrans](#)

If you decide to work on a school travel plan, see [Section 4: Travel Plan Advice on page 30](#).

This activity may take several sessions, depending on the actions chosen.



Part 6: Evaluating success

Objectives

Pupils will learn how to:

- Evaluate the effectiveness of their chosen actions
- Identify what they need to do next to achieve their aims

National Curriculum links

Science SC1: 1b, c, 2g, j, k, l, m

PSHE/Citizenship 1c, 5a

Resources needed

- Notes from Part 4
- Other equipment will depend on the activities taken but may include another set of the air quality measuring equipment used in Part 2

Class activity

After the actions have been implemented, discuss with the class:

- if they think their actions have achieved their aims
- how do they know?
- how they could find evidence that their actions worked

Return to the suggestions the groups made in Part 4 and look at the ideas there.

The best way to evaluate success will depend on the action taken. They might include:

- re-measuring air quality outside the school gate after a campaign against idling cars,
- surveying modes or routes of travel to school after implementing a school travel plan, using a hands up survey
- considering the kinds of responses they had from parents or the local community to an article or leaflet

Once they have evaluated the effectiveness of their actions they should:

- decide how to publicise results to the target audience
- plan the next steps



Section 3: Citizen Science Activities



For: Teachers

Citizen Science Activities offer different methods of enabling pupils to see tangible indicators of air pollution. These vary in complexity and cost, from activities which need no investment and little planning, to those which require more specialised equipment and span a period of weeks.

In this chapter we describe the following citizen science activities:

- [Lichen Bio-Indicator Study on page 23](#)
- [Diffusion Tube Samples on page 24](#)
- [Ghost Wipes on page 25](#)
- [Ozone Badges on page 26](#)
- [Surface Wipe Analysis on page 27](#)
- [Running Campaigns in School on page 28](#), including:
 - Badge competitions
 - Plays
 - Assemblies
 - Peppered moth pledges



All citizen science activity resource sheets can be found in [“Appendix 1: Classroom Activity Sheets & Citizen Science Resources”](#) on page 41

We recommend you use as many of these activities as time allows to reinforce learning and spark action!

The importance of citizen science is in the investigation, and in understanding the factors that contribute to your local air quality.

Once you have received the results for the particular tests you have chosen to carry out, it's time to consider how you want to best use this information in your school. The results can be analysed as closely as you feel useful to best identify sources and levels of air pollution, or can simply be used as a platform to communicate the concerns of air quality to others in your community.

Consider, for example, some of the following:

- Create a large simplified road map of the school, and mark on it the areas of high/low pollution
- Create posters to display the test results, and the impacts this may have on the health of the school community
- Upload information to global community science projects, such as the Eye on Earth network or Mapping for Change Community Maps.

Lichen Bio-Indicator Study

Suitable for Years: 4-6

Duration of Activity: 1 -1.5 hours (plus travel if offsite)

What is it?

Lichen monitoring is an easy way to observe the level of air pollution in your surrounding area, simply by identifying types of lichens that are present. This provides a basic idea of the extent of air pollution in your surrounding area, by identifying the presence of lichens which are sensitive to nitrogen and those which flourish in environments with high nitrogen level.

How to use it:

See the lichen identification guide and monitoring sheets for information on how to conduct your study. Lichen monitoring can be carried out as part of a lesson activity in and directly around the school, or as an activity by those walking to and from school. This will help to identify levels of air pollution not just at the school site itself, but also along the primary travel routes to and from the school. As some lichens change colour in the rain, this activity is ideally carried out when the weather is dry.

Costs of activity:

This activity solely requires observation and monitoring, and should incur no additional costs. Magnifying glasses are useful tools for this activity.

Resources Included:

The Open Air Laboratories (OPAL) [Air Survey field guide on page 44](#) (9 pages)

[Lichen Monitoring Sheet on page 53](#) (3 pages)

The Open Air Laboratories (OPAL) network: Lichen and air survey, guide and quiz can also be found at <http://www.opalexplornature.org/LichenGuide>



Diffusion Tube Samples

Suitable for Years: 3-6

Duration of Activity: Depends on the number of participants. A teacher and two pupils working together may take up to two hours to deploy 12 tubes across 12 different sites. After two weeks, collecting tubes may take one hour.

What is it?

Diffusion tubes are primarily used to measure the levels of harmful nitrogen dioxide in the air, by use of a specialised sampling tube. These provide an accurate measurement of levels of certain types of air pollution.

How to use it:

Tubes should be left outdoors on the school site for about two weeks. Children should follow the instructions included in the resources section on how to collect samples, which should then be returned to the supplier for analysis and report. Information can then be used to map out nitrogen dioxide levels around your school. Children will benefit from learning scientific sampling techniques, such as taking data samples along a transect, mapping and analysis of data.

Costs of activity:

A list of suppliers for diffusion tubes is included below. Analysis and reports are often included in supply costs.

Estimated Cost: £130

Cost at approx £9.50 per unit, including analysis and estimated delivery– enough to test 12 sites (1 tube per site, plus a control tube)

Contact supplier for up-to-date cost.

Equipment can be ordered from:

<http://www.gradko.co.uk/contact.shtml>

Resources Included:

[Diffusion Tube Factsheet on page 56](#) (1 page)

[Diffusion Tube Sampling Instructions on page 57](#) (4 Pages)

[Diffusion Tube Record Form on page 61](#) (2 pages)



Ghost Wipes

Suitable for Years: 3-6

Duration of Activity: Depends on the numbers of participants and samples. It takes 5-10 minutes to wipe a surface and record the information.

What is it?

Ghost wipes are used to monitor the air quality in schools, by measuring the amount of heavy metals in air-borne particulate pollutants (such as lead, beryllium, cadmium, zinc and other harmful elements) that collect on surfaces. These provide an accurate measure of harmful pollutants in the air.

How to use it:

Samples should be taken twice over the period of a week – once at the beginning of the experiment, and once at the end. Locations should be both indoor and outdoor, the number of which can vary to suit your needs. Samples will then have to be returned to the supplier for analysis.

Costs of activity:

A list of suppliers for ghost wipes is included below. Analysis and reports are usually included in supply costs, although costs may vary according to number of metals the samples are analysed for.

Estimated Cost: £700 + VAT

Cost at approx £20-25 per unit, including analysis and delivery - enough to test 15 sites with 30 samples (wipe each site twice)

Contact supplier for up-to-date cost.

Equipment can be ordered from:

<http://www.alcontrol.com/>

Resources included:

[Ghost Wipe Instructions on page 63](#) (2 pages)

[Ghost Wipe Test Guidelines for Teachers on page 65](#) (1 page)

[Ghost Wipe Test Record Form on page 66](#) (1 page)



Ozone Badges

Suitable for Years: 3-6

Duration of Activity: Depends on the numbers of participants and samples. It takes 10 minutes to expose one badge and 10 minutes to compare the colour and record the result.

What is it?

Ozone badges are used to easily identify concentrations of harmful Ozone in the air, and provide a near immediate result displayed through a colour change in the badge.

How to use it:

Ozone badges usually require simply removing their seal, and exposing the badge or test strip to the air for a predetermined amount of time (usually around 10 minutes). The colour change is then compared to the control sheet, to measure the amount of ozone measured.

Costs of activity:

Ozone badges or test strips are usually supplied in boxes of 50; a list of suppliers is included below.

Estimated Cost: £100-150

Approximated cost for orders of 50 units.

Equipment can be ordered from:

www.skcltd.com (part number 526-300 - email enquiries@skcltd.com for cost and to order)

www.epakelectronics.com/uvps_safety_gas_detection.htm

www.airconcern.co.uk/ozone-test-sticks-sk-p-48.html

Resources Included:

[Ozone Badge Activity Sheet on page 67](#) (1 page)

[Ozone Badge Record Form on page 68](#) (1 page)



Surface Wipe Analysis

Suitable for Years: 3-6

Duration of Activity: 1 hour

What is it?

Surface wipe analysis is a cost-effective and easy way to identify levels of particulate matter, specifically in relation to their concentrations at different heights and locations.

How to use it:

Surface wipe analysis uses a piece of sticky tape or moist cotton wool ball to sample the particulate matter that is deposited on surfaces. You can use this technique to sample the deposition of particulate matter on surfaces in different locations, or at different heights. You can sample a range of surfaces using this technique including, leaves on trees, poles, walls or doors around school. Your sample provides an immediate visual indication of levels of pollution. It is also useful to explore how levels of pollution may vary depending on height and distance from roads. Greater concentrations of particulate matter at lower levels pose a greater risk to children.

Costs of activity:

Costs for this activity are minimal, requiring only cotton balls or sticky tape, to wipe surfaces.

Resources Included:

[Surface Wipe Instructions on page 69](#) (1 page)

[Surface Wipe Record Form on page 70](#) (3 pages)

Basic info on:

www.opalexplornature.org/sites/default/files/7/file/OPAL-SE-Roadside-Soot-Activity.pdf

Running Campaigns in School

There are a number of social marketing activities, designed to increase engagement and awareness of issues surrounding air quality which have proved successful in school.

Badge competition – classes can compete to design the badges which best represent their understanding of air quality, the winner being made into a badge for Air Quality Champions to wear

Estimated Cost: £0.20-£1.00 per badge depending on size and number required.

Approximated cost for orders of 50 units. Equipment can be ordered from:

www.ecoincentives.com/

www.ecoeveryday.biz

www.simoney.co.uk

Plays - these have been successful in several schools to promote green issues and sustainable transport in an easily accessible way to all ages. This can be especially useful to engage parents and increase awareness amongst them of their children's and school's endeavours. This has also been used as a successful method for fundraising, charging a nominal admission fee to parents and the community to attend.

Assemblies – these can be delivered by a class or teachers to easily explain to the school community the efforts and activities designed to investigate and improve air quality. Some school events, such as cultural day, coffee mornings, and parents evening, are good opportunities to approach parents and raise their awareness of air quality.

Peppered Moth Pledges – the Peppered Moth is a good case study that teaches students about air quality and air pollution. Story-telling or competitions about peppered moth can be used in conjunction with School Travel Plans to commit to more sustainable forms of travel into school.

Resources Included: [Peppered Moth Activity Sheet on page 73](#) (1 page)

[Peppered Moth Pledges Sheet on page 74](#) (1 page)

Electing Air Quality Champions – pupils, teachers, parents and school governors can make up an Air Quality team, who will drive forward activities designed to investigate and improve air quality around school. The pupil members of air quality team should be gender-balanced and across different classes.

Idling Surveys/Travel Questionnaires – surveys used in conjunction with School Travel Plans to investigate levels of idling cars outside of school, as well as most common methods of travel currently being used in schools.

Resources Included: [Idling Survey Instructions on page 75](#) (1 page)

[Idling Survey Record Form on page 76](#) (1 page)

Case Study: Green Theatre Touring Local Schools

Wandsworth Council used theatrical performances to successfully raise awareness of green issues and promote sustainable travel across the borough. Organising a tour of the Big Wheel Theatre Company, ten schools were visited with each performance providing practical examples of how pupils can improve their local environment.

“This is a fantastic and fun way to get these important messages across. The children clearly loved every minute of it and went away thinking hard about how they can do their bit tackle climate change and pollution.”
Cllr Jonathan Cook, Wandsworth Council's Environment Spokesman.

Next Steps

It's important not to think of data collection as the end of the investigation into improving the air quality around your school stop.

Use the findings and issues raised from the Citizen Science section of this toolkit to strengthen efforts to improve the air quality around your school.

This can be done by:

- Identifying the major sources of air pollution around your school. Are higher levels of NO₂ found inside or outside the school? What could this mean in terms of what is creating the air pollution?
- Promoting and sharing findings with the rest of the school and home.
- Identify aspects that impact air quality that you would like to tackle.
- Incorporate findings into lessons (links to example lesson plans such as those by Green Generation are included below).
- If the data you have collected is accurate, consider taking further measurements over time to see how any changes you make have improved air quality.
- Measuring the results and success of your community science and social marketing campaign by carrying out follow up surveys etc. Have you found an improvement in attitudes toward travelling to school, or a reduction in cars idling outside the school grounds?
- Investigating how to make improvements to air quality around your school. Read on to the next three chapters for more ideas.

Case Study: Camden Council's Schools Air Quality Project



As part of a project to educate schools about the impacts of air pollution, Camden Council offered several schools in the borough the opportunity to participate in free *air quality and art* or *air quality and film making* workshops.

During these workshops students learnt how air pollution affects them and what they can do to improve local air quality and protect themselves from pollution. Groups of twenty students from 3 schools worked with an environmental educator and a professional film maker to produce three short films about air quality, focusing on health impacts, links between air quality and climate change, and methods of monitoring air pollution.

The films produced by the students are available to view online here:

www.camden.gov.uk/schoolsmonitoringairquality

www.camden.gov.uk/schoolsairqualityhealth

www.camden.gov.uk/schoolsairqualityclimatechange



For more information please contact airquality@camden.gov.uk.

[Citizen Science Activities: Helpful Links and Further Resources on page 78](#)



Section 4: Travel Plan Advice



For: Teachers
Governors

The goal of this section of the toolkit is to encourage, enable, and empower schools to maximize the air quality benefits of their individual School Travel Plan (STP) and to help schools tackle the challenges to increasing sustainable transport for school journeys.

School Travel Plans support schools by putting in place an action plan to encourage safer and active travel behaviour. They are an effective way of improving air quality around your school, through the promotion of cycling and walking. Reducing the number of cars driving to and from school each day will have a positive effect on reducing the emissions present in the air around your school.

Measuring Progress

TfL wants to ensure all schools in London have an active STP to promote safer and active travel for the entire school community, helping to improve health and wellbeing. TfL operates a national recognised school travel plan accreditation scheme STAR (School Travel Accredited and Recognised) scheme. All accredited schools receive a plaque, kite mark logo (displayed on a plaque and certificate) and are invited to attend a training and best practice workshop.

For further guidance on school travel plans, STAR accreditation and case studies, visit: www.lscp.org.uk/staccreditation/index.php

Case Study: Overcoming A Lack Of Cycle And Scooter Storage On Site

St. Vincent's Catholic Primary School, Westminster

St. Vincent's School in Marylebone has a comprehensive STP and has received a Silver Eco School award. However, one problem they face is a lack of safe cycle and scooter storage on campus. St. Vincent's highlighted other forms of low-emission transport. Expectations that pupils and staff walk all or part of the way to school are embedded in the school's prospectus, promoting walking as the preferred mode of school related transport.

They also participate in the Westminster Wiser Walking Scheme, which helps equip pupils with road safety tactics and are committed to participation in WOW (Walk on Wednesdays) and other special walking events taking place throughout the borough.



TfL Campaign Toolkits

TfL in partnership with the London Boroughs have produced a range of easy to use campaign toolkits to help schools deliver effective walking, cycling, road safety and other travel initiatives. Visit: www.staccreditation.org.uk

Simple and Effective Actions to Maximise Air Quality Benefits

All schools will have unique challenges to overcome when implementing a successful school travel plan and maximising air quality benefits. There are many common barriers schools may encounter, such as cost, awareness, apathy, time and safety concerns.

Simple and effective solutions that you can use to reduce emissions and exposure to air quality associated with travel to and from school include:

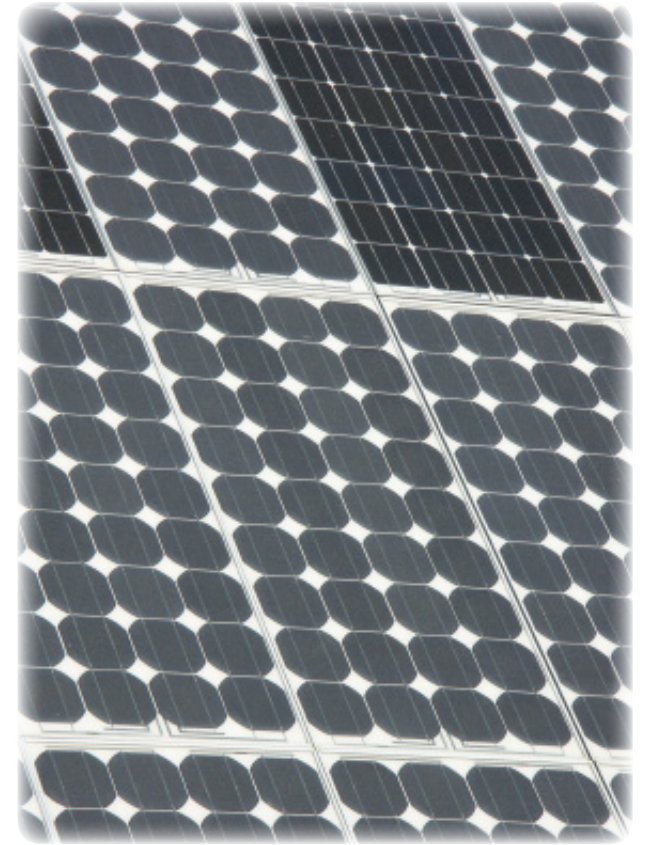
- Mark out and publicise walking and cycling routes which are safer and with cleaner air, as chosen by your staff and pupils or through websites such as [Walkit](#). Encourage participation through a walking or cycling “bus” scheme.
- Publicise existing cycling routes and networks, such as those found on the [TFL](#) and [Sustrans](#) websites
- Create park and stride zones, marking out exclusion areas within which parents are not allowed to park in (i.e. within one mile). Identify possible areas where parents can park, and walk the remaining distance (further ideas and guidance can be found on the [Walk to School](#) website).
- Create and publicise a public transport route map to highlight to staff and pupils opportunities for travelling to school by public transport.
- If walking, cycling or using public transport is not practical, consider setting up a car share scheme.
- Design competitions amongst parents, pupils and classes to promote healthier ways of getting to school
- Create scooter and cycle park areas for safe storage during the day. Funding may be available for cycle and scooter parking; please contact your borough officer of TFL for further details.
- Offer incentives or prizes for sustainable travel - TFL, local councils and sustainable transport charities may be able to support you.
- Link themes and projects to school curriculum, and use online learning resources to increase interest (e.g. Generation Green, [Young Crossrail](#)). Ensure that cycling and walking are part of the physical education curriculum to help steer pupils towards healthier choices outside the classroom.
- Establishing pupil and teacher air quality/healthy lifestyle champions to raise awareness can be very effective.
- Encourage school participation in cycle proficiency training offered by the British Cycling Team Go-Ride scheme and TFL, and take part in the Met Police’s free cycle security marking scheme



[Travel Plan Advice: Helpful Links and Further Resources on page 79](#)



Section 5: Reducing Emissions from School Buildings



For: **Governors and support staff**
Maintenance Team

All but the most efficient buildings release emissions of gaseous pollutants, including nitrogen dioxide, particulate matter and carbon dioxide. These pollutants not only contribute to poor outdoor air quality and climate change, they also give rise to poor indoor air quality. Poor ventilation can lead to concentrations of air pollutants in buildings, which at high levels can cause a risk to health.

This section aims to identify some of the key sources of building related emissions. By implementing the recommendations set out in this section, you will not only reduce the emissions of pollution from your buildings, you may be able to reduce your energy costs as well. Projects to reduce school buildings emissions also provide an opportunity to influence and educate your school community on the issues of air quality and energy consumption.

Where do emissions come from?

Whether you are in a primary or secondary school, it is estimated that the energy consumption from your school building will account for roughly 37% of the school's overall greenhouse gas footprint⁵. The contribution of school buildings to local air pollution is harder to establish, but we know that equipment such as boilers make a significant contribution.

Typical sources of pollution from school buildings include:

- Boilers (combustion of gas releasing nitrogen dioxide)
- Back-up generators (combustion of petrol)
- Air conditioning systems
- Kitchens and canteens
- Vehicle: school transport, supplies and deliveries, cars idling
- Garden equipment (lawnmowers, leaf blowers etc running off petrol)
- Other equipment: gas-fired water heaters

Opportunities for Emission Reduction

In most cases understanding and managing your energy consumption will also enable you to reduce the levels of pollutant emissions. We have identified a number of actions schools can take to reduce energy consumption and emissions of pollution.



Understanding Energy Use, and Improving Monitoring and Measurement

- Create a Green Team of champions and use them to identify all the sources of emissions in your school building. What equipment gives rise to emissions?
- Monitor usage over a period of time, e.g. a week, a month. When and how often is the emissions source used? Report on areas of waste, across all spectrums of school (each year groups, staff department etc)
- Where possible, establish permanent mechanisms to monitor energy or equipment use (e.g. meter readings, use of smart meters)
- Create targets for measurable improvements (for larger schools) and include these in the School Environmental Policy. You could set summer and winter standard temperature levels, lighting levels for classrooms, energy targets etc.



Increasing Engagement (Staff and Pupils)

- Empower pupils to drive change by involving them in the school Green Team
- Encourage teachers to get involved too
- Promote your activities through school newsletters, assemblies and events

Reducing Energy Demand & Improving Building Efficiency

- Ensure key staff fully understand how to use the school's energy management systems (i.e. programming thermostats to fully manage heating)
- Make low cost improvements to energy efficiency (install energy efficient light bulbs, roof and wall insulation, draught-proof windows)
- Check that there are energy efficient appliances in place. This is especially the case for kitchens, or areas where there can be a high energy demand.
- Make the most of existing features of school for example, by maximising the use of natural lighting etc
- Reduce energy waste (switching off appliances when not in use, installing occupancy sensors for lights, installing Thermostatic Radiator Valves to control temperature etc)
- Investigate energy efficiency of key building systems (i.e. most efficient boiler in place, investigating more suitable solutions such as Combined Heat and Power CHP)

Investigate Opportunities for Renewable Energy Provision

- Investigate potential for on-site renewable energy generation, e.g. Photo Voltaic solar panels, wind turbines, ground source heat pumps etc (see case study below and further resources)
- If renewable energy options are not possible, ensure energy supplies are from a green provider

Reducing Emissions from Procurement

- Source supplies locally where possible - reducing emissions from transport and delivery (e.g. food/stationery supplies)
- Use sustainable products (i.e. recycled paper and stationery, cleaning products with low environmental impacts, energy efficient kitchen/office equipment – Energy Star Label/A-G energy rating)
- Implement a “no idling” policy for delivery vehicles at the school, and encourage them to do the same elsewhere
- Use fuel efficient vehicles for all aspects of transport (denoted by an A-M rating)

The RE:FIT Programme

RE:FIT is a public programme offering a cost neutral way to reduce energy use and cut carbon emissions in public sector buildings. The aim of RE:FIT is to retrofit public buildings with energy efficient measures, guaranteeing annual energy and cost savings.

This programme can help overcome the common barriers of accessing capital funding, and lacking suitable expertise internally, by having an energy service company appointed to a school.

To find out more about RE:FIT, or to register your interest in reducing the carbon footprint of your school, please contact: REFIT@london.gov.uk.

Case Study: Eco Reps And Renewable Energy

Ringmer Community College, Lewes

Despite the building being over 50 years old, Ringmer Community College has introduced a number of initiatives to improve its environmental performance, including Photo Voltaic (solar) Panels, installation of a Ground Source Heat Pump, and a community with over 200 Eco Reps who are eager to push forward further sustainability initiatives.

["Reducing Emissions From School Buildings: Helpful Links and Teaching Resources" on page 81](#)



Section 6: Reducing Exposure to Pollution in School



For: **Governors and support staff**

This section provides information and advice on reducing the exposure of staff and pupils to poor air quality.

Potential Sources of Pollution

Common sources of air pollution within school grounds include those outlined in the previous chapter, as well as those originating from off the school site. External sources include nearby road transport and fuel combustion in nearby buildings or industrial areas⁶. This section outlines some practical measures schools can take to minimise pupil and staff exposure to poor air quality.



How to Reduce Exposure

Supplies and Deliveries

For large deliveries, such as stationery and kitchen supplies, ensure a 'no engine idle' policy for vendors' delivery trucks. Deliveries should be arranged before or after hours that children are in lessons.

The Low Emission Zone was introduced across most of Greater London in 2008 to limit the effects of the worst polluting goods vehicles. Only vehicles meeting strict European standards for particulate matter are unaffected by the zone. However, you can still request that your vendors use even lower or zero emission delivery vehicles. More information about the LEZ can be found on the [TFL website](#).

Multiple suppliers could be consolidated, decreasing the number of delivery vehicles on campus. Improved/expanded storage facilities allow for greater capacity, requiring less frequent deliveries.

Greening Your School

Pollution on school grounds can be minimised by increasing the amount of foliage. Plants "reduce the amount of carbon dioxide in the air, they increase oxygen, and they help eliminate toxins"⁸. Studying and increasing the number of plants in the classrooms, throughout campus and on the grounds, could be linked to the school's science curriculum, and choosing herb, vegetable and flower varieties would be an ideal class project. Low maintenance plants that excel at purifying air by absorbing pollution include cacti and ivy, as well as:

- English ivy
- Aloe vera
- Boston fern
- Weeping fig
- Janet Craig Dracaena
- Peace lily
- Spider plants
- Reed palm
- Cornstalk Dracaena
- Heartleaf Philodendron
- Golden Pothos
- Chinese Evergreen
- Snake Plant
- Warneck Dracaena
- Philodendron Selloum
- Bamboo or Reed Palm
- Red-Edged Dracaena
- Elephant Ear Philodendron



Installing a green roof can be another source for air purification and pollution reduction on the school grounds and could serve as a school project in conjunction with the school's curriculum. The air quality benefits of a green roof stem from the plants' ability to reduce carbon dioxide levels and airborne particulates. Other benefits include increasing biodiversity, improving the thermal performance of buildings, and reducing surface run-off of water (see case studies for examples of school installing green roofs).

Construction and Grounds management

Construction and gardening work requiring the use of power tools can give rise to the levels of pollutants in the air, especially particulate matter. Where possible, this work should be done outside school hours or at least at times when pupils and staff will not be exposed.

Technologies such as low energy ventilation systems, and Mechanical Heat Recovery Ventilation (MHRV) systems can ensure fresh air circulation within the school building without causing increases in carbon emissions.

Pupil and Parent Behaviour

Ensure pupil congregation areas such as cycle/scooter racks and benches are not near roads where exposure to vehicular emissions are highest. Locating outdoor play areas away from roads or the perimeter of the school grounds can also reduce the risk of exposure.

Parents and teachers should be discouraged from driving to school. A no idling policy should be enforced adjacent to the school grounds.



Time spent by pupils outdoors can also be minimised on days where high levels of pollution are expected. This can be found on DEFRA's Air Information Resource website: <http://uk-air.defra.gov.uk/>

Case Study: Green Roofing

King Alfred School Green Roof, Golders Green, London

In 2010, King Alfred School completed the installation of a circle of green roofs surrounding one of their playgrounds.

The roof has been a huge success with parents, teachers and students, providing a rich variety of plants and flowers.

Engaging key stakeholders

In order to maximize success in reducing buildings and transport emissions, it is useful to involve people who are responsible for initiating plans and ensuring actions are carried out. Obviously the more support you can obtain from colleagues the better.

Try to involve:

- Governors
- Teachers
- Support/ administration staff
- Ground staff, estate managers and technicians
- Parents.

Some of the key actions you may like to take include:

- Creating and integrating an air quality action plan into your school's short, medium and long-term planning.
- Identifying and creating opportunities for the diverse group of school stakeholders to move towards your air quality action plan.
- Actively engaging with the Headteacher, Chair and / or Strategic group of Governors to promote the agenda for promotion of air quality and reduction of emissions.
- Creating regular 'working parties' of a range of key staff to progress plans and ensure 'ownership' is maintained.
- Providing regular progress report at staff meetings.
- Publicising your plans and progress through school newsletter, letters home, annual parent questionnaires, parents' evenings.

[Reducing Exposure to Pollution: Links & Resources on page 83](#)



Appendix 1: Classroom Activity Sheets & Citizen Science Resources

1. Learn About Air Pollution!

[Air Pollution Lesson Sheet on page 42](#) (2 pages)

2. Lichen Bio-Indicator Study

[The Open Air Laboratories \(OPAL\) Air Survey field guide on paOPAL Air Survey on page 44](#) (9 pages)

[Lichen Monitoring Sheet on page 53](#) (3 pages)

3. Diffusion Tube Samples

[Diffusion Tube Factsheet on page 56](#) (1 page)

[Diffusion Tube Sampling Instructions on page 57](#) (4 Pages)

[Diffusion Tube Record Form on page 61](#) (1 page)

4. Ghost Wipes

[Ghost Wipe Instructions on page 63](#) (2 pages)

[Ghost Wipe Test Guidelines for Teachers on page 65](#) (1 page)

[Ghost Wipe Test Record Form on page 66](#) (1 page)

5. Ozone Badges

[Ozone Badge Activity Sheet on page 67](#) (1 page)

[Ozone Badge Record Form on page 68](#) (1 page)

6. Surface Wipe Activity

[Surface Wipe Instructions on page 69](#) (1 page)

[Surface Wipe Record Form on page 70](#) (3 pages)

7. Peppered moth

[Peppered Moth Activity Sheet on page 73](#) (1 page)

[Peppered Moth Pledges Sheet on page 74](#) (1 page)

8. Idling Survey

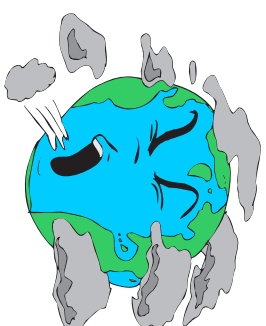
[Idling Survey Instructions on page 75](#) (1 page)

[Idling Survey Record Form on page 76](#) (1 page)

Air Pollution Lesson Sheet

What is air pollution?

Air pollution is anything that causes the air to become contaminated with pollutants at levels harmful to our health or the environment.



What makes air dirty?

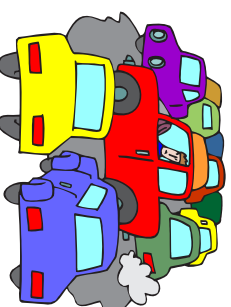
Generally, air pollution comes from the burning of fossil fuels such as coal, oil, natural gas, petrol or diesel. This happens when we use energy supplies to do everyday activities, such as cooking or washing at home and travelling by cars.



London has suffered from air pollution since the beginning of the Industrial Revolution in the 18th century. Smoke and fog together create 'smog' which makes it really hard to breathe and see clearly. More than 4000 people died in the Great London Smog in 1952! Industrial processes and domestic heating were the main contributors to air pollution in London until the 1970s.

Air pollution today

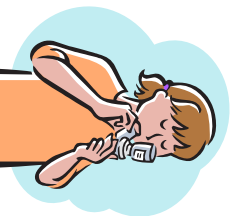
Today, when we think of air pollution, we should think of **transport**, especially **cars**. Today there are about **23 million** vehicles on the road in Britain, and **20 million** of them are cars! The fuel they use - **petrol** and **diesel** – cause bad gases to be ejected from the exhaust. These gases can be very dangerous for **children**.



Health Alert- how does air pollution affect you?

Air pollution is known to cause breathing problems, lung and heart diseases, such as asthma. Children are particularly at risk, as your bodies are less resilient and the pollutants have a more concentrated effect. Air pollution can:

- Affect your immune system, so that you can catch infections more easily.
- Make you cough, splutter, wheeze, sneeze, dizzy and it can make your eyes itch.
- Give you green snot, and more boogies than your nostrils have space for.
- Pollution can be blamed for an estimated 200 premature deaths in the capital each year. An additional 1,200 or so serious health incidents requiring hospital admission can be attributed to pollution.



What are the pollutants?

Most pollutants are much too small to see without a microscope, but they still get into our lungs and affect our health. The main nasty pollutants in the UK are O₃, SO₂, NO₂, PM_{2.5} and PM₁₀. The most severe pollutants NO₂ and Particulates including :

- **NO₂** (Nitrogen oxides) – NO₂ also contributes to acid rain, which damages trees and the stone on buildings. You can see the effect of NO₂ on a hot day in summer, when it combines with other chemicals to make the sky look heavy and brownish grey.
- **Particulates** (particulate matter, PM) - tiny particles of dust and soot that are released into the air. When you breathe them in, they settle in the lower parts of your lungs. There are natural sources of particulates. However, in London, the largest source of PM₁₀ is road traffic. Lorries and diesel vehicles produce the most particulates in cities.

Everyone can help make our air cleaner!

Actions CHILDREN can take

- **Travel to school**
 - ✓ Walk, cycle or scooter to school! It is good exercise and can reduce air pollution.
 - ✓ Use public transport: take the bus, tube or train instead of the car.
 - ✓ If you have to travel to school by car, try car-sharing with other friends.
- **No idling**
 - ✓ If you have to be picked up by car, tell your parents not to leave the engine on while they wait for you. This is called 'idling' and it is a big cause of air pollution around schools. Turning off the engine could reduce air pollution and also save your parents' money.
 - ✓ You can design signs and posters to tell people 'no idling' around your school.
- **Spread the word!**
 - ✓ Discuss air quality issues with your teachers, friends and family.
 - ✓ Make sure everyone you know is aware of the dangers of air pollution.
- **Simple actions at home!**
 - ✓ Energy saving actions: such as switch on equipment only when needed, set the thermostat at the lowest comfortable temperature within an average of 18°C and 21°C. These simple actions can reduce CO2 emitted which contribute to air pollution.



Actions PARENTS & TEACHERS can take

- **Promote sustainable travel**
 - ✓ Encourage your children and their friends to walk and cycle.
 - ✓ Encourage friends and family to walk and cycle or car-share.
 - ✓ Reduce the amount your family uses the car.
 - ✓ Discuss air quality issues with your school, friends and family.
- **If you must drive**
 - ✓ Fully inflate car tyres so your car uses less petrol.
 - ✓ Switch the engine off while waiting for your child after school.
 - ✓ Ensure that you have your vehicle serviced at regular intervals.
 - ✓ Try to use your car less frequently to reduce pollution, particularly for journeys under 2km.
 - ✓ Don't start your engine until you're ready to travel. Turn the engine off if you are waiting or stuck in a traffic jam.
 - ✓ Avoid rapid acceleration and heavy braking: they both increase fuel consumption and air pollution.
 - ✓ Stay within the speed limit: you use 30% more fuel to travel the same distance at 70mph instead of 50mph.





The OPAL Air Survey

By **OPAL Air Centre**, **Imperial College London** and **British Lichen Society**

Introduction

Good air quality is important. It is essential for our health and for the health of the natural environment. Although air quality in Britain is better today than it has been for many decades, pollutants can still reach levels which can cause harm to human health, food supplies, water quality and biological diversity.

About the Air Survey

By joining in the **OPAL Air Survey**, and submitting your results to the OPAL website (www.OPALexplorenature.org), you will be helping to build up a detailed picture of the impact of air quality in your local area and across the country.

The **OPAL Air Survey** has two parts:

- **Activity 1** uses lichens on trees
- **Activity 2** uses a fungus (*Rhizisma*) that causes black spots on sycamore leaves

These activities do not have to be carried out in the same place or at the same time.

Instructions for carrying out both parts of the **OPAL Air Survey** are on this chart. The A4 workbook includes tables in which to enter your results. This symbol  indicates when you need to write something down.

Before you start the survey please refer to the workbook where you will find more detailed instructions and background information.

Record in the workbook any insects or other creatures you find on the tree during your survey.

Air pollution

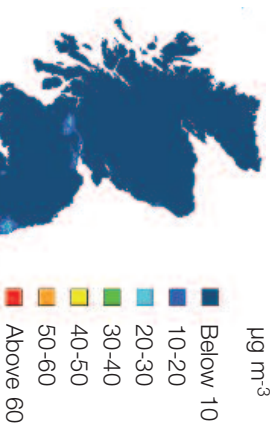
We are particularly interested in two types of pollution which contain nitrogen: ammonia and oxides of nitrogen (nitric oxide and nitrogen dioxide).

Look at the national maps for nitrogen dioxide and ammonia (Maps 1 and 2). Are levels of nitrogen dioxide and ammonia high or low in your area?

You can find out more information on air quality where you live or work by visiting the website

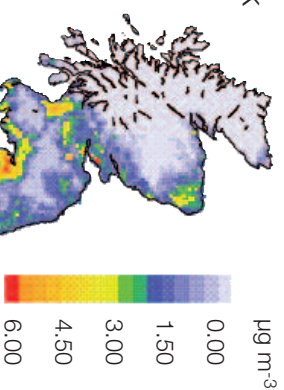
www.airquality.co.uk

See page 2 of the workbook to find out more about the sources of these pollutants.



Map 1.
Nitrogen dioxide in Britain
(average concentrations for 2007)

© AEA Technology 2007



Map 2.
Ammonia in Britain
(average concentrations for 2005)

© CEH Edinburgh 2005

The survey starts here

+ Safe fieldwork

We don't advise you to work on your own. Take a responsible friend who can help with your survey, and in case things go wrong. Make sure that you know what to do in an emergency. Be careful not to trip over tree roots. Watch out for low-hanging branches and falling branches. Take care to avoid twigs in the eye, and be sure not to damage any tree, its twigs or branches.



Try to carry out the survey when the weather is dry (as some lichens change colour in the rain).

Essential equipment to take outside with you

- This pack which contains: the fold-out chart, workbook, Tree Chart, OPAL magnifier
- A tape measure (or string and the ruler below)
- A pencil or waterproof pen

Useful items to take outside (if you have them)

- A map and GPS device if available
- A mobile phone
- A camera

When you are ready to start the survey, turn over the chart for instructions on how to begin the first activity

Guide to indicator lichens

Can you find any of these lichens?

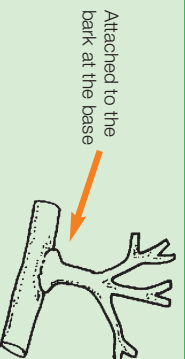
Look for the nine lichens in the photographs

Nitrogen-sensitive lichens are outlined in **blue**

Nitrogen-loving lichens are outlined in **red**

Intermediate lichens can be found in clean and polluted conditions and are outlined in **grey**

The nine types of lichen shown in the photographs are all bushy or leafy.



Bushy lichen

Branched and shrub-like, attached to the bark at the base



Leafy lichen

Leaf-like lobes closely or loosely attached to the bark from the lower surface

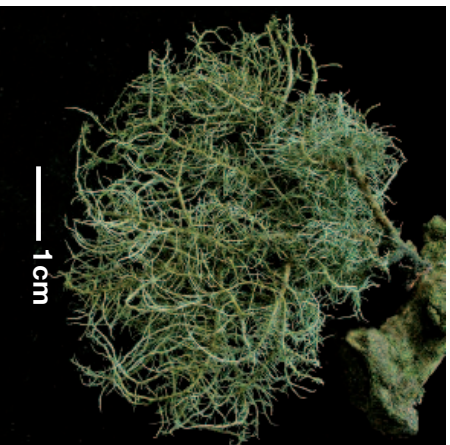


Crusty lichen

Closely attached as if pressed on the bark. Crusty lichens are difficult to identify, so are not included in this survey, but you can find pictures of some on the OPAL and iSpot websites

Nitrogen-sensitive

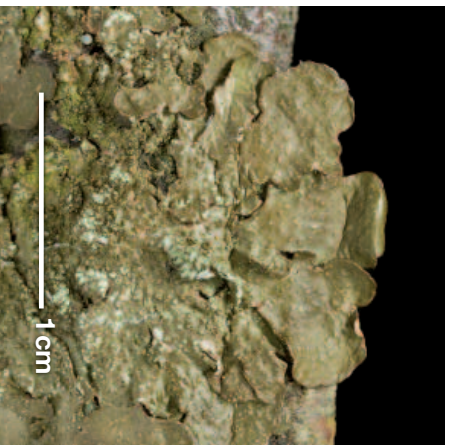
1. *Usnea*



- branches thread-like
- grey-green all round

Intermediate

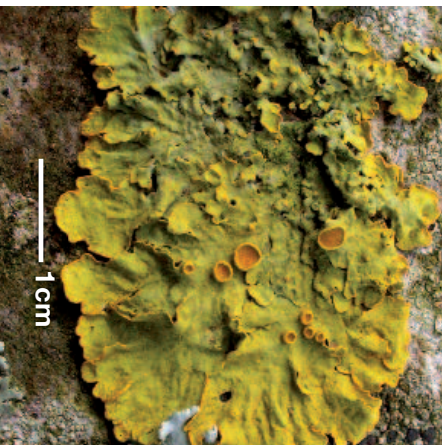
4. *Melanelia*



- dull brown lobes, closely attached to the bark
- paler areas show when surface is rubbed

Nitrogen-loving

7. *Leafy Xanthoria*



- lobes broad and spreading
- lobes yellow/orange to greenish yellow
- orange fruiting bodies often present



Nitrogen-sensitive

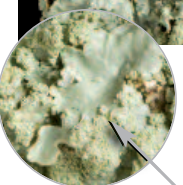
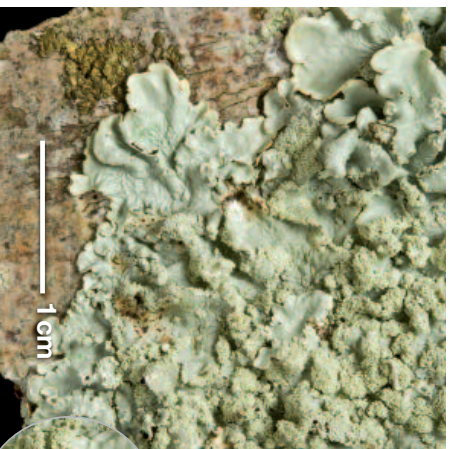
2. *Evernia*



- lobes flattened, strap-like
- grey-green on top, white below

Intermediate

5. *Flavoparmelia*



- broad, apple-green lobes
- wrinkled surface on which powdery spots may develop

Nitrogen-loving

8. *Cushion Xanthoria*



- lobes small and clustered
- lobes yellow to green-grey
- orange fruiting bodies usually present



Nitrogen-sensitive

3. *Hypogymnia*

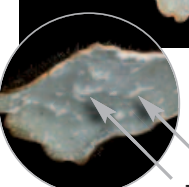
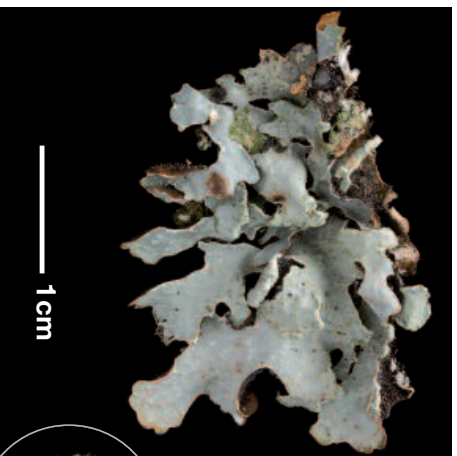


- lobes greyish on top, pale brown below
- lobe ends often become powdery
- lobes puffed up and hollow



Intermediate

6. *Parmelia*

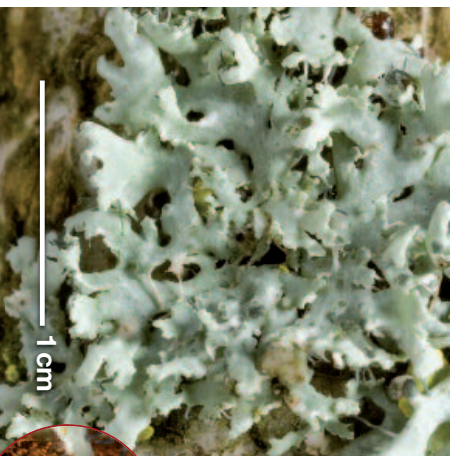


- lobes thin, loosely attached to the bark
- lobes grey on top, dark brown below
- pattern of white lines on the surface



Nitrogen-loving

9. *Physcia*



- lobes grey on top, whitish below
- lobe ends raised up becoming powdery
- black-tipped whiskers on the lobe edges



Activity 1: Lichens on trees

Why lichens?

Lichens have long been known to be sensitive indicators of air quality. They were used in the past to map areas affected by sulphur dioxide pollution from industrial and domestic sources. Today, lichens occur widely in our towns, cities and countryside, on a diverse range of surfaces from concrete pavements to park and woodland trees. This survey will help us find out how lichens are being influenced by current atmospheric conditions.

Indicator lichens we are looking for

We have selected nine lichens that can be used as indicators of local air quality. We know that some lichens are sensitive to nitrogen in the form of ammonia or nitrogen oxides (so called 'nitrogen-sensitive' lichens), and that they are unable to survive in areas with high levels of these pollutants. Others thrive with increased levels of nitrogen compounds ('nitrogen-loving' lichens), and yet others (intermediates) can be found in both clean and polluted conditions. Help us to map these indicator lichens on trees across the country.

Lichens on trees

Lichens on trees will vary with bark type and the age of the bark, as well as with air quality and climate. Lichens on the trunks of older trees may have been there for many years, while young trees or twigs may support lichens that have recently colonised new bark. We would like you to help us find out if the lichens on the trunk (the oldest part of the tree) are different from the lichens on the twigs (youngest part of the tree). Do trunks or twigs have more pollution-sensitive indicator species?

Record your results in the workbook (pages 6–7) as you carry out your survey, and do not forget to enter them into the OPAL website at the end.

A Site characteristics

First choose your site. Look for a site with deciduous trees (use the enclosed Tree Guide) and lots of light. We suggest oak, ash or sycamore. Avoid evergreen trees and trees which are heavily shaded (e.g. beech and horse chestnut) or covered in ivy. If sampling in woodland, use trees at the edge rather than the centre. Choose 2–4 trees of the same type if possible.



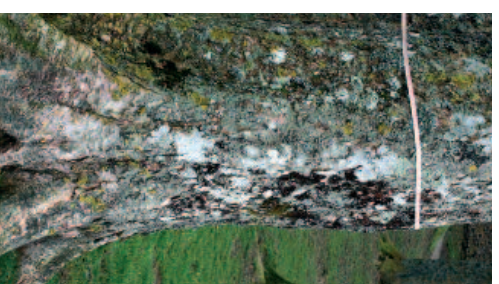
Answer Questions 1–7.

B Tree characteristics



Record for each tree:

- the type (species) of tree, or answer 'unknown' if you are not sure
- the girth of the trunk at 1 m above the ground




Measuring girth

C Record indicator lichens on the trunk

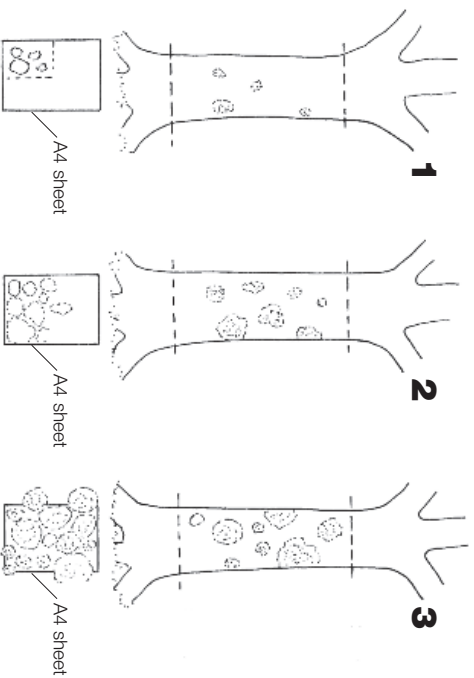
Choose the side of the trunk with the most lichens. Focus just on the lichens at 50–200 cm above ground level.



Examining lichens
50–200 cm above the
ground

 Record the total amount of each indicator lichen you see on the side of the trunk you have chosen as follows:

- 0 None (this is an important result)
- 1 Small amount overall (amounting to less than ¼ of an A4 sheet of paper in total)
- 2 Medium amount overall (amounting to between ¼ up to one A4 sheet in total)
- 3 Large amount overall (more than one A4 sheet in total)



Count how many other types of lichen there are.

 Record this number in the table.

Look for green or orange algae on the trunk.


 Record in the table any algae you find.



Orange alga



Green alga

 Record any insects or other organisms you find on the tree (illustrated on page 7 of the workbook). You can find more information and help with identification on the OPAL website.

Record lichens on twigs

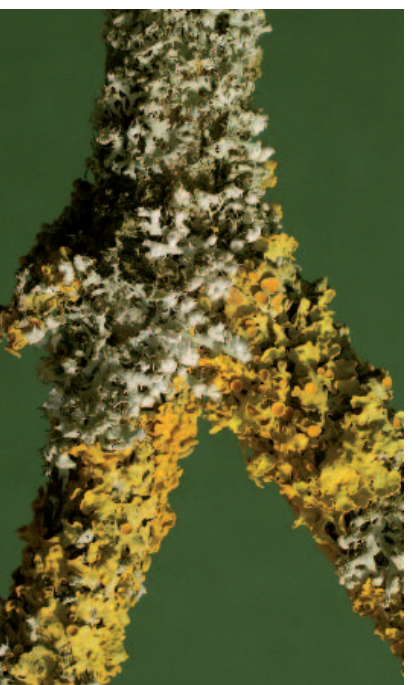
Can you reach the twigs? If so, check if any of the indicator lichens are present. Don't spend more than 5 minutes looking.

- Avoid dead or fallen twigs
- Only record from twigs under 2 cm in diameter up to a length of 1 m

Take care to avoid twigs in the eye!




Nitrogen-sensitive lichens



Nitrogen-tolerant lichens

 Record the presence of indicator lichens with a tick (✓). Enter zero (0) for each indicator species which was not present when you looked.

 If there are green or orange algae on the twigs enter a tick in the box.

Complete your survey

Upload your results to the OPAL website
www.OPALexplorenature.org

There is a map on the OPAL website to help you find your location and postcode.

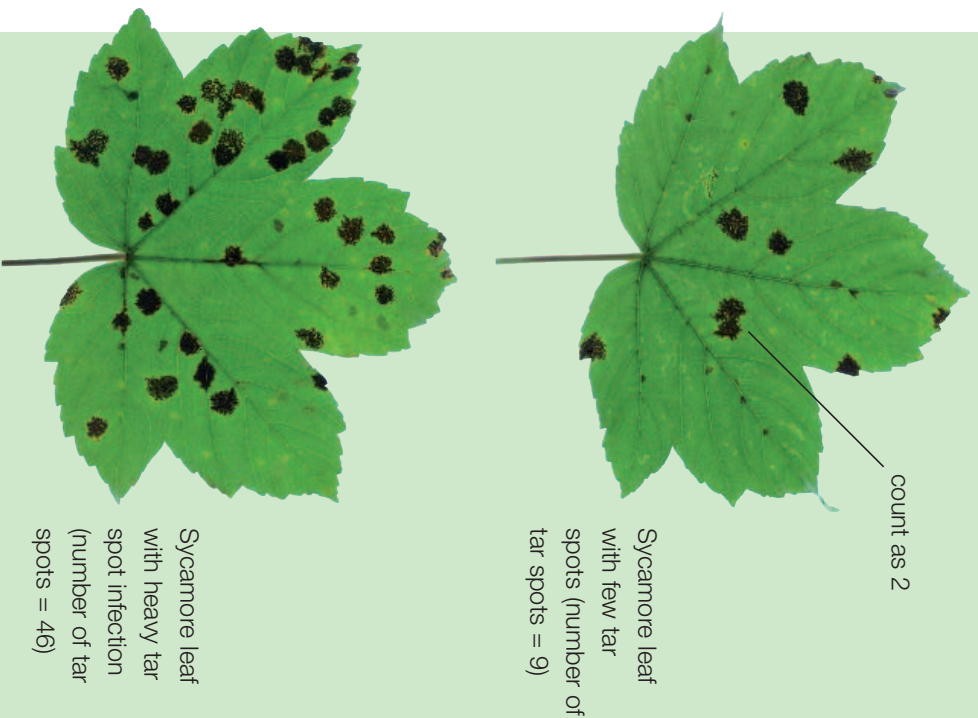
End of Activity 1


Activity 2: Tar spot of sycamore

You may have seen 'tar spots' on the leaves of sycamore trees. These are caused by the parasitic fungus *Rhytisma acerinum*.

The fungus is widely distributed across England; fungal spores spend the winter in dead leaves on the ground and infect the tree's new leaves in late spring. After infection the disease develops into large, easily identified black spots ('tar spots'), up to 15 mm wide, in July and August.

Many factors affect the performance of fungi, including climate and air pollution. Studies have shown that tar spot fungus is reduced by sulphur dioxide and oxides of nitrogen. This means that where there are more tar spots, it is likely that the levels of these pollutants will be lower.



 Record your results as you carry out your survey (Page 8 in the workbook)

A Site characteristics

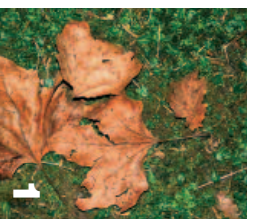
Choose 2–4 sycamore trees. Use the enclosed Tree Guide to help you. There is no need to remove any of the leaves. Either choose leaves still attached to the tree or collect fallen leaves from under the tree. You do not have to carry out the tar spot survey in the same place as the lichen survey.

 Answer Questions 1–3.


B Tree characteristics

 Record for each sycamore tree:

- the girth of each trunk at 1 m above the ground
- the amount of fallen leaves lying under each tree (0 = no fallen leaves, 1 = a small amount of fallen leaves, 2 = lots of fallen leaves) – see photographs below



C Record leaf information

 Choose 10 leaves randomly from each tree. Record for each leaf:

- the number of tar spots, including any partial (not full) spots
- the width of the leaf (in cm) at its widest point – use the ruler on the other side of this chart

D Complete your survey

Upload your results to the OPAL website
www.OPALexploration.org

End of Activity 2

What do your results mean?

Activities 1 and 2 give us new information about species that are sensitive to two different types of air pollution – ammonia (mainly from agriculture) and oxides of nitrogen (mainly from traffic and energy generation).

For lichens, when you enter results on www.OPALexplorenature.org, a score is calculated which can be compared with a national scale.

Where there are plenty of nitrogen-sensitive lichens on tree trunks, there is likely to be no intensive farming, dense traffic or heavy industry.

In contrast, in areas where nitrogen-loving species (like *Xanthoria* and *Physcia*) are abundant, levels of nitrogen-containing pollutants are likely to be higher.

High numbers of tar spots on sycamore leaves may also indicate relatively clean air.

More information about what your results mean can be found in the accompanying workbook.

If you would like help with lichen identification visit the iSpot website (www.iSpot.org.uk) or use the links on the OPAL webpages.



Tree trunk at the edge of a field fertilised by cow manure. Nitrogen-containing pollutants from the manure have increased the abundance of nitrogen-loving species of lichen



Tree trunk on the edge of woodland away from sources of nitrogen, where the air is relatively clean. Nitrogen-sensitive species of lichen are abundant



Open Air Laboratories (OPAL) is a partnership initiative which is encouraging people to spend more time outside understanding the world around them. OPAL wants to get everybody involved in exploring, studying but most of all enjoying their local environment. OPAL will be running a programme of events and activities until the end of 2012. To find out more about events in your region please visit the website: www.OPALexplorenature.org

Supported by
The National Lottery
through the Big Lottery Fund



Photographs by: Harry Taylor², William Purvis², Barbara Hilton², Ann Allen², James Cook¹, Emma Green¹, Pat Wolseley^{2,3}, Barbara Hilton², Linda Davies^{1,2}, Nigel Bell¹, Nathan Callaghan¹, Emma Green¹, Imperial College London² British Lichen Society³ Natural History Museum
Map 1 is © AEA Technology 2007 and produced with permission from DEFRA. Map 2 is © CEH 2005 and produced with permission from DEFRA.

Lichen Monitoring Sheet

School: _____

Date: _____ Time: _____ Location: _____ Weather: _____

Names of champions/ participants: _____

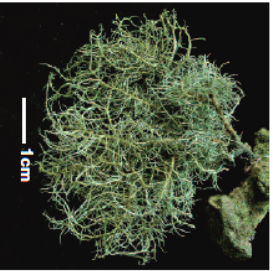

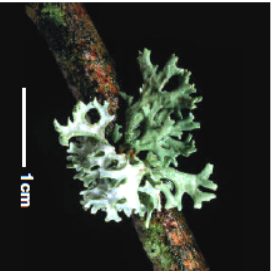



A lichen is made up of two organisms living together: a fungus and an alga. Lichens usually attach themselves to trees, but they can also be found on other surfaces. So what kind of air do they like?

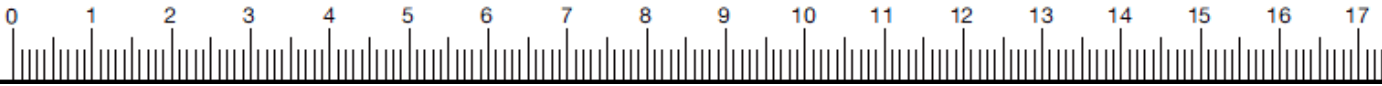
- Nitrogen-sensitive lichens only live in clean air
- Nitrogen-loving lichens can live in dirty air
- Some lichens are not affected by air quality and can live anywhere!

You can work out if the air is polluted by looking at the types of lichen growing. Different lichen species display different shapes and colours. These pictures and magnifying glasses will help you to identify them.



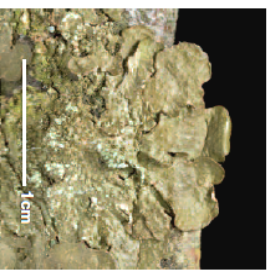

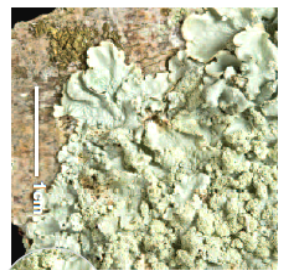

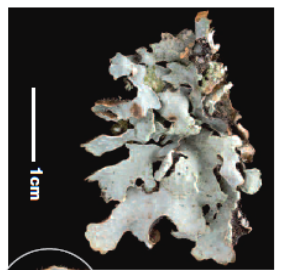

The Clean Team : Nitrogen-sensitive

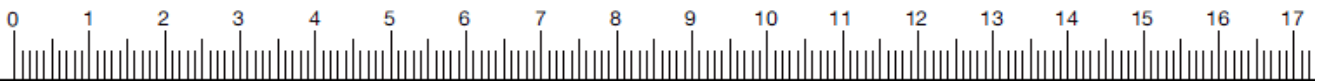
Can you find these lichens?		
<p>1. Usnea</p>  <ul style="list-style-type: none"> • branches thread-like • grey-green all round 	<p>How much area does it cover? (A) small: less than ¼ A4 sheet (B) medium: ¼ up to one A4 sheet (C) large: more than one A4 sheet</p>	<p>How many trees with this lichen did you see?</p>
<p>2. Evernia</p>  <ul style="list-style-type: none"> • lobes flattened, strap-like • grey-green on top, white below 	<p><i>I have other names: "Tree moss" and "beard moss"</i></p>	
<p>3. Hypogymnia</p>  <ul style="list-style-type: none"> • lobes greyish on top, pale brown below • lobe ends often become powdery • lobes puffed up and hollow 	<p><i>You can call me "oak moss"! I can be used to make perfumes.</i></p>	
<p><i>My nickname is "tube lichen"!</i></p>		

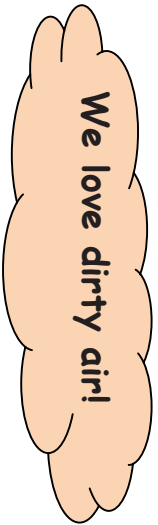


Air quality makes no difference to us.
We're happy anywhere.

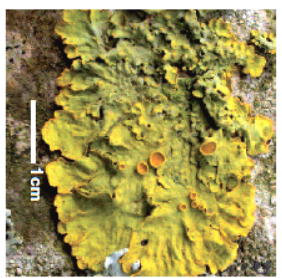







The Grow-Anywhere Gang : Intermediate

<p>Can you find these lichens?</p>	<p>How much area does it cover? (A) small: less than ¼ A4 sheet (B) medium: ¼ up to one A4 sheet (C) large: more than one A4 sheet</p>	<p>How many trees with this lichen did you see?</p>
<p>4. Melanelixia</p>  <ul style="list-style-type: none"> dull brown lobes, closely attached to the bark paler areas show when surface is rubbed 	<p><i>Some people also call me "camouflage lichen"</i></p>	
<p>5. Flavoparmelia</p>  <ul style="list-style-type: none"> broad, apple-green lobes wrinkled surface on which powdery spots may develop 	<p><i>I am found in woodland but becoming common in towns!</i></p>	
<p>6. Parmelia</p>  <ul style="list-style-type: none"> lobes thin, loosely attached to the bark lobes grey on top, dark brown below pattern of white lines on the surface 	<p><i>I am pretty hardy! Bird droppings do not kill me!</i></p>	

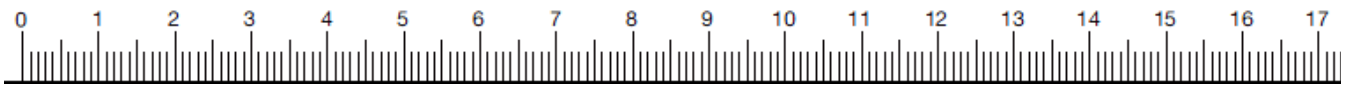




The Pollution Gang : Nitrogen-loving

<p>Can you find these lichens?</p>		
<p>7. Leafy Xanthoria</p>  <ul style="list-style-type: none"> lobes broad and spreading lobes yellow/orange to greenish yellow orange fruiting bodies often present 	<p>How much area does it cover? (A) small: less than ¼ A4 sheet (B) medium : ¼ up to one A4 sheet (C) large: more than one A4 sheet</p>	<p>How many trees with this lichen did you see?</p>
<p>8. Cushion Xanthoria</p>  <ul style="list-style-type: none"> lobes small and clustered lobes yellow to green-grey orange fruiting bodies usually present 	<p><i>We have different colours from orange to green!</i></p> 	
<p>9. Physcia</p>   <ul style="list-style-type: none"> lobes grey on top, whitish below lobe ends raised up becoming powdery black-tipped whiskers on the lobe edges 	<p><i>I am popular in big cities and major roads.</i></p>	

Images courtesy of the Open Air Laboratories (OPAL)



Diffusion Tube Factsheet

Hello, I'm Paul, the Palmes Diffusion Tube!



About Me:

I measure how much of different types of gases there are in the air, but my favourite thing to do is to measure **Nitrogen Dioxide (NO₂)**. If there is a lot of Nitrogen Dioxide in the air it usually means that the air is very polluted. A lot of this pollution is caused by cars, as Nitrogen Dioxide is one of the gases that come out of cars.

How I work:

I have a special steel mesh which is coated in a special chemical, which is hidden under my colour cap (it may be red, grey, or other colours!). When gases pass over this mesh the chemical changes slightly. This chemical change tells us how much Nitrogen Dioxide there is in the air.

How to use me:

The first thing to do is to take off the white plastic cap at the bottom of my tube. After that I need to be left outside, with my black mount stuck to a wall, for about two weeks. I need to have my colour cap pointing towards the sky; otherwise I will fill up with water if it rains. After two weeks I will have measured the gases in the air, the lab will analyse me and tell you if the amount of Nitrogen Dioxide is safe or dangerous to your health.

Top Tips:



You need to be careful where you put me as I can't measure gases well if I'm in a windy spot.



Don't put me in a doorway or hole in a wall because I won't be able to reach the air.



It's a good idea to write down what the weather is like when I'm outside because this can affect how much Nitrogen Dioxide I can reach.

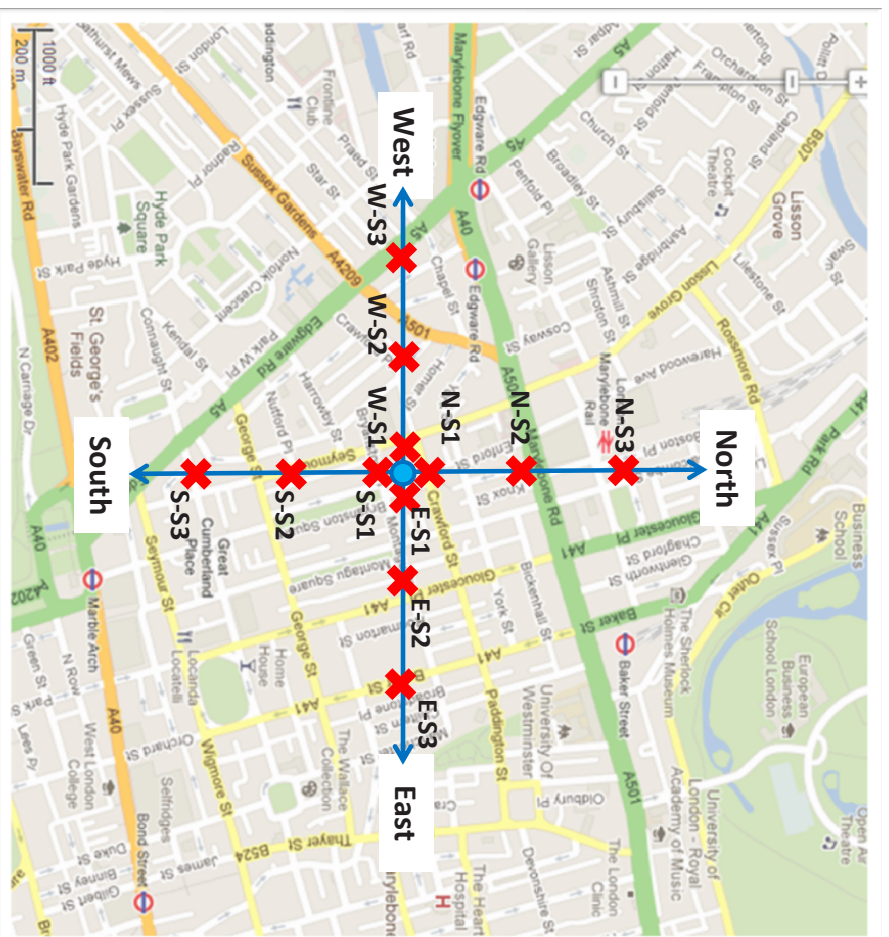
Diffusion Tube Sampling Instructions

What you will need:

- 13 Diffusion tubes (12 sampling tubes and 1 control tube)
- 13 black plastic diffusion tube wall mounts
- 12 'Do Not Disturb' signs
- 4 record forms
- Map of your school neighbourhood. The map should have your school in the middle and **cover 400m toward North, South, East and West.**
- Ruler
- Pencil
- Re-sealable plastic bag
- Permanent marker pen to label tubes

Where to put your tubes:

Take your map and, using your ruler, draw **four lines** pointing North, South, East and West. These **sampling lines** should cross over with your school in the middle, just like the picture below. Looking at the scale at the bottom of the map you can see that these lines cover 400m on the ground.



On each of your lines draw three crosses. The first cross will be in your school building or the street next to your school. The next two crosses are 200m and 400m away from your school. These crosses show you where you will need to put your diffusion tubes.

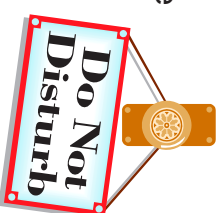
1. On each line, number the crosses 1, 2 and 3 with number 1 closest to your school, number 2 in the middle (200 away from your school), and number 3 the furthest (400m away from your school).
2. Write your name, today's date and the name of your school at the top of your sampling sheet. Write your name and the name of your sampling line (North, South, East or west) on your plastic bag. When you collect your tubes in two weeks time, you will put them into this bag.
3. Circle the name of your sampling line (North, South, East or West) at the top of your sampling record sheet.
4. Take three of your tubes and a waterproof marker pen. Write the name of your sampling line (N,S,E or W) and the tube number 1, 2 and 3 on their colour caps. These will be your '**sampling**' tubes. On your record sheet write the six digit ID number found on each tube, in the box that has the same number as the colour lid.
5. Take your map, sampling sheet, and diffusion tubes and walk North to cross 1 on your sampling line.
6. When you get to your first site, look for a good place to put your diffusion tubes. **Remember!** Your site needs to be:
 - Not covered by trees, bushes or other plants
 - On an open wallYou might be able to minimise the risk of the tubes going missing by trying to site them in locations that you know (i.e. neighbours' walls, other schools etc), or by placing them up to 3 meters high
7. When you have picked a good place to put your tubes, measure two metres from the ground and mark a point on the wall. This is where you will put your first diffusion tube!



The above picture shows the first sampling tube and the control tube in place on the school ground

Putting your tubes up

8. Take your tubes and put them into black plastic wall mounts. Peel the tape off the back of the mounts and stick them onto the wall.
9. Write what time it is on your sampling sheet under “time cap removed”, and then remove the white plastic cap on the **bottom** of the sampling tube with N-1 written on it. Put the white plastic cap in your plastic bag.
10. Stick one of your signs underneath the tubes so that no one tries to move them.
11. When you have done this spend 5 minutes making some notes about the area around your sampling site in the box labelled ‘Site Characteristics’.
 - Are you near a main road?
 - Are there any trees nearby?
 - Is there a crossing near your tubes?
 - Is there a car-park nearby?
 - Write as much as you can because this will help you work out why pollution levels might be different later on.
12. Go to your next sampling point and repeat steps 8 to 11 with your tube labelled ‘N-2’, making notes in the boxes for ‘Sample Site 2’.
13. Move onto your third and final sampling point and repeat steps 8 to 11 with the tube labelled ‘N-3’, writing your notes in the boxes for ‘Sample Site 3’
14. Repeat the process for the three other directions (East South and West).
15. Prepare the control tube, and put it up in the same way as the other tubes. Locate it somewhere in the school site, such as in your classroom or next to another tube in the school grounds. **Do not remove either cap from the control tube.**
16. Check that you’ve done everything correctly and give your sampling sheet and map back to your teacher. Everyone’s information is very important so we need to make sure it has all been collected the same way.



Well Done! You've started your pollution monitoring!



Collecting your tubes

17. After 2 weeks, go back to where you placed your tubes.
18. When you get to your first sampling site check that your open sampling tube is still there. Have they been damaged at all? Has anything in the area changed? Write down anything that you think is interesting in the box on your sampling sheet labelled 'Tube condition'.
19. Remove the open diffusion tube from where you stuck it, and **put the white plastic lid back on the sampling tube**, and place it back into the bag. Check the date and time and write this in the 'date and time cap replaced' box for this tube on your sampling sheet.
20. Walk along to your next sampling site and repeat steps 17 to 19.
21. Next, move to your last sampling site and repeat steps 17 to 19.
22. Repeat for each sampling line (North, South, East and West), until all tubes are collected.
23. When you get back to school, work out how many hours each of your tubes was outside for. Your teacher can help you with this. Write the number of hours the tubes at each sampling site were outside in the box 'Hours tubes outside for'.
24. Once at school, take down your sealed control tube and check that it doesn't have any cracks. If it does, make sure that you write these down in the 'Tube conditions' box on your sampling sheet. Then, put your sealed control tube into your plastic bag.
25. Make sure you check over all of your notes with your teacher and get them to check that everything is correct! We don't want any little mistakes to mess up your results!



Congratulations! You're all finished! Now you just have to wait to get your results back and look over them with your class.

Diffusion Tube Record Form

Name: _____

School: _____

Date: _____

North Line					
Sampling Tube N-1	Six digit ID number	Date and Time cap removed	Date and Time cap replaced and tube collected	Hours Tubes outside for	
	Site characteristics (building/road works/traffic diversions)		Tube condition (Dirt? Insects? Fallen?) Has anything changed in the area?		
	Six digit ID number	Date and Time cap removed	Date and Time cap replaced and tube collected	Hours Tubes outside for	
Sampling Tube N-2	Site characteristics		Tube condition		
	Six digit ID number	Date and Time cap removed	Date and Time cap replaced and tube collected	Hours Tubes outside for	
Sampling Tube N-3	Site characteristics		Tube condition		

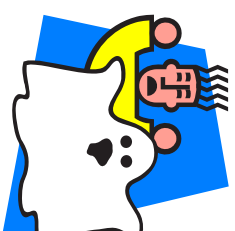
South Line					
Sampling Tube S-1	Six digit ID number	Date and Time cap removed	Date and Time cap replaced and tube collected	Hours Tubes outside for	
	Site characteristics (building/road works/traffic diversions)		Tube condition (Dirt? Insects? Fallen?) Has anything changed in the area?		
	Six digit ID number	Date and Time cap removed	Date and Time cap replaced and tube collected	Hours Tubes outside for	
Sampling Tube S-2	Site characteristics		Tube condition		
Sampling Tube S-3	Six digit ID number	Date and Time cap removed	Date and Time cap replaced and tube collected	Hours Tubes outside for	
	Site characteristics		Tube condition		

East Line					
Sampling Tube E-1	Six digit ID number	Date and Time cap removed	Date and Time cap replaced and tube collected	Hours Tubes outside for	
	Site characteristics (building/road works/traffic diversions)		Tube condition (Dirt? Insects? Fallen?) Has anything changed in the area?		
Sampling Tube E-2	Six digit ID number	Date and Time cap removed	Date and Time cap replaced and tube collected	Hours Tubes outside for	
	Site characteristics		Tube condition		
Sampling Tube E-3	Six digit ID number	Date and Time cap removed	Date and Time cap replaced and tube collected	Hours Tubes outside for	
	Site characteristics		Tube condition		

West Line					
Sampling Tube W-1	Six digit ID number	Date and Time cap removed	Date and Time cap replaced and tube collected	Hours Tubes outside for	
	Site characteristics (building/road works/traffic diversions)		Tube condition (Dirt? Insects? Fallen?) Has anything changed in the area?		
Sampling Tube W-2	Six digit ID number	Date and Time cap removed	Date and Time cap replaced and tube collected	Hours Tubes outside for	
	Site characteristics		Tube condition		
Sampling Tube W-3	Six digit ID number	Date and Time cap removed	Date and Time cap replaced and tube collected	Hours Tubes outside for	
	Site characteristics		Tube condition		

Control Tube	Six digit ID number	Site characteristics		Tube condition	

Ghost Wipe Instructions



Ghost wipes are used to test the air quality in schools by measuring how much heavy metals in pollutants collect on surfaces. The purpose of the test is to identify what heavy metals there are, how much there is and then suggest what health impacts this may cause.

***** Please READ through the instructions and Guidelines for Teachers*****

What do you need

	To perform the sampling process, you will need:
	<ul style="list-style-type: none"> ✓ 1 pair of gloves ✓ 1 ghost wipe ✓ 1 easy-seal bag (with information tag) ✓ 1 cardboard square (to define wiping area) ✓ 1 pen ✓ 1 school map ✓ 1 masking tape (to fix the cardboard square)

Pictures of the process: 5 main steps

WEAR (gloves) → **FOLD** (wipe) → **WIPE** (surface) → **SEAL** (sample) → **WRITE** (information)

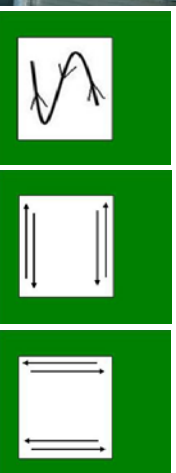
1. **WEAR:** Put on the gloves



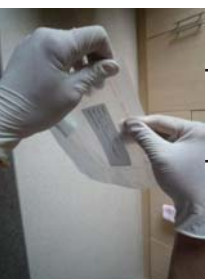
2. **FOLD:** Take out the wipe and fold it to a smaller size that you feel easy to wipe.



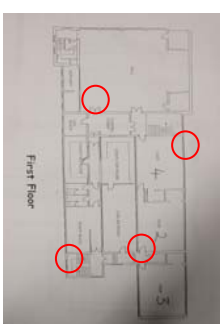
3. **WIPE:** Choose and wipe a surface



4. **SEAL:** Secure the sampled wipe in the easy-seal bag



5. WRITE: Write down the sampling information and mark the school map. Mark your name and the sampling code and on *both* the bag and the map.



TIPS:

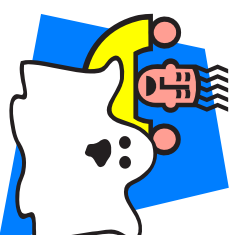
- (a) **Fix your ghost wipe poster** next to your wipe square to remind you where you left it and to make sure other people don't touch it.
- (b) **DO NOT** clean, wash or stain the decided wiping area after the first wiping exercise.
- (c) **After 1 week:** Wipe the same area to collect second sample.

Instructions in writing:

<p>1. WEAR: Put on the gloves</p>	<ul style="list-style-type: none"> ➤ Open the envelope package ➤ Put on the gloves
<p>2. FOLD: Take out the wipe</p>	<ul style="list-style-type: none"> ➤ Open the ghost wipe wrapper ➤ Take out the ghost wipe ➤ Fold the ghost wipe into a small and easy-to-hold size.
<p>3. WIPE: Choose a corner of the surface and wipe it well within the square</p>	<ul style="list-style-type: none"> ➤ Choose 15 surfaces, they can be horizontal or vertical surface. Such as windows, windows, street signs, tables: <u>(a list of suggested surfaces is on Guidelines for Teachers)</u> ➤ Use the cardboard square to identify the area. ➤ Fix the cardboard by masking tape carefully ➤ Make sure the ghost wipe touches ONLY inside the square (don't drop it!) ➤ Use the ghost wipe to clean the surface <ul style="list-style-type: none"> ○ Wipe inside the cardboard square area ○ Repeat zigzag, top to bottom, and right to left motions until clean. ➤ Leave the square on the surface so you can wipe the same place after 1 week.
<p>4. SEAL: Secure the sampled wipe in the easy-seal bag</p>	<ul style="list-style-type: none"> ➤ Open the easy-seal bag ➤ Put the ghost wipe into the bag ➤ Seal the ghost wipe in the easy-seal bag
<p>5. WRITE: Write down the sampling information and mark the map</p>	<ul style="list-style-type: none"> ➤ Write on the bag: <ul style="list-style-type: none"> ○ Sample Code and location ○ Your name / your class or year group ○ Date and time of sampling ○ Short description of the surface (eg: glass window, rough wall) ➤ Mark the location on the map
<p>2nd sample wiping</p>	<ul style="list-style-type: none"> ➤ After 1 week, perform the ghost wipe test again. Collect the sample from the same spot you wiped for the first sample. ➤ Now you have 30 samples collected (15 surfaces, 2 wipes each)
<p>Return the wipes (Teacher)</p>	<ul style="list-style-type: none"> ➤ Complete the record form, contact your wipe company and return the wipes. It usually takes 10 working days to process the wipes.

Ghost Wipe Test Guidelines for Teachers

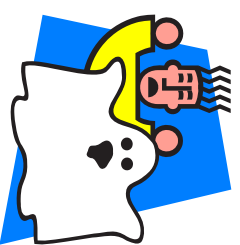
- 1. Materials:** It depends on your budget and how many locations you want to test. We suggest you **wipe 15 surfaces twice to collect 30 samples**. In this case, you need to prepare 30 wipes, 30 easy-seal bags with information tags, 15 cardboard squares with 10cm x 10cm wiping area, a pair of gloves, masking tape, a pen and a school map.
- 2. Making posters before wiping:** Design posters/warning signs (around A4 size) with “*Ghost Wipe Test, do not touch me!*”. It can be an artistic activity to promote the awareness of air pollution in the school.
- 3. Choose surfaces.** A list of different surfaces is recommended below. However, teachers and pupils are encouraged to choose other surfaces to wipe. They may reveal how different material/ location/ maintenance affects air quality.
- 4. First Wipe: Please read the Ghost Wipe Test Instructions for details and tips**
WEAR (gloves) → **FOLD** (wipe) → **WIPE** (surface) → **SEAL** (sample) → **WRITE** (information)
 → **Leave the square on the surface and put the warning poster for one week**
- 5. Second Wipe:** after one week, repeat the same process on the surfaces.
- 6. Return the samples:** Complete the table on the page labeled “Ghost Wipe Record Form” (see example below) and contact your wipe company. Before returning samples, ask if you need to fill out other record sheets. It usually takes 10 working days to process the analysis.



Suggested surface	Suggested location	First Wipe sample Code	Second Wipe sample Code
1 Window	Inside, ground floor	1-1	1-2
2 Window	Outside, facing street, ground floor	2-1	2-2
3 Window	Inside, top floor	3-1	3-2
4 Main door	Outside, facing street, ground floor	4-1	4-2
5 Main door	Inside, ground floor	5-1	5-2
6 Side door/ Wall	Outside, ground floor, facing street	6-1	6-2
7 Room door/ wall	Classroom	7-1	7-2
8 Basement door	Basement	8-1	8-2
9 Roof wall	Roof wall outside	9-1	9-2
10 Notice board	inside school	10-1	10-2
11 Outdoor table/chair	Outside, horizontal surface	11-1	11-2
12 Outside wall	Child collection zone (idling area)	12-1	12-2
13 Goal post	Playground outside	13-1	13-2
14 Street /traffic sign1	Outside, near school	14-1	14-2
15 Street / traffic sign2	Outside, near school	15-1	15-2

EXAMPLE:

Ghost Wipe Test Record Form



School:
Contact:
Total samples:
Date of the First Wipe:
Date of the Second Wipe:

surface	location	First wipe sample code	Second wipe sample code
1		1-1	1-2
2		2-1	2-2
3		3-1	3-2
4		4-1	4-2
5		5-1	5-2
6		6-1	6-2
7		7-1	7-2
8		8-1	8-2
9		9-1	9-2
10		10-1	10-2
11		11-1	11-2
12		12-1	12-2
13		13-1	13-2
14		14-1	14-2
15		15-1	15-2

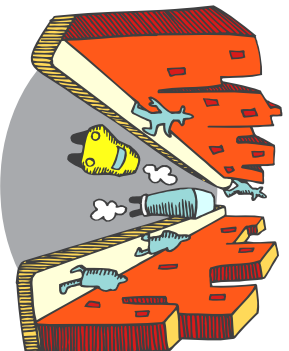
Ozone Badge Activity Sheet

How does it work?

Ozone badges are very easy to use - all you need to do is remove their seal and leave them for about 10 minutes. If you watch closely you will see the badge slowly change colour, you can then compare the final colour to the control sheet to see how much Ozone there is.

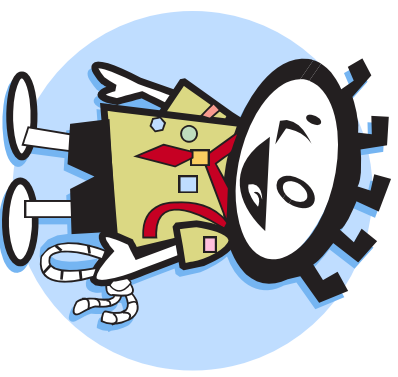
How many Ozone badges do you need:

In order to compare results with your classmates you will need between 30 and 50 Ozone badges for your whole school. These need to be collected from different locations (such as your school playground, a road and a park near the school) and at different date and times (such as morning, lunch time and afternoon).



How to organize your pupils:

Pupils should divide into three groups: morning, noon and afternoon. Each group will spend 1 to 1 and a half hours visiting different locations: school, roads and parks. You will need to spend about 20 minutes at each location to give 10 minutes to expose badges and 10 minutes to compare colours and record the data.



Ozone Badge Record Form

School: _____ Date: _____ Weather: _____

Group: Morning Noon Afternoon

Participants: _____

Location 1: School			
Location Description	Exposing Time (10 minutes)	Sample Code	Result
	____:____ to ____:____	School -1	
	____:____ to ____:____	School -2	
	____:____ to ____:____	School -3	
	____:____ to ____:____	School -4	
	____:____ to ____:____	School -5	
Location 2: Road/ busy main street			
Location Description	Exposing Time (10 minutes)	Sample Code	Result
	____:____ to ____:____	Road - 1	
	____:____ to ____:____	Road - 2	
	____:____ to ____:____	Road - 3	
	____:____ to ____:____	Road - 4	
	____:____ to ____:____	Road - 5	
Location3: Park/ green area			
Location Description	Exposing Time (10 minutes)	Sample Code	Result
	____:____ to ____:____	Park - 1	
	____:____ to ____:____	Park - 2	
	____:____ to ____:____	Park - 3	
	____:____ to ____:____	Park - 4	
	____:____ to ____:____	Park - 5	

Surface Wipe Instructions

What is it?

Surface wipe analysis is an easy way to measure how much particulate matter there is at different locations and different heights.

How to use it:

Surface wipe analysis uses a piece of sticky tape or moist cotton wool ball to sample the particulate matter on surfaces. You can sample lots of surfaces using surface wipe analysis including leaves on trees, poles, walls or doors around school. Your sample will show you how much pollution there is straight away. It is also useful to explore how levels of pollution may be different at different heights and different distances from roads. If there is a lot of pollution at low heights this could be dangerous to children.

What do you need?

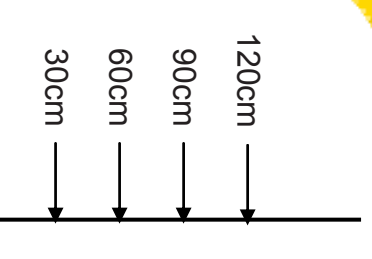
1. 2cm wide clear sticky tape or cotton wool balls
2. A tape measure at least 120 cm long

Sampling steps:

1. Find the surfaces you want to measure (tip: avoid wet surfaces). We suggest three different surfaces:
 - a door inside school
 - a wall outside school, and
 - a pole of street/traffic sign.



2. Use the tape measure to identify 4 spots at different heights: 120cm, 90cm, 60cm, 30cm



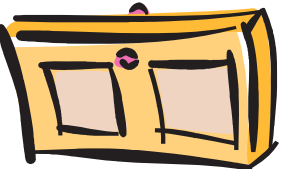
3. For sticky tape - cut the clear tape into 10cm strips. Press the sticky side of the tape firmly onto the surface, leave for 10 seconds and then remove it.
For cotton wool – dampen a cotton wool ball in a little water and wipe over a small area (about 10cm by 2cm)
4. Dirt and pollutants from the surface will have stuck to the tape or ball. Paste the tape or ball on the record sheet.
5. Repeat the steps above, and then compare the levels of pollution at different heights from the same surface.
6. Mark the pollution level from 1 to 4: 1 for the dirtiest sample and 4 for the cleanest sample.
Could you tell lower or higher heights are more polluted?
7. Repeat steps 1 to 6 for two other surfaces. Can you tell which surface is more polluted?

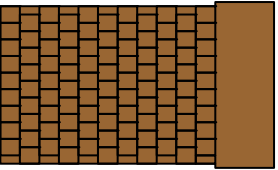
Surface Wipe Record Form

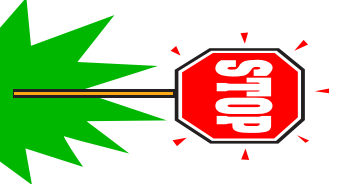
School: _____ **Date:** _____ **Weather:** _____

Participants: _____

Paste your tape or cotton wool samples below. Can you see the differences between them? Try to compare the samples and mark their levels of pollution: 1 for the dirtiest sample, 4 is the cleanest sample.

Location 1: Door inside school			
Surface details	Height	Paste your tape samples here!	Level 1 to 4
	120cm		
	90cm		
	60cm		
	30cm		

Location 2: Wall outside school				
Surface details	Height	Paste your tape samples here!	Level 1 to 4	
	120cm			
	90cm			
	60cm			
	30cm			

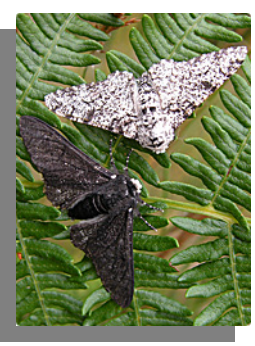
Location 3: Pole of street/ traffic sign			
Surface details	Height	Paste your tape samples here!	Level 1 to 4
	120cm		
	90cm		
	60cm		
	30cm		

Peppered Moth Activity Sheet

Air pollution affects not only people but also plants and animals. The Peppered Moth is a good example that students can learn air quality and air pollution!

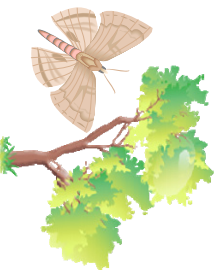
The Peppered Moth

The Peppered Moth is widespread in Britain and Ireland and is frequently found in back gardens. It is one of the best known examples of evolution by natural selection, Darwin's great discovery, and is often referred to as 'Darwin's moth'.



The Peppered Moth and Air Pollution

Peppered Moths are normally **white** with **black** speckles across the wings, giving it its name. Originally, the peppered moths wing colours camouflaged them against the light-coloured trees and lichens that they rested on.



However, in the nineteenth century, during the Industrial Revolution in England, widespread pollution killed off lichens and blackened urban tree trunks and walls. Therefore the normal, pale, speckled forms of the Peppered Moth were no longer camouflaged from predators on the soot-blackened trees. Black Peppered Moths thrived in these situations and the normal pale form became rare. Over successive generations, the black moths came to outnumber the pale forms in our towns and cities.



In the mid-twentieth century controls were introduced to reduce air pollution and as the air quality improved tree trunks became cleaner and lichen growth increased. As pollution has been greatly reduced, the balance swung back the other way.

Peppered Moth Activities

- **Key Message:** White peppered moths indicate less pollution, better air quality
- **The peppered moth story:** Tell students about the story, including the relationship between the moth and air quality, its evolution in UK history.
- **Observation:** Ask pupils if they have seen moths before? Are they peppered moths? What colour are they? Encourage pupils to observe moths in school, gardens, parks, and other places they visit.
- **Moth competition:** It can be an activity to promote sustainable travel. Get your class to draw and cut out a big black moth. Each member of the class can make an air quality pledge eg to walk or cycle to school, Each morning the class can put a white dot on the black moth if they have done their pledge until covered in white dots. It can be competition between classes in your school, or between groups in one class.

More information about peppered moth: <http://www.mothscount.org/>

(Photograph by Chris Manley from <http://www.amentsoc.org/about/news/0111/>)

Peppered Moth Pledges Sheet



My name is

My pledge to improve air quality is

.....



My name is

My pledge to improve air quality is

.....



My name is

My pledge to improve air quality is

.....



My name is

My pledge to improve air quality is

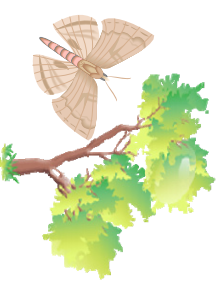
.....



My name is

My pledge to improve air quality is

.....



My name is

My pledge to improve air quality is

.....



Idling Survey Instructions

Is car idling contributing to air pollution around your school?



What is idling?

When people leave their car engine running while they have stopped, this is called 'idling'. A car is 'idling' if it has been left running for over **one minute** after stopping or parking.

Idling can cause pollution around school when parents pick up or drop off children. Their cars cough out dirty, smelly fumes. Yuck!

How do we monitor idling?


To work out if idling is causing pollution around your school, you can count the number of **parents' cars** outside your school that are idling.

It's best to count parents cars idling during the busy time in the morning before school starts and again in the afternoon when school ends. For example, if your school starts at 9:00 and ends at 3:30, you should do the survey from 8:30 - 9:00am and 3:15 - 3:45pm, because parents may come earlier to drop off or wait for their children.

Choose to do your idling survey on a day when most pupils leave school around the same time. Your teacher will send you, in groups, to a location beside the road near your school where parents drop off their children.

Instructions:

Fill out the form on the next page with your name, the date, and your location. You will be counting cars in two 15 minute blocks. Follow the steps below so we can compare everyone's results later on.

1. In a group of three, choose who you will be:
 - Champion 1 **Observer** : spot and identify parents' cars
 - Champion 2 **Timer** : time how long parents' cars are left idling
 - Champion 3 **Recorder** : record the number of cars idling and not idling
2. What is the time? Write the time in the column 'Start Time' (e.g. 8:30am). What time should you stop counting cars? The **Timer** should make sure that you stop counting cars after 15 minutes.
3. The **Observer** looks for parents' cars that are idling and not idling and tells the **Timer**.
4. The **Timer** uses a stop watch to time if cars have been idling for at least **one minute**.
5. The **Recorder** puts one dash in the column 'Number of cars idling' every time the **Observer** and the **Timer** find an idling car, and one dash in the column 'Number of cars not idling' every time the **Observer** spots a parked car that is not idling. 
6. At the end of 15 minutes, the **Timer** tells the **Observer** to stop counting and the **Recorder** writes the finish time in the column 'End Time' (e.g. 8:45 am). Add up the number of cars idling and not idling and record this in the 'total' column.
7. After a 1 minute break, you can swap jobs. Repeat steps 1-6 and record your findings in the second row.
8. When you finish counting cars for the second time, add up all the cars idling and put this number in the 'total' column on the bottom row. Add up all the cars not idling and put this number in the 'total' column on the bottom row.
9. Repeat steps 1-8 again in the afternoon.
10. At the end of the day, give your record form to your teacher. Do you think idling is a problem at your school? If yes, what can you do about it?



Congratulations! You've completed your idling survey.

Idling Survey Record Form

School: _____ Date: _____ Location/ street: _____

Supervisor: _____ Observer: _____ Timer: _____ Recorder: _____

Morning AM

Session	Start time	End time	Number of cars idling	Total	Number of cars NOT idling	Total
Morning Session 1						
Morning Session 2						
Total number of			cars idling		cars not idling	

Afternoon PM

Session	Start time	End time	Number of cars idling	Total	Number of cars NOT idling	Total
Afternoon Session 1						
Afternoon Session 2						
Total number of			cars idling		cars not idling	

Appendix 2: Further Reading, Links and Case Studies

About Air Quality: Helpful Links and Further Resources

London Air Quality Network: Contains information about air quality in and around Greater London
<http://www.londonair.org.uk/>

DEFRA UK-AIR: Air Quality Forecasts, current pollution levels and related news and information
<http://uk-air.defra.gov.uk/>

Clearing the Air: The Mayor's air quality strategy
<http://www.london.gov.uk/sites/default/files/Air%20Quality%20Strategy%20v3.pdf>

Mapping for Change: Community Maps
[http://www.communitymaps.org.uk/version5/includes/MiniSite.php?minisitename=Air Quality Monitoring&minisite_group=](http://www.communitymaps.org.uk/version5/includes/MiniSite.php?minisitename=Air%20Quality%20Monitoring&minisite_group=)

About Air Quality: References

1. Mayor's Air Quality Strategy, <http://www.london.gov.uk/improving-air-quality>
2. [Effects of Air Pollution](#), Defra 2012
3. [Air Quality Expert Group](#), 2005 (published by Defra)
4. London Air Quality Network report 14 (2009), <http://www.londonair.org.uk/>

Citizen Science Activities: Helpful Links and Further Resources

Eye on Earth: Interactive tool to display and discover information about the environment, including air quality information from monitoring stations and user feedback.

<http://watch.eyearth.org/>

British Gas' Generation Green: Produces lessons plans and resources linking issues of sustainability into different areas of the curriculum.

www.generationgreen.co.uk/resources/type/activity

EDF's Energy Programme for Greener Schools: Resources and information on renewable energy schemes for schools, including example lesson plans.

www.jointhepod.org/activities/

DCSF's Energy Display Meters Programme (scheme now closed)

Lessons plans and resources for schools, broken down into different Key Stage groups.

www.energydisplaymeter.co.uk/lesson-plans/default.aspx

Suschool: Child-friendly explanations and ideas for action on themes such as climate change, transport and energy efficiency.

www.suschool.org.uk/

The Open Air Laboratories (OPAL) network: Lichen and air survey, guide and quiz

<http://www.opalexplornature.org/LichenGuide>

Travel Plan Advice: Helpful Links and Further Resources

STAR Accreditation: TFL's accreditation framework for school travel plans

<http://lscp.org.uk/staccreditation/index.php>

Walkit: Suggests walking routes between desired locations exposing you to the least pollution and or congestion throughout London

www.walkit.com

Young London: TFL's initiative offering a range of programmes and resources aimed at young people to promote safer, responsible travel.

www.tfl.gov.uk/younglondon

Department for Education: Provides information and best practice around STPs; offers historical and instructive ideas about how schools with a travel plan can get new capital funding; and suggests practical ideas for encouraging pupils to walk, cycle or use public transport to travel to school.

www.education.gov.uk/search/results?q=travel+plans

SUSTRANS: Information and practical solutions to transport challenges for schools, parents, pupils, councils and anybody interested in school travel initiatives with the goal of enabling many more people to travel in ways that benefit their health and the environment.

www.sustrans.org.uk

Walk to School Campaign: Encourages parents and children to make walking to school part of their daily routine through campaigns, promotions and a wide-ranging variety of helpful resources. This website also provides a comprehensive list of links to other useful sources.

www.walktoschool.org.uk

London Cycling Campaign: You can find the latest news and information about cycling safety, events and campaigns for better cycling conditions across London.

<http://lcc.org.uk/>

Department for Transport Bikeability Campaign: Get your school cycling. "Cycling proficiency for the 21st century" – includes survey templates, games and information on getting cycling training in your school.

www.dft.gov.uk/bikeability/

Travel Plan Advice: Funding Resources

The following may be useful if you are looking for sources of funding to enable you to introduce certain measures highlighted from your School Travel Plan.

Awards for All (Big Lottery Fund)

www.awardsforall.org.uk

National Lottery Funding

www.lotteryfunding.org.uk/

The Co-operative Group: providing walking bus materials and resources, as well as free school trips

www.co-operative.coop/corporate/ethicsinaction/climatechange/climate-change-projects/walking-buses/

Funding Central

www.fundingcentral.org.uk

City Bridge Trust

www.citybridgetrust.org.uk

Travel Plan Advice: Case Studies

Overcoming Road Safety Issues: St. Edward's Primary School, Westminster

St. Edward's developed their travel plan in 2009 in which they highlighted several challenges facing the school. A high percentage of their pupils (61%) walk to school and road safety is a big concern for parents. In response to these concerns, the school has ensured that Community Support Officers are available at the beginning and end of the school day to help move cars off the zebra crossings and zig-zag lines where children cross. Additionally, the school is participating in the council's pedestrian skills training for pupils and staff and has introduced the WOW (Walking on Wednesday) initiative.

Reducing Numbers of Families Driving from Within 1 Mile: Randal Cremer, Hackney

Randal Cremer set out a specific target of reducing the number of families who live within one mile of the school driving each day from 10% to 8%. This was achieved through information distributed in the school newsletter, as well as promoting the health and environmental benefits during coffee mornings and Walk to School Week. As an alternative, they provided information on local bus and cycle routes for staff and parents, and encouraged car sharing where appropriate.

Illustrating Public Transport Links to School and School Catchment Area: Christ Church, Camden

Christ Church school has created a detailed travel plan, with clear information of its placement in the area. Included within are maps, information on transport links to the school, and information on the school's catchment area. It also goes some way to highlight the areas of the school curriculum and policies which already address sustainable transport.

Reducing Emissions From School Buildings: Helpful Links and Teaching Resources

National Reports and Guidance

Carbon Trust: Resources and advice for schools to reduce energy consumption
www.carbontrust.co.uk/schools

Carbon Trust: Carbon Footprint Calculator
www.carbontrust.co.uk/cut-carbon-reduce-costs/calculate/footprint-calculator/pages/footprinting-tools.aspx

DCSF (Department for Education): A Carbon Management Strategy for Schools, 2010:
www.education.gov.uk/publications/eOrderingDownload/DCSF-00366-2010.pdf

Target Zero: School Guidance Report
www.targetzero.info/guidance_reports/summary/school/

ATL: Education Union's Sustainability Toolkit
www.atl.org.uk/Images/ATL%20sustainable%20schools%20toolkit.pdf

Teaching Resources

EDF's Energy Programme for Greener Schools: Resources and information on renewable energy schemes for schools, including example lesson plans.
<http://www.jointhepod.org/activities/7-11/energy/>

Less-En: Top Ten Tips for Schools
<http://www.less-en.org//?page=EnergyEfficiencyandRetrofittingTip-1503>

Sustainable Energy Resources

Green Energy Scheme: Independently checked green energy providers
<http://www.greenenergyscheme.org/>

Solar4Schools: Run by SolarCentury (private company), set up in 2008 to help schools access renewable energy through Solar Power.
<http://www.solar4schools.co.uk/>

Award Programmes

Eco-Schools England: International award programme encouraging sustainability in schools
<http://www.keepbritaintidy.org/ecoschools>

Ashden Award Program: For individuals and organisations making difference by using sustainable energy at a local level.
<http://www.ashden.org/schools>

Reducing Emissions From School Buildings: Case Studies

Efficient Energy Production: Hindley Primary School, Wigan

In 2006 Hindley Primary School installed a mini CHP (Combined Heat and Power) to generate electricity and heating simultaneously and more efficiently from a single fuel source. This has been ideal for supporting the high thermal baseload of the school building and its hydrotherapy pool.

Sustainable Buildings: Acharacle Primary school, Lochaber Scotland

Acharacle Primary School was opened in 2009 as a wholly sustainable energy efficient building. All of its internal building materials are natural, and primarily constructed of timber, and create a space so efficient that heat from occupants and ICT equipment is sufficient to keep it warm. The school also boasts an on-site wind turbine to generate its own power, and large triple-glazed windows to provide the maximum natural light possible, cutting down on energy needs.

Sustainable Procurement: South Moreton School, Didcot

As the focus of a pilot project to source local food for school meals, the County Facilities Management sourced food from a local farm shop and butchers, no more than 6 miles from the school. The result was an increase in school meals uptake by 17%, and a reduction in food miles by 69% each week.

Reducing Emissions From School Buildings: References

5. DCSF (Department for Education): [A Carbon Management Strategy for Schools](#), 2010

Reducing Exposure to Pollution: Links & Resources

Directory of Green Roof Resources

<http://greenroofdirectory.com/>

British Gas: Smarter Living with House Plants

www.britishgasnewsroom.co.uk/2011/07/smarter-living-with-house-plants

The Growing Schools Garden: Developing learning outside the classroom, including increasing greening of school grounds

www.thegrowingschoolsgarden.org.uk/

Budding Gardeners: Supporting school gardening projects

<http://www.buddinggardeners.co.uk/How2.aspx>

Capital Growth: Supports community food growing projects

www.capitalgrowth.org/our_support/getting_started/

Woodland Trust: Awards, competitions and seasonally themed outdoor activity packs

www.naturedetectives.org.uk/schools/

Reducing Exposure to Pollution: References

6. Defra. 2010. Air Pollution in the UK 2010.(<http://airquality.defra.gov.uk>) [Accessed 17 Jan, 2012].
7. Europa, 2010, [Summary of legislation](#)
8. Stone, B. 28 December, 2010. [Help Reduce Pollution by Growing Plants](#) [Accessed 17 Jan, 2012].

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