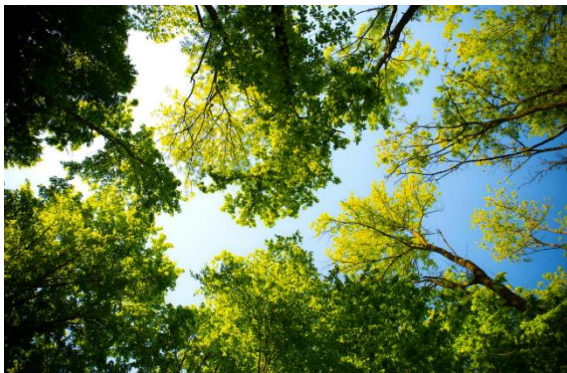




# THE GLOBE PROGRAM

**Welcome to the 8<sup>th</sup> GLOBE Ireland Air Quality Campaign!**



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## Introduction

Dear Teachers,

Welcome to the GLOBE Air Quality Campaign. Thank you for participating in this citizen-science initiative!

While Ireland's overall air quality is generally good by international standards it is now apparent that local air quality may not be as consistently good. It is now considered that any level of air pollution is not acceptable and poses a risk ([World Health Organisation](#)). There are often wide variations in local air quality going undetected that can have significant impacts on the health and wellbeing of local communities, so we want you to investigate the quality of the air around your school!

This project is coordinated by the GLOBE Team (Ireland), as part of The Environmental Education Unit (EEU) of An Taisce and is sponsored by the Irish Environmental Protection Agency (EPA). GLOBE is an international Environmental and Science Education program that is sponsored by NASA in the USA. 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. There are many ways to participate in GLOBE, opportunities exist across multiple areas of Earth and Environmental Sciences – Atmosphere, Biosphere, Pedosphere and Hydrosphere. There are also a series of GLOBE [educational measurement campaigns](#) that teachers and their students can participate in.

Teachers are encouraged to sign up for a GLOBE Teacher account [here](#). This is not necessary for participation in this air quality campaign, however GLOBE has some excellent teacher resources, provides access to a large dataset of earth observations, communicates on new measurement campaigns and has teacher e-training opportunities [here](#).



## About the GLOBE Ireland Air Quality Campaign

The GLOBE Air Quality Campaign is a citizen science project to assess traffic-related air pollution at schools. The campaign measures nitrogen dioxide gas in the air, a principal pollutant associated with vehicle emissions. This is an educational project designed to raise awareness about air pollution and showcase the potential of citizen science to gather unique datasets and insights into our environment. Last Year, 305 teachers registered to participate in the GLOBE Air Quality campaigns, collecting over 600 nitrogen dioxide measurements at schools. The campaign also provides a collaborative platform for schools to share their research and insights.

We want this investigation to be empowering. We will **invite you to share your findings and solutions** by creating either a research poster, a student blog post or a creative poster showing your results and interpretation of your local traffic-related air quality. This can be shared with the GLOBE Team at the end of the campaign period. Please also feel free to share your school's photos and campaign stories with **@GLOBEireland** on Twitter.

This project is funded by the Irish Environmental Protection Agency (EPA). The EEU of An Taisce, the GLOBE programme and the EPA are partnering 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 forecasts to the public. You can find more information about the EPA at [www.epa.ie](http://www.epa.ie) and to find out more about citizen science initiatives in Ireland, please visit: [www.epacitizenscience.ie](http://www.epacitizenscience.ie).

This booklet is designed to support teachers in the implementation of the GLOBE Air Quality Campaign with their class. If you need any help during the investigation, please email [globe@eeu.antaisce.org](mailto:globe@eeu.antaisce.org)

## Overview of Air Quality Campaign

In September/October, students across Ireland will measure nitrogen dioxide (NO<sub>2</sub>) - a principal pollutant from car exhaust emissions - at three locations around their schools. Schools will be provided with the necessary equipment and guidance to carry out nitrogen dioxide measurements.

The main purposes of the campaign are to:

- Raise awareness about air pollution through a practical investigation
- Collect accurate data that can be used in students' research projects

- Share knowledge with school communities
- Complement official air quality monitoring performed by the EPA on local air quality
- Promote behaviour change

Teachers, please see an approximate air quality **campaign timeline** in the appendices to help you plan your classes. You will also find a list of **available resources** to help guide your class.

The campaign is easy to follow but we will hold a teacher information session in September to give teachers an opportunity to hear more about the campaign and ask questions. A zoom link will be shared in September to all registered teachers.

We hope you enjoy participating!

## Teacher Instructions

Prepare your class for the investigation

We encourage teachers to prepare for the campaign by introducing the topic of air quality to your students. Teachers may like to use the GLOBE [Air Quality module](#) as a guide, it contains ideas around engaging the class, links to current air quality reference material and further content to help guide your students. You can also find PowerPoint Presentations on traffic-related air pollution to assist classroom teaching:

- [Primary School Presentation](#)
- [Secondary School Presentation](#)

In addition, schools may wish to use the Green Schools resources designed for the [Travel](#) and [Global Citizenship – Travel](#) flags.

We recommend that students begin their investigation by creating a [map](#) of their school area. The purpose of this task is to choose where to install the tubes on the school grounds. We encourage student involvement in the planning of this investigation to promote ownership and interest in the outcomes.

Watch out for your air quality pack's arrival

The air quality packs will be arriving in schools just before the beginning of the measurement period. For this campaign, we plan on the packs arriving between September 22<sup>nd</sup> - September 28<sup>th</sup> \* (please note this date may change, watch your email for any updates). Please keep an eye out for your air quality pack, occasionally they can sit on desks/in mail slots for weeks! Your pack will contain 3 diffusion tubes with caps, mounting hardware (cable ties and tube holder), mounting instructions and a pre-addressed/pre-paid envelope to return your tubes after exposure.

Please install your tubes on time

We appreciate the school schedule does not allow for every teacher to install tubes on the exact same date, please try to install them as close to the beginning of the scheduled monitoring period as possible. This allows the EPA to use the results for research purposes and allows schools to compare results to other participating schools' results for the same measurement period.



Figure 1. Mounted Diffusion Tube - Photo credit to Dominican College Sion Hill

Please record your actual tube installation date and collection date

You will receive a link to an online tube installation form and after the measurement period, a tube collection form, these should only take 2-3 minutes to complete. You will be asked to enter your tube number (on sticker on side of tube), the date and the time of installation and, following the 4-week measurement period, the date, and the time of collection. The laboratory conducting the tube analysis uses this tube exposure duration to fine tune it's

analysis and provide an accurate result. We will be sending an online form to collect this exposure information with your installation instructions.

#### Collect supplementary information

There are factors that influence the concentration of nitrogen dioxide NO<sub>2</sub> in the air. The primary factor is traffic, which is the principal source of NO<sub>2</sub> in Ireland, the higher the volume of traffic, the higher the concentration of NO<sub>2</sub> in the air. We recommend that the students conduct a short [traffic count](#) at/near the school during the measurement period (while tubes are mounted) to support the interpretation of their results. Weather can also influence air pollutants – see [here](#) for more details, we encourage students to collect weather observations around wind direction, wind speed and rainfall while the tubes are mounted. The weather observations will also aid result interpretation. Check out [GLOBE Atmosphere protocols](#) for more information.

Please post your tubes back ASAP

The first batch of tubes will be sent to the UK laboratory approximately 1 week after the measurement period ends, meaning schools that return their tubes promptly should have their results by late November 2022.

#### Air Quality Campaign results and data analysis

You will receive your results by email from GLOBE Ireland directly. Your results will be shared with the EPA Analytics team who will add your NO<sub>2</sub> results on to the EPA [GLOBE air quality map viewer](#) – feel free to share this with students to help them see past results and their own school's NO<sub>2</sub> levels when received. The EPA analytics team also create summary graphs of NO<sub>2</sub> concentration at schools located in different settings (urban, suburban, large towns > 5000, small towns <5000, and rural areas). It is clear from looking at past campaign results (below) that the concentration of NO<sub>2</sub> is higher in urban/suburban settings compared to rural areas and smaller towns.

$\mu\text{g}/\text{m}^3$	Colour Code	NO <sub>2</sub> Level Description
>40	Red	High
30-40	Orange	Medium to High
20-30	Yellow	Medium
10-20	Green	Low to Medium
0-10	Blue	Low

Figure 2. Nitrogen Dioxide concentration scale, shown in microgram per cubic metre ( $\mu\text{g}/\text{m}^3$ ) with associated NO<sub>2</sub> level description.

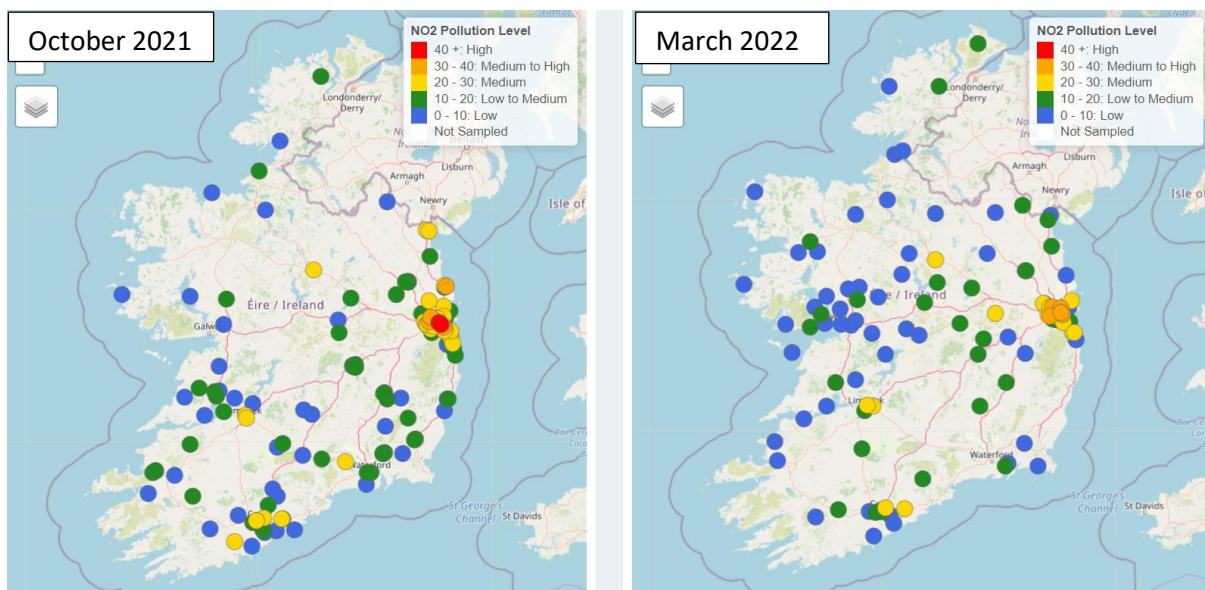


Figure 3: EPA Map view of school air quality measurements for the GLOBE 2021/22 Air Quality Campaigns (<https://analyticsepa.shinyapps.io/GlobeMar22/>)

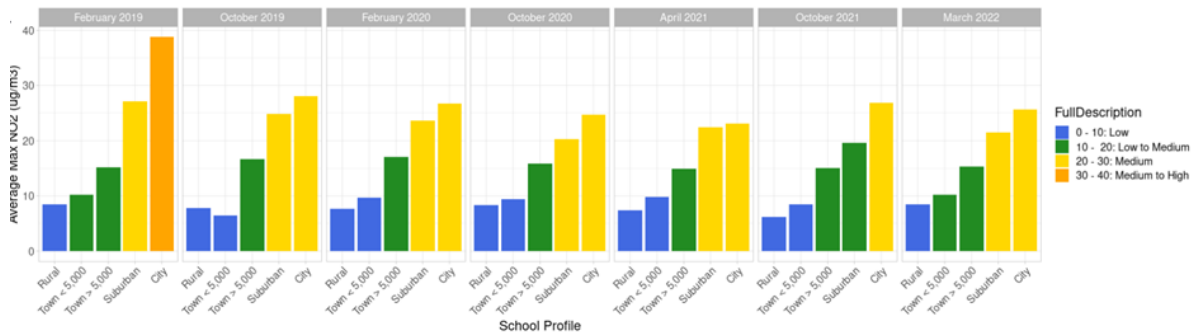


Figure 4. EPA Analytics summary graphs of GLOBE Air Quality Campaign nitrogen dioxide results from 2019 through 2022 (<https://analyticsepa.shinyapps.io/GlobeMar22/>)

### Share your results

We invite schools to create either a research poster, a student blog post or a creative poster showing your results and interpretation of your local traffic-related air quality. This can be shared with the GLOBE Team at the end of the campaign period – see examples of previous research posters and creative artwork below and on our [GLOBE air quality campaign page](#). We typically organise a national GLOBE air quality event at the end of the school year to give students an opportunity to share their air quality investigation story. Last May 2022, we were joined by over 200 participants that included teachers, students, and scientists at our online event. We were delighted to have the EPA Programme Manager and GLOBE Director join our event and share their thoughts with schools on the importance of school-based citizen science.

Share your results on Twitter! **@GLOBEireland**



Figure 5. School engagement – St Malachy's NS (Left) and Oatlands College secondary school (right)



# Air Quality (NO<sub>2</sub>) Monitoring Campaign 2021/22

## Rockford Manor Secondary School

*Valentina Martin, Zoey McLoughlin & Jodie Brennan - Transition Year*



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### Abstract

During Autumn 2021, our Transition Year students participated in a citizen science project, to monitor the air quality (concentrations of Nitrogen Dioxide, NO<sub>2</sub>) of our outdoor school environment. Students from other schools in Ireland have also measured the NO<sub>2</sub> levels within their school grounds. Diffusion tubes were placed at three different locations around our school grounds to measure NO<sub>2</sub> concentrations. We compared our results to the Nitrogen Dioxide Scale, which indicates that the average Nitrogen Dioxide levels around Rockford Manor are in the low-medium range.

### Research Methods

We placed three diffusion tubes at different locations to measure the NO<sub>2</sub> levels in the air around our school grounds. The first tube was secured to a flagpole at the front of our school on the main road, a location that is exposed to a lot of traffic. The second was placed at the basketball court which had some exposure to the traffic but not as much as the first tube. The basketball court is in an elevated position. The remaining tube was placed behind the school hall in a green space which is sheltered from the traffic. The tubes were put up on the 11<sup>th</sup> of October 2021 and taken down four weeks later on the 8<sup>th</sup> of November. They were then sent to a laboratory for analysis.



### Results <sup>4,5</sup>

Diffusion tube results - average NO<sub>2</sub> concentration

TUBE	LOCATION	RESULT
Tube 1	Flag (On main road)	18.29 µg/m <sup>3</sup>
Tube 2	Basketball (Near main road)	16.12 µg/m <sup>3</sup>
Tube 3	Hall (Sheltered)	13.13 µg/m <sup>3</sup>

As shown in the results, the tube that was by the road and exposed to the most traffic (tube 1) had the greatest concentration of NO<sub>2</sub>. The tube that was placed in the basketball court (tube 2) had less NO<sub>2</sub> as it was further away from the road. The tube that contained the least NO<sub>2</sub> was the one placed in the green open space behind our school hall (tube 3). It was the furthest from the road and was in the most remote and isolated area of the school. It should also be noted that the results are average values over a four week period. Nitrogen dioxide concentrations fluctuate depending on the amount of traffic in the area at any given time.

### Discussion

The EU and World Health Organization (WHO) have created the nitrogen dioxide scale for good health? The EU has set an annual mean limit of 40 µg/m<sup>3</sup> NO<sub>2</sub> and the WHO has set an annual mean limit of 10 µg/m<sup>3</sup> NO<sub>2</sub> for good health. Our results indicate that the air quality around Rockford Manor is in the low-medium category on the scale (10-20 µg/m<sup>3</sup>). This is considered to be safe for our health according to the EU Annual standards but exceeds the limit set by the WHO. This means that, the NO<sub>2</sub> levels may be too high, and requires action. If the NO<sub>2</sub> levels keep increasing in the area due to exhaust fumes and human activity around the school, it could have a serious long-term effect on our respiratory health.



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### Research questions

1. What is Nitrogen Dioxide?
2. How much NO<sub>2</sub> is there in different parts of our outdoor school environment?
3. Is our school air quality within the recommended level of healthy NO<sub>2</sub> exposure?
4. Do weather conditions affect our air quality?

### Introduction

Rockford Manor is a Presentation Secondary School located on Stradbroke Road, Blackrock, Co. Dublin. The school is situated next to a main road and a busy roundabout, as shown in our site map. The school is in a suburban area, which has mixed, commercial and residential use. Due to the location of the school, we think that there could possibly be higher NO<sub>2</sub> levels in the air at the front of the school grounds and lower NO<sub>2</sub> levels in the green space to the rear of our school building as it is sheltered from traffic.

NO<sub>2</sub> (Nitrogen Dioxide) is a red-brown gas that is produced when fuel is burned in the engines of vehicles such as cars, trucks and buses. Elevated levels of NO<sub>2</sub> can lead to damage to the human respiratory tract and an increase in the risk of asthma and respiratory infections. NO<sub>2</sub> can also react with other chemicals in the air to form particulate matter and ozone which are harmful when inhaled.<sup>4,6</sup>

We conducted an analysis of the levels of NO<sub>2</sub> in our school using specialised diffusion tubes which we obtained from An Taisce and The Globe Program. During our air monitoring campaign we also recorded local daily weather conditions and conducted a traffic survey to gain insight into the factors that may affect our air quality.

### Traffic survey results

There is quite a lot of traffic passing our school. The levels of traffic vary greatly over a 24 hour period with the greatest amounts as might be expected during morning and evening rush hours. The graph shows sample traffic levels in the area at mid-morning.



### Wind direction and speed

Wind direction and speed data collected during the monitoring period show that the prevailing winds came from southerly and westerly directions. Traffic pollution from New Road may be blown towards our basketball courts. The green space to the rear of our school building was most likely sheltered from traffic pollution from the roads adjacent to the school by these winds.




### Conclusions

In conclusion, we found that the levels of NO<sub>2</sub> in the school were moderately low. There was an average of 15.8 µg/m<sup>3</sup> over all three diffusion tests. We noticed that there were higher NO<sub>2</sub> levels at the front of the school due to the fact that this location is next to a busy road. Our traffic survey on the roads in the immediate vicinity of the school showed that Stradbroke road was the busiest road with an average of 12.8 cars per minute and 0.8 larger vehicles per minute. It would also seem that weather and in particular wind conditions play an important role in our air quality. We would like to conduct further studies into the air quality around our school and plan to repeat our diffusion tube monitoring campaign in Spring 2022 to compare with these results.

### Bibliography

1. GOOGLE maps
2. The Globe Program health and Environment Impacts
3. The Globe Program Air Quality Module
4. Rockford Manor Students Traffic Survey
5. Rockford Manor Weather Analysis Report
6. EPA Website <https://www.epa.gov/no2-pollution/basic-information-about-no2>
7. <https://www.epa.europa.eu/data-and-maps/figures/hydrogen-dioxide-annual-liml-values-for-the-protection-of-human-health>

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## Air quality Campaign Ireland 2021/22



Figure 6. Research poster submitted by Rockford Manor Secondary School based on measurements from the October 2021 campaign.



Figure 7. Creative artwork and photos submitted by Bawnmore National School

## Appendices

### GLOBE Air Quality Campaign Timeline – September - November 2022

Phase	Activity	Time
Getting ready	Introduce the Air Quality Campaign to your students.	Before the measurement period – <b>September 2022</b>
	Pick locations for the NO <sub>2</sub> tubes - you are welcome to use our mapping lesson plan resource as a guide.	
	Install the NO <sub>2</sub> tubes following the protocol instructions (instructions will be sent via email and included in your air quality package)	September 29 <sup>th</sup>
Collecting supporting data	Optional - Use GLOBE <a href="#">educational materials</a> to gather supporting information: conduct a traffic count, record weather conditions, and examine your school's local topography.	<b>September 29<sup>th</sup> to October 26<sup>th</sup></b>
Receive your NO <sub>2</sub> results	Analyse and interpret your NO <sub>2</sub> results and compare your results to other schools around Ireland	Late November
Findings	Share your findings and solutions with the GLOBE Team, EEU.	December
Conclusion	Reflect on what has been learned and how it can be used for positive change.	

### [GLOBE Air Quality Campaign Resources](#) -

Resource Type	File Name	Purpose	Curriculum link	Learning Outcome
Module	<a href="#">TY Module on Air Quality</a>	Introduce the topic of air quality	TY group. JC Science, JC/LC Geography	Build knowledge and awareness around air quality
Lesson plan – design your Air Quality campaign study	<a href="#">AQC2 Mapping</a>	Create a map of your local school and surroundings to guide NO <sub>2</sub> tube placement for AQ campaign	JC Science (scientific process), JC/LC Geography (map creation, weather)	Develop: research skills, improve map work skills, observational methods, identifying prevailing winds and understand the practical scientific process

<b>Lesson plan</b> Cloud and weather observations	<a href="#">AQC3 Cloud</a> and <a href="#">TY Module on Weather</a>	Gather cloud and weather information to support AQ campaign	JC Geography (weather) and Science (Earth)	Build knowledge base around what drives weather, how weather can impact air pollution and develop hands-on data recording skills
<b>Lesson Plan</b> Conduct traffic count survey	<a href="#">AQC4 Traffic Count</a>	Gather data on traffic levels close to the school to support AQ campaign	JC Mathematics (graphs, statistics) Geography (Transport)	Develop hands-on data recording skills and data analysis skills. Increase understanding around link between traffic and NO <sub>2</sub>
<b>Lesson Plan</b> Examine your local terrain	<a href="#">AQC5 Topography</a>	Examine the landscape features around school to support AQ campaign	JC Geography (landscape, map reading)	Develop map reading skills, identification of landforms (valley, hills) on maps. Build knowledge on the effect of landscape on air pollution.
<b>Fact Sheet</b>	<a href="#">Traffic-related Air Pollution</a>	Raise Awareness	TY group. JC Science, JC/LC Geography	Increase knowledge base on basic facts on topic of traffic-related air pollution and air quality.
<b>Fact Sheet</b>	<a href="#">Air Pollution and weather</a>			
<b>Fact Sheet</b>	<a href="#">Air Pollution Health and Environment</a>			