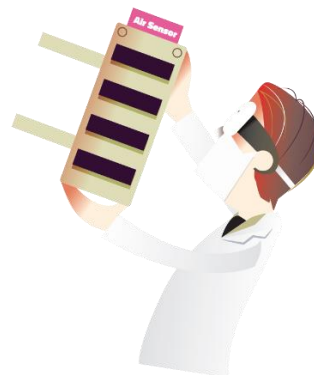


Catch them if you can!

An investigation of air pollution by students in Europe.



From "[Learning about air quality](#)" - copyright 2015 Scottish Environmental Protection Agency & North Lanarkshire Council.

Teacher resource

NO₂ measurements & learning activities

Welcome!

Along with hundreds of students in Europe, your students are going to **collect important traffic-related air pollution data**. Around thirty schools in Ireland will contribute to this exciting citizen science initiative to **promote awareness about air pollution and collect a set of accurate data** that can be used by schools and scientists for research purposes, and to inform policy.

TV programmes and newspaper articles often cite the number of premature deaths attributable to air pollution to highlight the negative impact of air pollution on human health. In Ireland, it is estimated at 1,510 people every year. This is 10 times more than road deaths! The World Health Organization (WHO) has described air pollution as the 'single biggest environmental health risk'. Cleaner air will translate into health benefits for everyone.

While Ireland's overall air quality is generally good by international standards it is now considered that any level of air pollution is not acceptable and poses a risk. There are often wide variations in local air quality going undetected that can have significant impacts on the health and wellbeing of local communities and we want you to investigate the quality of the air around your school!

Acknowledging that air pollution can feel like a grim topic, it is introduced here in a fun and engaging manner: in this investigation, the pollutants are portrayed as criminals on the run that your students are tasked to catch. We want this investigation to be empowering and GLOBE will be inviting you to share your findings and solutions with other schools at an end-of-year event.

If you need any help during the investigation, please email Sabrina Moore (smoore@eeu.antaisce.org).

We wish you a good journey and look forward to working with you!

Project timeline

Schools deploy the instruments to measure NO ₂ .	From week of January 28 th for 4 weeks
Students' learning is enhanced by learning activities.	Any time (January-April).
GLOBE team shares NO ₂ measurements with your school.	End of March.
School conducts data analysis and complete a short research project.	By end of April.
End-of-year showcase event.	Early May.

Links to the curriculum

This campaign offers the opportunity to conduct a practical investigation: students will collect air pollution and other relevant data, ask questions, analyze data and communicate their findings and plan of actions. This project fits well with the:

- strand "Environmental awareness and care" of SESE at primary school.

- new Junior Cycle curriculum Geography and Science (e.g. SOL7, 9, 10, 13, 17, 19).

It can also be conducted with Transition Year students or as a geographical investigation for the Leaving Certificate examination.

The resource can be interpreted and adapted where necessary for primary schools by participating teachers across the primary level curriculum.

Partners in this project

This initiative will take place in thirteen¹ European countries in 2019 under the umbrella of the European Environmental Agency. In Ireland, the project is coordinated by An Taisce as part of the GLOBE Air Quality Campaign and supported by the Environmental Protection Agency.

An Taisce

The Environmental Education Unit (EEU) of An Taisce is responsible for coordinating some of Ireland's most successful environmental programmes and prestigious award schemes (including GLOBE, Learning About Forests and Green-Schools).

This initiative is part of the GLOBE Air quality Campaign. GLOBE provides students and the public worldwide with the opportunity to participate in citizen science and contribute meaningfully to our understanding of the Earth system and global environment. For more information about GLOBE, visit:

- [About GLOBE](#)
- [2018-2019 programme in Ireland](#)
- [What Teachers & Students can expect](#)
- [Registration for Teachers](#)

Environmental Protection Agency (EPA)

The Environmental Protection Agency (EPA) is partnering with An Taisce to support this investigation to encourage greater understanding and involvement of the public in air quality issues. In Ireland, the EPA is responsible for monitoring outdoor air quality. Together with local authorities, the EPA manages a national network of monitoring stations that is being greatly expanded, with the aim of providing ongoing [air quality data](#) and forecast to the public. You can find more information about the EPA at www.epa.ie and to find out more about citizen science initiatives in Ireland, please visit: www.epacitizenscience.ie.

European Environmental Agency (EEA)

The [European Environmental Agency](#) (EEA) is a European-funded organization that provides sound and independent information on the environment to policy makers and the public to support sustainable development. The EEA is responsible for the overall coordination of this initiative and facilitates the development of harmonised protocols, exchange of data, data processing and analysis, as well as offering a coordinated communication approach.

¹ Ireland, Belgium, Estonia, France, Germany, Iceland, Italy, Luxembourg, Malta, Spain, Sweden, Switzerland and the Netherlands.

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This resource includes the detailed procedure to measure nitrogen dioxide (NO₂) (see section 3.a). It also contains suggested activities to enhance your students' experience and learning.

1. Setting the scene for your students

The purpose of this introductory message from GLOBE and the EPA is to get your students excited about this project. Feel free to read it aloud or have one of your students act it:

Dear Citizen scientists,

GLOBE and the Environmental Protection Agency are calling on you to catch some dangerous criminals! They are not the usual suspects: nor humans, beasts or zombies. They are mostly invisible and often do not smell. And their favourite mode of transport is the wind. Any idea who I am talking about?

Air pollutants! Although it is hard to see, air pollution is around us and responsible for serious diseases and even deaths. Many of the sources of air pollution also fuel climate change. So, we need to act to tackle this serious health and environmental problem!

Together with hundreds of schools in Europe, YOU can make a difference. As a citizen scientist, you will collect data at your school that will be like a piece of a puzzle. Once we get all the pieces of the puzzle, we will have a better view of the situation in Ireland and Europe. A team of scientists will then analyze all the data - including yours. Your contribution is key, so thank you for your help!

You have installed some diffusion tubes around your school grounds to measure levels of traffic-related air pollution. While the tubes are working away and trapping air pollution, you will conduct some complementary surveys on weather and traffic. Once you have completed your investigation, you will send a brief to GLOBE with your findings.

But remember, we are trying to catch some important criminals! A good investigation starts with understanding their profile and habits (what do they look like, where do they come from, etc.?). So, go on and get some good quality information about these culprits, the weapon they use and their victims!

2. Learning about air pollution

It is suggested to find out first what your students already know about air pollution – they may already know a lot or have misconceptions. Then, we suggest that they research some high-level information about air pollution.

Detailed information about air pollution is available in the accompanying resource “[Some Facts about Air Pollution](#)”.

a. Initial knowledge

Using the ‘[think, pair and share](#)’ technique, ask your students what they know about air pollution. Do they remember coming across a programme, news article or social media post on this topic? What is their experience of air pollution (the smell of exhausts, asthma attacks, etc.)? What areas in Ireland are the most polluted and why?

b. Research

The students are organized in three groups each responsible for one of the topics below. Once the research is completed, the whole class debriefs.

i. “Wanted”

The students look for information about the two main air pollutants of concern in Ireland and the rest of Europe (nitrogen dioxide (NO₂) and particulate matter (PM)). The student handouts for NO₂ and PM are in appendix 1.

ii. Victim files

It is now recognized that everybody is affected by air pollution. However, some people are more at risk. The “Victims” files aim at raising awareness and create a level of empathy by thinking of someone you know who may particularly be affected. The student handout is in appendix 2.

iii. Weapons

This section aims at identifying the most common sources of air pollution. Also, your students mark sources of pollution near the school on a map² (e.g. Google satellite view of the area surrounding the school). This information is going to be useful when the class decides where to measure NO₂. An example of a marked map is in appendix 3.

c. Debriefing session

Representatives from each group present their findings. At the end of the session, you may want to highlight some of the key learnings, recap on what air pollution is and why it matters. Following the session, the handouts are filed for future reference (this desktop research will be useful to put together a short research report).

² Several maps can be used to show sources of pollution close to the school (e.g. busy road) and further away (e.g. industry upwind).

3. Investigating local air pollution

a. Key measurement: nitrogen dioxide (NO₂)

All schools ideally follow the same procedure to ensure that the results are accurate and comparable. Schools install the diffusion tubes and **start the measurements the week of January 28th**; they take them down and **send them to the laboratory for analysis the week of February 25th**.

i. Principles of the measurement

NO₂ is measured by the diffusion tubes:

- The white cap is removed during the measurement period (and put back on at the end of it).
- The grey cap contains the material that absorbs NO₂ over the measurement period.
- The plastic tube channels the air.

Please use the recording sheet to record³ the day and time the measurements started and ended, as well as the location of the tubes on the school grounds.

The laboratory will measure the NO₂ level and extrapolate the average concentration over the period. It is then possible to assess the air quality at the location and put it in perspective with other values such as the EU and WHO guidelines or measurements by monitoring stations.

ii. Storing the diffusion tubes

Until the tubes are installed, thank you for **storing them in a fridge at 5-10°C**. When taken down, please follow the same procedure until they are sent to the laboratory for analysis.

iii. Picking three locations

NO₂ will be measured at three locations on the school grounds:

- Two tubes are installed **in two different locations** that you view as **'exposed'** to traffic pollution (e.g. near a main road, idling cars or main drop off point for the school).
- The third tube is placed **away from traffic** (e.g. backyard).

Suggested activity with your students:

- use a map of the surroundings of the school that also shows the streets, intersections, etc. to see where the tubes would be best placed **with regards to traffic**.
- then, go outside and see where the tubes would be installed; a post such as a lamppost is ideal as the clip can then be secured using the cable tie. Otherwise, choose a flat surface such as a wall or window but make sure it is **away from a corner** (the air is more turbulent near corners). The tubes are harmless but will be placed at **around 2 to 2.5 metres high**, so that they are out of reach.

³ There is no need to calculate the exposure time (hours).

- once agreed, the three locations are marked on a map and added to the investigation file.

iv. Installing the clips

The clips (black tube holders) are installed first.

Scenario 1 (recommended): the clip is secured with a cable tie (e.g. tied to a pole). In this case, run the cable tie through the opening of the clip. Before sticking the clip, ensure the surface is clean and dry. Stick the clip. Finally, tie the cable to the pole (or equivalent).

Scenario 2: the clip cannot be secured with a cable tie (e.g. flat surface). Before sticking the clip, ensure the surface is clean and dry. Stick the clip. The adhesive takes 24 hours for full strength, so wait for 24 hours before you insert the tube in the tube holder.

v. Installing the tubes and updating the records

Place the tube into the clip. The tube should be placed **vertically with the grey cap at the top**. **Unscrew the white cap and store it as it will have to be screwed back on when the recording period is over.**

Take the sheet 'diffusion tube monitoring record' and look up the 'sampling and exposure' data section. Write the **date, time and location** of installation.

Leave the diffusion tubes there until the end of the measurement period (**around four weeks**).



Clip stuck to a lamppost and secured by a cable tie.

Note that the grey cap is at the top and the white cap has been unscrewed to allow air to pass through the tube.

vi. Removing the tubes and updating the records

Remove the tube from the clip and **screw the white cap back on**. Make sure it is closed properly.

Write the **date and time** on which you removed the tubes on the recording sheet. **Make a copy of the recording sheet** and add it to your investigation file.

Remove the clip and store safely for future investigations. Carefully removed the plastic cable tie and dispose of carefully.

vii. Posting the tubes for analysis

Please **send the tubes and the recording sheet as soon as possible** to the laboratory for analysis:

Gradko International Limited, St. Martins House, 77 Wales Street, Winchester SO23 0RH, UK

Thank you for notifying the GLOBE team when you are done (smoore@eeu.antaisce.org).

You are done! 😊

What happens next? The measurements will be shared by the GLOBE Team of An Taisce as soon as they are available (around the end of March).

b. Other measurements

In addition to NO₂ measurements, you may want to measure some contextual data about the weather and vehicle traffic over the period of the measurement. These measurements are suggested as they will enrich the experience of your students and the analysis of the results (but are not mandatory).

i. Weather measurements:

Weather impacts air pollution in different manners. Here are a few examples:

- Wind: local air pollution is dispersed by windy or stormy conditions. However, wind can also bring pollution from other areas (pollution travels!). For example, in August 2018 smoke from forest fires in California was brought across the Atlantic and over Ireland for a few days. So, the strength and direction of the wind will impact the quality of the air we breathe.
- Sun and wind: what we consider to be good weather (still air and sunny conditions) can foster the build-up of pollutants. Sunlight triggers chemical reactions between different types of pollutants, leading to secondary pollutants that can be even more harmful. In this manner, NO₂ combines with VOC (Volatile Organic Compounds) on sunny and still days and leads to the formation of smog.
- Rain: rain 'cleans' the air by washing pollutants down to the ground.

During the air quality campaign, note what the weather is like. Is it sunny, windy or wet? You can measure weather conditions by following the GLOBE protocols and save your measurements on the GLOBE database (see the [GLOBE Teaching Resource](#) for more details).

- Rainfall: install a rain gauge at your schools and record the amount of precipitation on a daily or weekly basis.
- Wind: make an [anemometer](#) to measure wind speed and a wind vane to identify the wind direction [link from GLOBE website].
- Barometric pressure: use a barometer to check whether barometric pressure is it high or low and to see if it is changing from a day to the next? Areas of higher pressure are associated with more stable weather: less wind and little rain. For example, at Christmas time and over the first two

weeks of January, Ireland has been experiencing mild, dry and still weather as an area of high pressure was lingering over Ireland.

- Sun: you can also record the number of sunny days in the period.

ii. Traffic survey

This activity aims at assessing the traffic that goes by your school and can be done several times during the NO₂ measurements. It is courtesy of the Scottish EPA who is also involved in this investigation.

The activity and handouts can be found here:
http://www.learnaboutair.com/geography/section_02.html

Additional resources will be shared during the campaign and will include tips to analyze, discuss and communicate your findings. In the meantime, please contact Sabrina Moore if you have any question (smoore@eeu.antaisce.org).

4. Appendices

1. Student handouts: "Wanted"

WANTED!

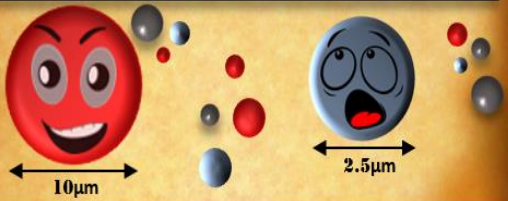
LOOKING FOR



NAME	NITROGEN DIOXIDE (NO ₂)
NICKNAME	THE SILENT KILLER
SOURCES	
CRIMES/ HEALTH IMPACTS	
W.H.O GUIDELINES	

WANTED!

LOOKING FOR



NAME	PARTICULATE MATTER 10 & 2.5
NICKNAME	PM10 & PM2.5
SOURCES	
CRIMES/ HEALTH IMPACTS	
W.H.O GUIDELINES	

Links to the editable handouts:

- [Nitrogen dioxide \(NO₂\)](#)
- [Particulate matter \(PM\)](#)

2. Student handout: victim file

Victim File

Profile:

Risk reason:

People you know:

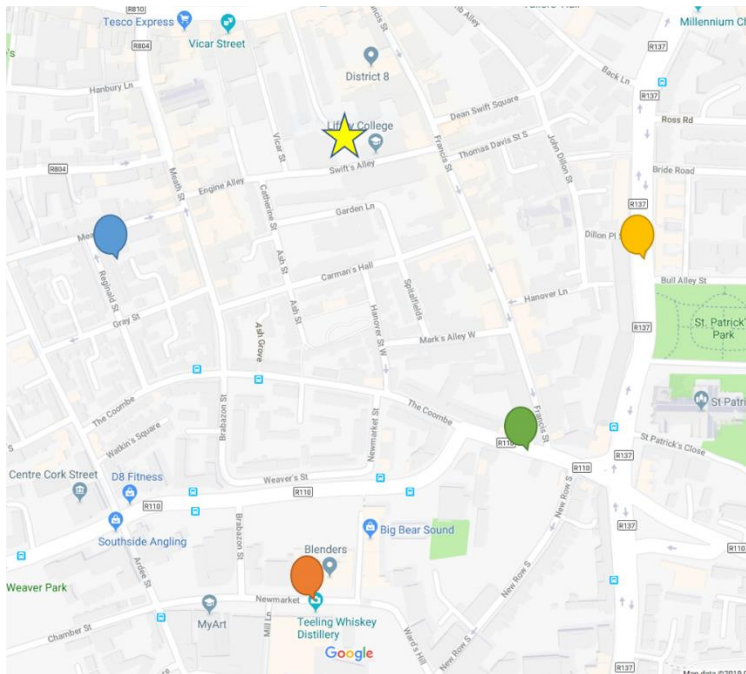
IMPORTANT

Link to the editable handout: [Victim file](#).

3. The weapons - mapping sources of pollution in the area

This is an example by the GLOBE team of mapping sources of air pollution near the office. Feel free to mark potential sources of air pollution on a map that includes your school to raise the awareness of your students.

Fuels/ sources in our local area:



Legend:

-  An Taisce office
-  Residential chimneys - older homes without central heating (NO₂, PM_{2.5} & PM₁₀)
-  Traffic on busy road (NO₂)
-  Construction of new hotel (PM₁₀ & PM_{2.5})
-  Whiskey distillery (VOC – Volatile organic compounds)

- To find a map of your local area:
www.google.ie/maps

4. Videos for the classroom

- Eco eye on air pollution (24 minutes): <https://youtu.be/AReB4wY8kQI>

“Our air is a natural resource we all take for granted. But how often do we consider the quality of the air we breathe? In Ireland over 1,500 deaths are caused every year by air pollution. Dr Lara Dungan investigates the main sources of air pollution in Ireland, including traffic emissions and solid fuel burning, the health impacts and possible solutions.”

- Eco eye on active travel (24 minutes): <https://youtu.be/jrvxrCTFkhw>

“Dr Lara Dungan explores why our society has turned its back on being active. With easy unhealthy choices everywhere, what hope do we have to reverse the trends? She discovers that while sedentary work and personal choices play a part, the built environment around us has been geared for the car, making it more and more difficult to get around using our legs and feet. She will explore the reasons for this and figure out what we can do to change.”

5. Some recommended sources of information

- Irish EPA: <http://www.epa.ie/air/quality/>
- Scottish EPA: <http://www.learnaboutair.com/>
- Articles by Gary Fuller in the Guardian: <https://www.theguardian.com/profile/gary-fuller>
- WHO: <https://www.who.int/airpollution/ambient/en/>
- Green-schools Travel: https://greenschoolsireland.org/resources/theme_category/travel/

EEA resources:

- <https://www.eea.europa.eu/themes/air/multimedia>
- <https://www.eea.europa.eu/media/infographics/air-pollution-from-emissions-to-exposure>
- <https://www.eea.europa.eu/signals/signals-2013/infographics/sources-of-air-pollution-in-europe>

6. FAQ

This is to help you respond to some of your students' questions.

Why is air pollution called a criminal?

Continued exposure to air pollution can lead to serious respiratory and heart problems that affect people's quality of life and even their life expectancy. It is estimated that in Ireland air pollution leads to 1,510 premature deaths per year. This is 10 times more than road deaths!

What countries take part in the investigation?

Schools in thirteen countries in Europe will take part in this investigation: Ireland, Belgium, Estonia, France, Germany, Iceland, Italy, Luxembourg, Malta, Spain, Sweden, Switzerland and the Netherlands. In Ireland, around thirty schools will contribute to the better understanding of local air pollution.