

<p><b>Science context</b> Air pollution Human activity can lead to changes in the environment</p> <p><b>HSW</b> Making observations and inferences, evaluating scientific evidence and working methods</p> <p><b>Mathematics</b> Geometry and measures: construction, loci and bearings</p> <p><b>Where?</b> In and around the school grounds</p> <p><b>Time</b> This activity can take up to three lessons: the first focuses on planning, the second focuses on collecting and presenting data, and the third focuses on analysis of evidence and evaluation of methods.</p>	<h2 style="text-align: center;">Air Pollution</h2> <p><b>Lesson summary</b> In this activity, students will consider methods to measure air pollution*. They will investigate the range of air pollution levels within their school grounds. They will decide on the best place to locate an open-air café, within the grounds, using data collected to support their decision.</p> <p><b>Cognitive potential</b> This activity gives students the opportunity to identify an appropriate approach to data collection and to critically analyse and evaluate evidence from their observations and experiments.</p> <p><b>Central theme and skills</b> Air pollution Making observations and inferences, evaluating scientific evidence and working methods</p> <p><b>Key resources</b> Clipboard Long tape measure/ trundle wheel Sticky tape White paper Sample leaves (from outside) Hand lenses Poster paper Pens and pencils</p> <p>Optional : Sound datalogger Tree identification key Microscope slides Digital camera Graph paper photocopied onto acetate</p> <p><b>Setting the scene (15mins)</b> In class, show the YouTube Clip: <a href="http://www.youtube.com/watch?v=UcWpkWBX04E">http://www.youtube.com/watch?v=UcWpkWBX04E</a></p> <p>After presenting them with this, ask the class to discuss in their groups the following questions: <b>Why do we hear about air pollution in the news? What do you think are the key sources of air pollution in our town/ city? How does air pollution affect the environment and us?</b></p> <p>The website: <a href="http://www.londonair.org.uk">http://www.londonair.org.uk</a> can also be used to present regional and local air pollution data sets. Explain to the class that one of the air pollutants, particulate carbon, deposits on surfaces and this is what makes the surfaces dirty. Model, how clear sticky tape stuck on a leaf/ bark/ wall and then carefully removed is one way of observing and collecting evidence of the particulate carbon deposits.</p>
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Give each group a leaf and some clear sticky tape to try it out and ask them to think about how this method could help them to investigate the following problem:

**You have to decide where would be the best location for a new open-air café in** (whatever local park/square you decide to use-show them a photo of this site). **It is hoped that all the community- children, mothers, babies and the elderly- will be able to enjoy the outdoor seating. The local authority has become increasingly concerned about the health risks associated with air pollution. Your job is to locate the café in an area where the levels of air pollution are low.**

**How will you go about your investigation?**

Ask different groups to share their ideas with the class. Challenge them to consider how a range of sites and sampling might make their investigation more reliable by asking them and the class questions around this:

**What evidence will you collect? What will this tell you? Where will you collect it?**

**How much evidence do you think you need to collect to convince the local authority that this is a good place to locate a café?**

**How will you present your data?**

After the whole class discussion, give the groups some time to write out and refine their plans in class so that they are ready when they go out to the local park in the next session.

*Observations outside (15-30mins)*

Take the class to the local area. Have a brief whole class discussion before sending them off to check that they have the resources they need, are clear about what they are going to do and what data they are going to collect. This includes locating sites on a map, labelling and numbering their data and collecting any other data (what they notice about the sites-traffic, parked cars, types of transport, sunny spots, areas that the community seem to enjoy using) that might be of use. Ask questions to help them recall and plan effective strategies for collaborative group work.

Give the groups 15-20 mins to collect their data. During this time, move around the different groups, observing and listening to them. At one or two points in this time slot, stop and bring them back as a whole class to share ideas, findings, other observations that you think might be of interest to the whole class.

If possible, take some digital photographs of the local park, the different sites and the groups at work.

*Sharing ideas and provoking conflict (30- 45 minutes)*

Back in class give the groups some time to gather their data, make up graphs and prepare it for a presentation - you may want them to do this as a poster, on PowerPoint, or even as a small set of handouts that can be photocopied and presented to the rest of the class in the presentation session. Support them through this with some questions that encourage them to analyse their graphs and use this evidence to draw conclusions. These questions could be up on the IWB or on a prompt sheet:

**Describe what your graphs show about the distribution of solid particulates within the different sites.**

**Imagine you are explaining your results to a Year 7 pupil.**

**Explain why they show the trends they do. What reasons can you give for this pattern in the data?**

**Using your evidence, explain where you think the best place to locate an open-air café would be and why.**

Their presentations need to be completed by the end of the session or as part of homework so that they are ready to present these in session 3.

**Linking ideas together (30- 45mins)**

Select several groups to present their investigations. This could be completed outside at the different sites each group has chosen. Each time a group presents, the rest of the class acts as the local authority. Explain to the class that, as the local authority, their job is to:

- make sure that they understand how the presenters carried out the investigation (**Did they explain what they did clearly?**)
- check they did a thorough job (**Are you satisfied with how they went about their investigation?**)
- assess whether they think the evidence is convincing and reliable enough to make a decision upon (**Is their evidence reliable?**)

After each presentation, invite the students (local authority) to ask the presenters questions related to the ideas above. You could then ask the class to work in pairs to score (out of 5) each presentation under the headings above.

Then give the class about 10-15 minutes to go back into their groups to evaluate their own investigations. Again give them some prompt questions to help them record their ideas:

**In your experiment how have you attempted to make it as reliable as possible?**

**What were the main difficulties you found when collecting the results?**

**What information do you feel is missing to gain a better understanding of the amount of pollution in this area; and how might we collect this data?**

**If you could do the investigation again, what would you do differently? How would this strengthen your evidence?**

**Extension/homework/individual task**

Having discussed their ideas and recorded their thoughts as a group, you might want to use these questions above as a worksheet so that students can record their individual responses to these.

\*'Air pollution is made up of a mixture of gases and particles that have been released into the atmosphere by man-made processes. Such emissions are typically from the combustion of fossil fuels such as coal, oil, petrol or diesel. The sources, health effects and chemical behaviour of each separate pollutant are different, making the task of understanding and controlling air pollution as a whole very complex. There are seven main pollutants of concern - carbon monoxide (CO), nitrogen dioxide (NO<sub>2</sub>), ground level ozone (O<sub>3</sub>), particulate matter (PM10 and PM2.5, sulphur dioxide (SO<sub>2</sub>), hydrocarbons and lead).' (<http://www.londonair.org.uk>)

**Mathematical plug-ins**

1) Take a map of the region. Look for potential sources of pollution e.g. a road (straight lines), a factory (point), airports (point). By drawing appropriate lines, curves, angle bisectors on the map, find the optimum position for lack of pollution. The radius of the circles may change depending on how extreme the source of pollution is.

2) The gardening project:

**Background:**

You have been asked to design a garden for your new neighbours because they know you have the design skills and scientific knowledge to grow them a prize winning garden. You must first draw a scale drawing of the plot to include the key features that are already in the garden and those they want added. You must then decide what to plant in the flower beds based on a variety of scientific facts about the plot.

**Task 1: Scale Drawing**

Draw an accurate drawing of the garden described below. Use squared paper and use one square for 20cm. Remember 1m=100cm. Use a key for the colours and patterns you use

and mark on the compass directions.

Garden description

House: 5m wide, south facing

Garden: 5m wide (like the house), 4m long.

All sides that are not the house are fenced.

Greenhouse: In the far left corner of the garden.

It is 80cm wide and 160cm long.

It touches the back fence and is 40cm from the left fence.

Pond: The pond is a circle of radius 60cm. The centre of the pond is 2.5m from the left fence and 80cm from the back fence. It has a shingle path of 20cm around the edge of the whole pond.

Tree: Planted 40cm from the back fence and the right fence. The top is large, covering a radius of 120cm.

Patio: The patio is 3m wide and 120cm deep. It touches the house and the right hand Fence. It has a 40cm step around the whole patio to step down into the garden.

Flower beds: Wherever there is no shed, pond or patio, there is a flower bed of 80cm surrounding the garden.

**Task 2: What to plant**

Your neighbours want to fill their garden (and greenhouse) with plants. They want to plant in every patch of flowerbed. To do this you must find suitable plants for each part of the garden.

Write a list of factors affecting where a plant will grow best. Think about environmental factors and human factors of influence. If you are near a garden or potential garden site, go and have a look for inspiration. **What plants are growing where?**

**Look at your garden. What factors in particular do you need to consider when building your garden?**

Split your flowerbeds into several (about 6) sections depending on what the environment is like (e.g. Area 1 might be under the tree because it is shady, sheltered and the tree will take lots of the water).

Write your areas into the table below using a short description e.g. Under tree  
Look through the plants database provided.

Fill in the table below:

Area	Plant	Reason

Discuss with the other groups what plants they put where and why. Can you see any potential problems with any of the other garden designs? Was there any information you would have liked to help you design a better garden?

*This websites will aid this activity:*

[http://www.gardeninghelpuk.com/plants\\_for\\_places.htm](http://www.gardeninghelpuk.com/plants_for_places.htm)

[http://www.bbc.co.uk/gardening/design/virtualgarden\\_index.shtml](http://www.bbc.co.uk/gardening/design/virtualgarden_index.shtml)

<http://www.flightglobal.com/airspace/photos/response/images/23851/sikorsky-76-over-london-eye.jpg>