

Air Quality

INVESTIGATION 1: Lichen

What is lichen?

Lichen (pronounced “lie-ken”) is made up of two organisms living together: a fungus and an alga. Lichens usually attach themselves to trees but you can also find them on other surfaces, such as walls, fences and park benches.

How can lichen help measure air quality?

There are many different types of lichen that come in variety of shapes, sizes and colours. Different types of lichen react differently to Nitrogen Dioxide (NO₂) - a pollutant found commonly in the air around roads. The types of lichen found at particular locations, provide a good indication of air quality.

- Nitrogen-sensitive lichens can only live in clean air without NO₂
- Nitrogen-loving lichens thrive in dirty air where NO₂ is present
- Nitrogen-neutral lichens are not affected by NO₂ in the air and can live anywhere

Equipment

1) Lichen identification and record sheet 2) Pen or pencil 3) Magnifying glass (optional)

HOW TO DO IT

1) Select a location:

- Identify a location with plenty of light and deciduous trees, such as Oak, Ash or Sycamore. Avoid coniferous trees and trees which are heavily shaded (e.g. Beech and Horse Chestnut) or covered in Ivy.
- If sampling in a woodland, use trees at the edge rather than the centre.

2) Select two or three trees

- Trees with a single trunk are best.
- As some lichens change colour when wet, this activity is ideally carried out in dry weather.

3) Select part of the tree:

- Choose the side of the trunk with the most lichens.
- Focus just on the lichens between 50–150cm above ground level.

4) Select the lichen:

- Although there might be different types of lichen growing on the trunk, we are only interested in the six indicator lichens shown on the Lichen Identification Sheet.

5) Record the results:

- Record the total amount of each type of lichen you can see on the side of the tree trunk, ticking the relevant circle on the lichen identification and record sheet.
- What do the results indicate about the NO₂ levels in your local area?



no lichen present



small to medium amount (covering a total area LESS than one A4 sheet)



large amount overall (covering a total area MORE than one A4 sheet)

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Lichen Identification and Record Sheet

LOCATION: DATE:

Nitrogen sensitive	Tree 1	Tree 2	Tree 3
<p>USNEA</p> 	<input type="radio"/> <input type="radio"/> <input type="radio"/>	<input type="radio"/> <input type="radio"/> <input type="radio"/>	<input type="radio"/> <input type="radio"/> <input type="radio"/>
<p>EVERNIA</p> 	<input type="radio"/> <input type="radio"/> <input type="radio"/>	<input type="radio"/> <input type="radio"/> <input type="radio"/>	<input type="radio"/> <input type="radio"/> <input type="radio"/>
<p>HYPOGYMNI</p> 	<input type="radio"/> <input type="radio"/> <input type="radio"/>	<input type="radio"/> <input type="radio"/> <input type="radio"/>	<input type="radio"/> <input type="radio"/> <input type="radio"/>

Nitrogen loving	Tree 1	Tree 2	Tree 3
<p>LEAFY XANTHORIA</p> 	<input type="radio"/> <input type="radio"/> <input type="radio"/>	<input type="radio"/> <input type="radio"/> <input type="radio"/>	<input type="radio"/> <input type="radio"/> <input type="radio"/>
<p>CUSHION XANTHORIA</p> 	<input type="radio"/> <input type="radio"/> <input type="radio"/>	<input type="radio"/> <input type="radio"/> <input type="radio"/>	<input type="radio"/> <input type="radio"/> <input type="radio"/>
<p>PHYSCIA</p> 	<input type="radio"/> <input type="radio"/> <input type="radio"/>	<input type="radio"/> <input type="radio"/> <input type="radio"/>	<input type="radio"/> <input type="radio"/> <input type="radio"/>

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INVESTIGATION 2: Particulate Matter

What is PM (Particulate Matter)?

Examples of PM include dust, dirt, soot, pollen and mould. These air-borne particles are small enough to be inhaled into the lungs and can cause health problems.

How can PM help measure air quality?

PM such as soot settles on surfaces close to roads and can be quickly and easily measured using sticky tape or cotton wool! This method is called surface wipe analysis, and the amount of PM we measure can help us make conclusions about how dirty the air is.

How is surface wipe analysis used?

- Your sample will indicate how much PM is in the air immediately. It can be useful to investigate how levels of PM may be different at different heights and different distances from the road. For example, if there is a lot of PM at lower heights, this could be dangerous to children.
- Sticky tape or a moist cotton wool ball is used to sample the PM on surfaces. You can sample lots of surfaces using surface wipe analysis, including walls, gates, tree trunks,, lamp posts and even doors around school.

Equipment

- 1) Clear sticky tape (2cm wide) or cotton wool balls
- 2) Tape measure
- 3) Record sheet
- 4) Pen or pencil
- 5) Microscope to further examine the samples later (optional)

HOW TO DO IT

1) Identify locations for comparing levels of PM. For example:

Surface of school gates	Wall inside school	Wall outside school
A traffic sign or lamp post	A tree trunk on school grounds	A tree trunk in the street

2) Use the tape measure to take a sample at 4 different heights:

120cm 90cm 60cm 30cm

3) Take the sample

- Cut the sticky tape into 10cm strips. Press the sticky side of the tape firmly onto the surface. Leave for 10 seconds, remove and then attach to sample sheet.
- If using cotton wool, dampen the ball in a little water and wipe over a small area (10cm by 2cm). Dirt and pollutants from the surface will have stuck to the tape or ball.

4) Score

Compare the amount of PM between each sample and give each one a pollution mark between 1 and 4:

1 = the most PM and 4 = the least PM

Are lower or higher levels more polluted?



5) Compare

- Repeat the steps 1-5 above to compare the levels of PM at different heights and at different locations.
- Which locations are more polluted and why?

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PM Sample Record Sheet I

LOCATION 1: DATE:

Height cm	Attach sticky tape sample here	PM level 1 to 4
120		
90		
60		
30		

LOCATION 2: DATE:

Height cm	Attach sticky tape sample here	PM level 1 to 4
120		
90		
60		
30		

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PM Sample Record Sheet 2

LOCATION 3: DATE:

Height cm	Attach sticky tape sample here	PM level 1 to 4
120		
90		
60		
30		

LOCATION 4: DATE:

Height cm	Attach sticky tape sample here	PM level 1 to 4
120		
90		
60		
30		

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INVESTIGATION 3: Tar Spots

What are Tar Spots?

Tar spots are dark patches that appear on the leaves of Sycamore trees, caused by the fungus *Rhytisma acerinum*, which is found widely across the UK. The fungus causes large, black 'tar spots' to develop on the leaves by July and August (although they first appear a yellow-green colour). Despite the spots, the fungus is not thought to affect the health of infected trees.



How can tar spots help measure air quality?

Air polluted with NO_2 inhibits the growth of the fungus that causes 'tar spots' (*Rhytisma acerinum*). This fungus can tolerate up to 20 micrograms of NO_2 per cubic metre in the air (a microgram is one thousandth of a milligram).

Equipment

1) Record sheet 2) Pen or pencil 3) Tape measure

HOW TO DO IT

1) Choose two or three Sycamore trees to investigate.

You do not have to carry out the tar spot survey at the same time or in the same place as the lichen survey.

2) Record data for each Sycamore tree:

- The circumference of each tree trunk at 1.3 metres above the ground.
- The amount of fallen leaves lying under each tree.
- Write the numbers 0, 1 or 2 depending on the amount of fallen leaves:

0 = no fallen leaves 1 = a small amount of fallen leaves 2 = lots of fallen leaves

3) Choose 5 leaves from each Sycamore tree.

- Try to select leaves from different positions within the tree,
- Avoid taking all 5 leaves from the same branch or position.
- 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.

4) Record data for each leaf:

- The number of tar spots larger than 15mm wide, including any partial or merged spots (ignore any small marks or blemishes)
- The width of the leaf in cm at its widest point

5) Assess your results

- If you find few tar spots on your leaves, it can indicate that there are high levels of NO_2 in the air. However, it may also indicate an absence of fungal spores from fallen leaves that can also cause the infection.
- What could the results indicate about the air quality around your school?

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Tar Spot Record Sheet

	 <p>Tree 1</p> <p>Location:</p> <p>Trunk circumference:</p> <p>Fallen leaves Y / N</p>		 <p>Tree 2</p> <p>Location:</p> <p>Trunk circumference:</p> <p>Fallen leaves Y / N</p>		 <p>Tree 3</p> <p>Location:</p> <p>Trunk circumference:</p> <p>Fallen leaves Y / N</p>	
Leaf number	Number of 'tar spots'	Leaf width (cm)	Number of 'tar spots'	Leaf width (cm)	Number of 'tar spots'	Leaf width (cm)
1						
2						
3						
4						
5						

Ignore small spots and blemishes



Merged spots count as 2



Sycamore leaf with few tar spots
Number of tar spots = 3

Sycamore leaf with heavy tar spot infection
Number of tar spots = 12