

Key stage 3

Clean Air Schools

Engagement pack

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<https://soton.cc/schoolscleanair>



Introduction to the Clean Air schools project

The goal of this project is to align with the Defra Air Quality Grant which focuses on reducing the impact of pollution on health through awareness raising and behaviour change. The Council recognises that children are particularly at risk from the effects of pollution and hence aims to reduce their exposure to air pollution. This will be achieved by;

- **Improving awareness** of the impacts of poor air quality, and
- **Reducing exposure** to poor air quality in and around schools.

There are 4 main element to this project;

- **Awareness** – A set of classroom and fieldwork lessons are in this pack, each covering a distinct topic. These aim to build a basic understanding of air pollution science and fieldwork skills. The lessons will meet aspects of the curriculum already being taught in schools and where possible look to work across subject curriculums. They will also provide fun, interactive and outdoor learning opportunities.
- **Monitoring** – Provide real time AQ readings for NO₂, O₃ and PM(10,2.5) on the school site for the priority schools. Focus schools will use diffusion tubes to show monthly average readings of NO₂. These recordings will be used in the engagement with a focus group (eco students) to help them understand their local area.
- **Exposure** – Clean air routes to school will be the primary aim of this part of the project. Using students perceptions and understanding of the local area to derive a map with colour coded roads to show levels of pollution. Safety and level of greenery will also be taken into consideration. Mobile AQ monitors will be used to back the map up with real time pollution level data along the roads.
- **Action** – Empowering the students and the staff at the school to create a legacy of the project going forward. Getting students and staff to develop ideas through Clean Air Action Plans for how they can reduce their air quality impact. Lastly, offering a Clean Air Delivery fund to empower schools to deliver projects they've identified could reduce the impact of poor air quality.

Accreditations

This project will link with other schools and sustainability work within Southampton City Council.

- **Modeshift**: This project links heavily with the My Journey active travel campaigns. The link between active travel and improving AQ within a school is key. Many of the initiatives and content in the pack will add to your application for the Modeshift award. <https://myjourneysouthampton.com/education/>
- **Eco-Schools**: Eco-Schools programme is a simple seven-step framework that empowers young people to deliver impactful environmental actions in their school and local community. Again the work with AQ will overlap with the accreditation work to be awarded a green flag. <https://www.eco-schools.org.uk/>

Important things to consider

- Setting up an Eco-group to lead on the work for AQ and all things sustainability within the school.
- Setting up a Clean Air or Eco champion staff member to carry on and lead the engagement work.
- Make the most of the AQ sensors being provided to show the school and the local community.
- Getting the students to feedback and educate the whole school is vital.
- All relevant links are available at the end of this document and on the Clean Air schools webpage.

Timeline for delivering engagement pack

Term 1 - Autumn 2023		Term 2 – Spring 2024		Term 3 – Summer 2024	
Dates	September 2023 – December 2023	January 2024 – February 2024	February 2024 – March 2024	April 2024 – May 2024	June 2024 – July 2024
Assembly	Introduction to Air Quality assembly				Student run final assembly
Surveys	Hands up travel survey			Hands up travel survey	
Lessons	Investigat- ing pollution levels				
Fieldwork	Introduction to air quality	Lichen surveys		Traffic surveys	
Eco-group classroom activities		Analysis of surveys and AQ results	Pupil led engagement campaign	Pupil led campaigning andimplementing the action plan	Evaluate survey and AQ results
Other activities				Clean air routes to school map	
Staff actions & grant				Clean Air banner competition	Implement grant funding initiatives

- Introductory assemblies to be completed by the end of October.
- Classroom lessons for the whole school to be delivered by the end of Term 1 if possible (if they fit best into a lesson further on into the year that is fine).
- Traffic surveys to be combined with introduction assembly dates.
- Time needed for grant funded initiatives may take longer if applying for physical changes to the schools or enquiring about changes to nearby roads.
- This project has high likelihood that it will continue into next academic year 24/25.

KS3 scheme of work

The work is best suited to fit into the science curriculum but also overlaps with a range of subjects and enhances personal development skills for the students.

National curriculum links

Science: Carrying out scientific experiments and fieldwork and from this identifying patterns. Use a range of equipment, present findings in a table or graph, explain the data and understand trends. Apply sampling techniques, mathematical concepts and calculate results and present these results in an appropriate table or graph.

Biology: The structure and functions of the gas exchange system in humans. The impact of exercise, asthma on the human gas exchange system. How organisms affect, and are affected by, their environment, including the accumulation of toxic materials.

Chemistry: Chemical symbols and formulae for elements and compounds. The composition of the atmosphere and the production of carbon dioxide by human activity and the impact on climate

Physics: Fuels and energy resources, Calculation of fuel uses and costs in the domestic context.

Geography: Understand how human and physical processes interact to influence, and change landscapes, environments and the climate; and how human activity relies on effective functioning of natural systems.

Human geography relating to population and urbanisation; international development; and the use of natural resources. Use fieldwork in contrasting locations to collect, analyse and draw conclusions from geographical data, using multiple sources of increasingly complex information

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.

Maths: Using percentages, calculations of numbers of people traveling by each mode to school.

English: Developing skills of speaking, listening, reading and writing for a purpose, investigating, planning, predicting, debating, and communicating to the wider community.

Importance of air quality being delivered in lessons

Air pollution is a really important topic that should be taught from a young age as it impacts especially on children’s health and daily lives. It links to active travel and the health of children; from getting enough exercise to keeping children’s lungs healthy. It explains how substances and living beings can change in their environment and then cause harm to both humans and the environment.

This pack is a fun and interesting way of getting students involved in understanding and tackling environmental issues. By collecting scientific data we can better understand an issue like poor air quality. Citizen science can help develop student’s interest in science by practically applying learnt skills, in this case for a clear benefit.

By educating the whole school this allows every students to be able to make an informed decision on their actions.

Summary of pack

Activity and description	Target audience	Suggested delivery time	Resources available	Page no
Assembly – Introduction to air quality The introductory assembly is to give all pupils the basic information about AQ. The assembly will be interactive with information, data, questions and a video to finish.	Whole school	20 minutes	• PowerPoint Presentation • Sustainable Schools Officer support	8
Hands up survey – Travel mode and AQ This is to be completed in classrooms and data collated for the whole school. This will be done at the start of the school year and at the end (after the campaigning) to show differences.	Whole school (in classes)	10 minutes	• Instructions for teachers • Travel mode record sheet • My Journey support	9
Lesson 1 – Introduction to air quality Pupils will explore what we mean by AQ, where air pollution comes from, the key pollutants and how it effects the human body and the environment. Activities include talking about the pollution sources, watching videos on air pollution and its effects and discussing the health effects.	Whole school (in classes)	45 minutes - 1 hour	• Lesson plan • Student workbook • PowerPoint Presentation	11
Lesson 2 – Investigating pollution levels Students will learn what sources of pollution are at their school and how they can investigate them. This will then allow students to be able to say how they can reduce their air pollution and the schools. Introduce Diffusion tubes to the students. Allow them to look at a graph of pollution data and analyse the trends. Activities will include looking at NO ₂ data and creating and annotating a line graph to show a full school week with the peaks and troughs of pollution.	Whole school (in classes)	45 minutes - 1 hour	• Lesson plan • Student workbook • PowerPoint Presentation	17
Fieldwork session – Lichen surveys The effect of air pollution on living things and their environment. Pupils will have an introduction to lichen in the classroom and then taken out to the school grounds to look at trees and their type of lichen growing on them. The idea is to compare two trees, one closer to a road and one further away. Also to compare twigs compared to trunks.	Whole school	45 minutes - 1 hour	• Lesson plan • Site characteristics worksheet • Lichen identification tally sheet • Sustainable Schools Officer support for priority schools	25

Activity and description	Target audience	Suggested delivery time	Resources available	Page no
Fieldwork session – Traffic surveys Selected pupils in a focus group will work together to collect and look at data regarding the type and amount of traffic around the school grounds at school run time. All entrances to the site will be covered by different pupils and results collated. This will occur once before campaigns begin and once at the end of the year with the aim to see a difference. This will also happen at school pick up and drop off times.	Focus group	30 minutes at start and end of the day	• School traffic survey form • School travel survey instructions • My Journey support • Sustainable Schools Officer support	32
Classroom activity – Analysing results This lesson gives students the opportunity to use real data from AQ monitoring equipment in their schools and in the wider Southampton area. Background information is provided about why and how we monitor AQ, followed by handling data to create graphs (hand drawn graphs). This will allow the students to analyse the data for their school. Data from traffic surveys, diffusion tubes and Airly's will be used.	Focus group	45 minutes - 1 hour	• Data from Diffusion tubes or Airly monitor at school • Data from traffic surveys • Classroom session plan • Student workbook • Sustainable Schools Officer support	35
Classroom activity – Pupil led engagement campaign This lesson will focus on different methods of improving AQ in a city and at their school. Using real examples, students will look at the benefits and potential problems of each method. They may need internet access to find out more about some of the methods. They will help create an AQ action plan for their school and over the next few months work to deliver on their targets and campaign with the whole school to improve their air.	Focus group	45 minutes - 1 hour Then follow up action & campaigning time.	• Air quality action plans • Classroom session plan • Student workbook • Sustainable Schools Officer support	41
Classroom activity – Clean Air routes to school mapping Working with a map, determined by the area students travel from, use this to colour the roads on the map red or green depending on their air quality, safety and greenery. Allow the students to draw symbols that represent the road. This will be used to guide parents and students onto clean routes to get to school.	Focus group	45 minutes - 1 hour	• Blank map of the local area • Map with colour coded roads • Classroom session plan • Sustainable Schools Officer support	48
End of year clean air assembly Using the students work over the year and using the eco-students to present at the assembly, the actions, results and benefits will be presented to the whole school.	Focus group to whole school	20 minutes	• Data from air quality monitoring at the school • Sustainable Schools Officer support	

Focus group = Eco-group, Junior travel ambassador group, School council or after school club.

Introduction assembly and Hands up survey

Assembly

The assembly is to be delivered to the whole school. It is there to introduce the project and what the students will be working on over the course of the year. It will also give a brief introduction to the basics of air quality, linking in with active travel, sustainability and healthy living.

The Sustainable Schools officer at Southampton City Council will deliver this assembly to all target schools engaged with the Clean Air Project. If you are not a target school the PowerPoint presentation will be made available on the project website to be used.

An assembly led by the eco-group students will be part of the campaigning and part of showing off how the project has changed and helped the air quality at your school. This will happen at the end of the year.

Hands up survey

Undertaking a hands up survey to collect data on the students travel modes to and from school and AQ knowledge is vital data for the project and also for the school. This travel data is collected already through My Journey in a lot of schools in Southampton. If this is the case for your school this data will automatically be shared with the Sustainable Schools Officer for the project. Schools not engaged with My Journey will recieve a link to complete the survey online from the Sustainable Schools officer.

Travel data

If your schools doesn't already undertake these surveys then these will need to be undertaken at the start If your schools doesn't already undertake these surveys then these will need to be undertaken at the start of the school year and at the end. The surveys will be done in classrooms by each teacher and will take 5 minutes of a lessons time. The results will then be collated and combined to give a whole school travel data.

The teacher for each class will be asking the students how they travel to school and how they would like to travel to school. Read out the whole question first so everyone knows what the question is and what all the options are for their answer. One at a time, read out each answer and ask those with that answer to put their hand up. Count the number of hands up and write this down. The options are;

Walk	Bus
Cycle	Scooter
Train	Park and stride
Car	Other

Hands up survey form

School

Date

Class

Number of pupils

Currently travels by:

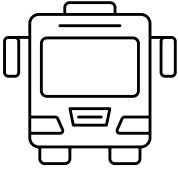
Would like to travel by:

Currently travels by:

Would like to travel by:



Walk



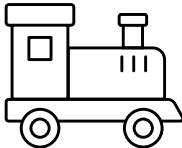
Bus



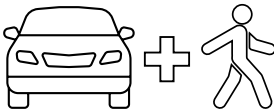
Cycle



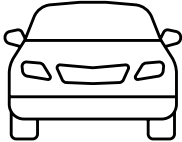
Scooter



Train



Park and stride



Car



Other

Whole school Lesson material and fieldwork section

Lesson 1

Introduction to air quality

Curriculum link:

- **Science:** The structure and functions of the gas exchange system in humans. The impact of exercise, asthma on the human gas exchange system. How organisms affect, and are affected by, their environment, including the accumulation of toxic materials. Chemical symbols and formulae for elements and compounds, the composition of the atmosphere and the production of carbon dioxide by human activity and the impact on climate
- **Geography:** Understand how human and physical processes interact to influence, and change landscapes, environments and the climate; and how human activity relies on effective functioning of natural systems.

Websites:

- <https://www.gov.uk/government/publications/health-matters-air-pollution/health-matters-air-pollution> – use this website for a lot of information for both the effects of air pollution, vulnerability and how to improve air quality.
- <https://www.bbc.co.uk/bitesize/topics/zhssgk7/articles/zq2m2v4> – Greenhouse gases and climate change – Humans and the environment – KS3 Biology – BBC Bitesize

Teacher lesson plan

Recap the basics of air pollution

What is air?

Air is a mixture of gases made up of mainly nitrogen and oxygen gas. Show picture in PowerPoint of composition of the air. See if the students can suggest the gases and their percentages in the air.

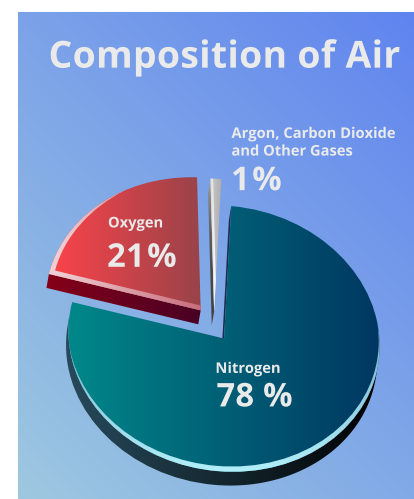
What is air pollution?

1. Ask pupils for suggestions
2. Then explain “Air pollution is the release of pollutants into the air around us, both indoors and outdoors. Pollutants are chemicals and substances that are harmful to our health or the natural environment, causing damage to the land, air or water.”

Sources of air pollution:

Activity: Get the students to use the workbook to group the sources of outdoor air pollution in the following 4 categories below. Let the students say all the answers they have come up and then read out and ask them to fill in their workbook with any answers left to fill any gaps in knowledge.

- **Mobile sources** – such as cars, buses, planes, trucks, taxis and trains
- **Stationary sources** – such as power plants, oil refineries, industrial facilities, and factories
- **Area sources** – such as agricultural areas, cities, and wood burning fireplaces and cooking.
- **Natural sources** – such as wind-blown dust, wildfires, and volcanoes



Lesson plans have been written to make it easier for teachers, not to add more work. If the content needs to be adapted to suit your school, curriculum, class or certain pupils please do. The importance is that all pupils learn the basics of air pollution, the effects of pollution and how to improve their local air pollution.

Mobile sources are the primary source of air pollution. Stationary sources, like power plants, emit large amounts of pollution from a single location, these are also known as point sources of pollution. Area sources are made up of lots of smaller pollution sources that aren't a big deal by themselves but when considered as a group can be.

Activity:

1. Then get them to think about the sources of indoor pollution, are they all different?
2. Get the students to then circle their answer for where they think most air pollution comes from in their city and around their school?
3. Ask students to share their answer out loud. It will be interesting to see how many have the same answer.

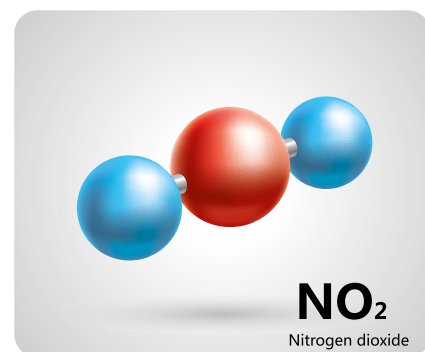
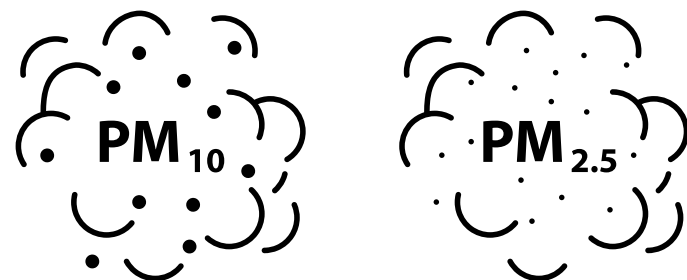
"The most common way for air to become polluted is through human actions like burning fuel. Vehicle emissions, especially in a city like Southampton, is the biggest source of air pollution."

Major pollutants:

1. Ask the students to put their hand up if they know the main forms of pollutants
2. Show students the images of the main forms of outdoor air pollution. (NO₂, PM and CO₂).
3. Explain the main pollution from traffic is nitrogen dioxide and particulate matter. These both also impact human health the most.

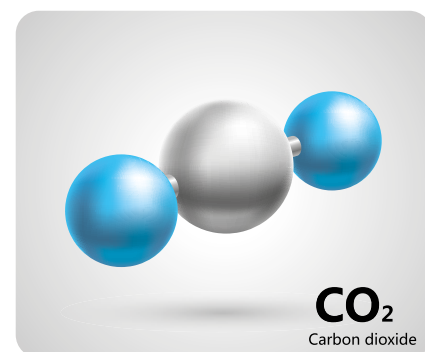
Particulate Matter (PM)

Tiny particles of dust and when breathed in can reach deep into the lungs. Largest source of PM₁₀ is road traffic. Ash shown on image of hair the particles are smaller than a strand of hair. These are inhalable and cause serious health problems.



Nitrogen Dioxide NO₂

Primarily gets in the air from the burning of fuel. Most common source is from road traffic. Directly linked to harm to human health.



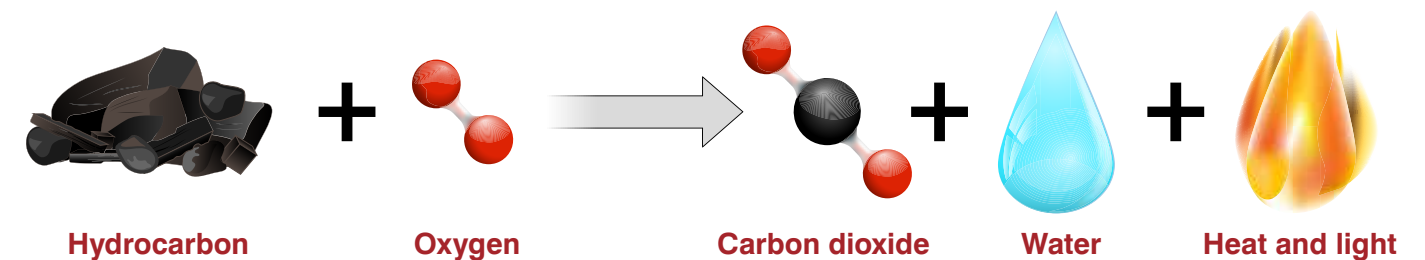
Carbon Dioxide CO₂

Fossil fuel usage is the primary source and from human impacts on forestry and agriculture. This pollutant mostly effects the environment and global warming.

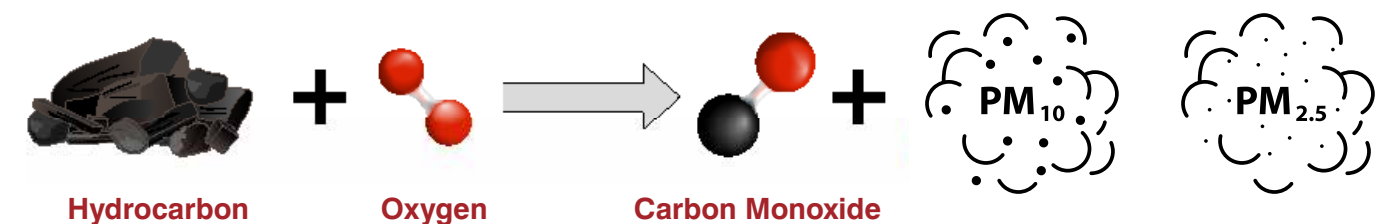
How is air pollution caused?

Combustion of fossil fuels is the largest source of air pollution. When fuels burn they react with oxygen in the air. Fuels are hydrocarbons and they can undertake a reaction called combustion when burnt:

1. Complete combustion



2 Incomplete combustion – with not enough oxygen present



How air pollution affects humans:

What do humans need to survive? Animals as well as humans need air, water, shelter and food to survive. All living things need oxygen to breathe and survive. Our bodies use it to turn the fuel from our food into energy. Without trees we wouldn't get enough oxygen.

Young children are closer to the sources of the air pollutants because they are shorter than adults, they also breathe more rapidly, and their lungs are not yet fully developed. This makes them more susceptible to the effects.

Why is air pollution bad for our health?

Discussion: how do you think air pollution affects us as humans? Get them to talk in small groups.

1. Ask pupils how air pollution affects them and their family? Ask the children if they or someone they know has asthma or other breathing problems? Is it more difficult to breathe on some days more than others? Is it more difficult to breathe or do you cough near busy roads? How do you think pollution affects this?
2. Explain that if a child breathes in high levels of air pollution over a long period of time, they are more at risk of:
 - Their lungs not working as well as they grow older.
 - Developing asthma during childhood or as an adult - and if they have asthma already, air pollution can make it worse.
 - Finding it harder to breathe or having a regular cough
 - Pollution can effect your ability to learn and your mental wellbeing.
 - Your heart can also be affected.

Reasons

- Car exhaust
- Industrial facilities
- Agriculture
- Household and industrial waste
- Radioactive objects



Health effects

lung diseases

heart disease

nasal irritation

headache

nausea

dizziness

What can you do

plant trees

eco-friendly modes of transport

Do not turn on lights or appliances unless necessary

Do not take a hot bath or shower for too long

choose recyclable packaging

use safe cleaners

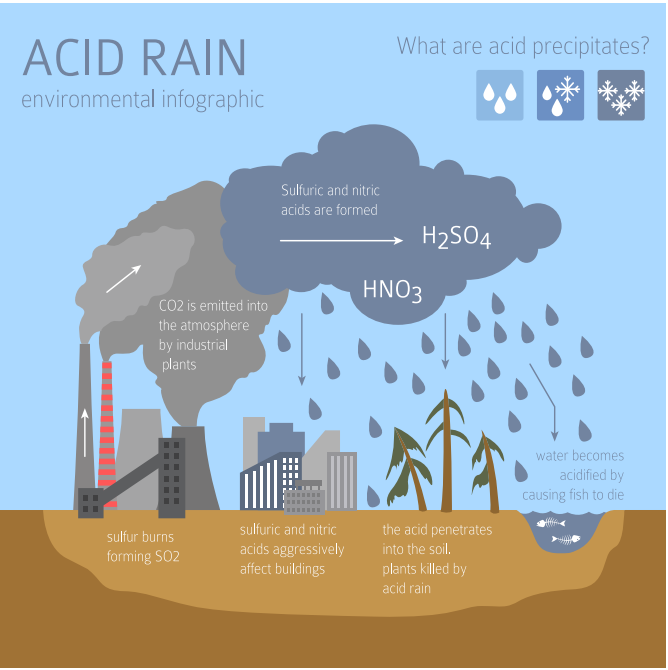
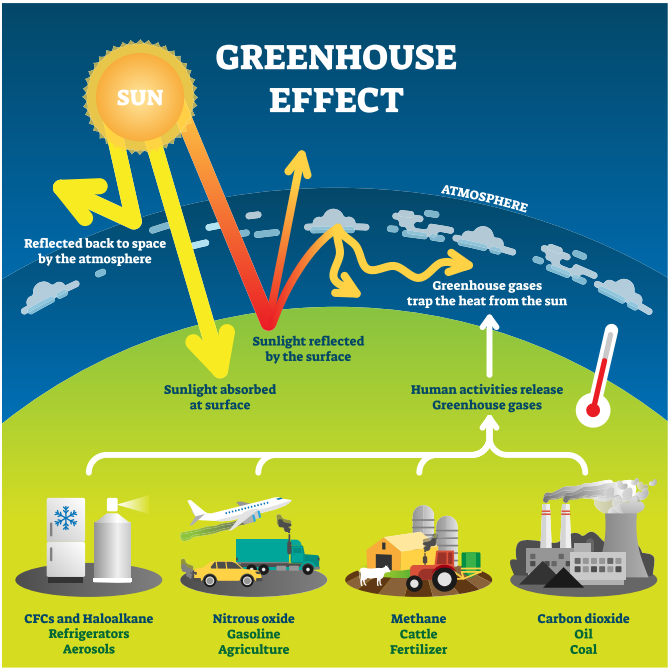
8.8 million causes of deaths per year worldwide can be attributed to polluted air

How air pollution affects the environment

Air pollution and the release of gasses into the atmosphere can have many negative effects on the environment.

Talk through these with the PowerPoint slides to see how pollution effects the climate.

- 1. **Global warming** – One type of air pollution is the addition of harmful gas into the air which trap heat in the earth’s atmosphere, this is one of the causes of global warming. This results in the earth heating up (climate change) and we see impacts like hotter summers, melting of the ice and sea levels rise. This can affect all living creatures.
- 2. **The ozone layer** – The ozone layer helps protect us from harmful rays from the sun. It is getting damaged from air pollution.
- 3. **Acid rain** – Acid rain is created when gasses get high into the air. The wind can blow these gasses for miles and then they get washed out of the air when it rains. This rain is called acid rain and can damage forests and kill fish.



Activity: Watch this video on CO₂ and how it is impacting our environment. It goes through a scientific experiment about the greenhouse gas effect.

<https://www.bbc.co.uk/bitesize/topics/z3fv4wx/articles/z6rtp4j>

Summary of lesson

Ask the students what the biggest thing they have learnt today. Explain in the next lesson we will be talking about monitoring air pollution and looking at ways to improve air quality.

Activity: Let the students watch a video to sum up what they have learnt.

<https://www.bbc.co.uk/bitesize/articles/zfbg4xs#zpwdqfr1>
https://www.youtube.com/watch?v=t7Q7y_xjR5E

Student workbook

Where does outdoor air pollution come from?

Mobile sources:

Stationary sources:

Area sources:

Natural sources:

What are the effects of pollution?

Lesson 2 Investigating pollution levels

Curriculum link:
• **Science:** Present findings in a table or graph, explain the data and understand trends.

Teacher lesson plan

Recap: Recap the basics of air pollution “Air pollution is anything that causes the air to become dirty and not what it should be. This can cause harm to humans but also to the environment.” The main gases polluting the air are NO₂, Particulates and CO₂. The main sources of air pollution are; Transport, Energy usage, burning fuel and natural causes.

Sources of pollution at school

Activity: Get the students to think of all the different sources of air pollution at and around the school. Come together and get the students to share their answers and then show the different sources.

Travel to and from school (car)	Idling in the car	Heating the school
Roadworks giving off dust	Lorries passing the school	Lighting inside the school
Cleaning chemicals	Busy road outside the school	Natural sources

Planning an air pollution investigation

Please use the section with your type of air quality monitoring, priority schools have an Airly sensor and focus schools have a diffusion tube.

Priority schools

Airly air quality monitor

Introduce the Airly as an air quality sensor. It shows live levels of air pollution and shows a colour depending on how good or bad pollution is. Show the students where the Airly has been located in the school (either in person or by picture and explanation).

Look at the Airly map and the schools Airly together on a screen and look through the NO₂ data for the past 24 hours of data. Access to the Airly map is here:<https://airly.org/map/en/>.

Explain that:

- 1. This machine measures the pollution mostly made by road transport.
- 2. Ask the students where they think the best place to put the Airly is if they want to measure an area students spend most of their time in? How about an area they think will be most polluted?
- 3. The ideal places would be the school playground or the main entrance and near the main road by the school
- 4. Get them to see how the bar chart at the bottom shows peaks and troughs, usually around school run times



Focus schools

Diffusion tubes

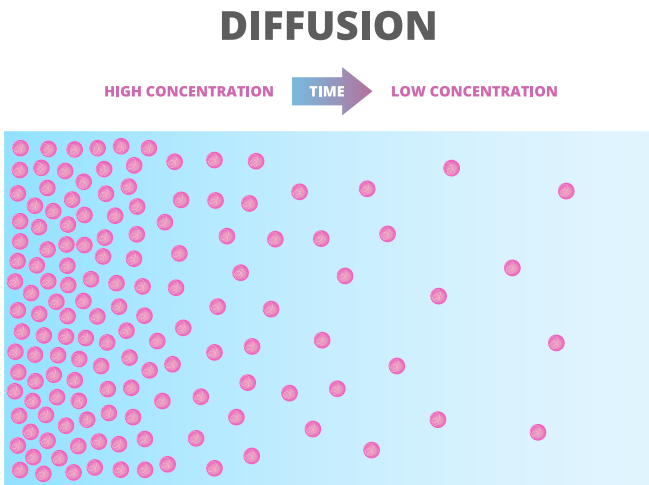
Introduce the diffusion tubes and explain to the students that they'll be used to measure the levels of nitrogen dioxide around their school.



Explain that Diffusion tubes are used to measure the levels of harmful Nitrogen Dioxide in the air, by use of a sampling tube and a filter. The more nitrogen dioxide in the air the more polluted. This measures the pollution mostly made by road transport.

Diffusion tubes are small plastic tubes with a cap at each end one of which is coloured. Under the coloured cap is a steel mesh disc which is coated with triethanolamine (TEA) a chemical that absorbs nitrogen dioxide. When gases pass over this mesh the chemical changes. This chemical change tells us how much nitrogen dioxide was in the air during the monitoring period. The bottom white cap is removed so that the air can get into the tube in a process known as molecular diffusion.

- 1. Ask the students where they think the best place to put the tube is if they want to measure an area students spend most of their time in? How about an area they think will be most polluted?
- 2. Explain that the ideal places would be the school playground or the main entrance and near the main road by the school.



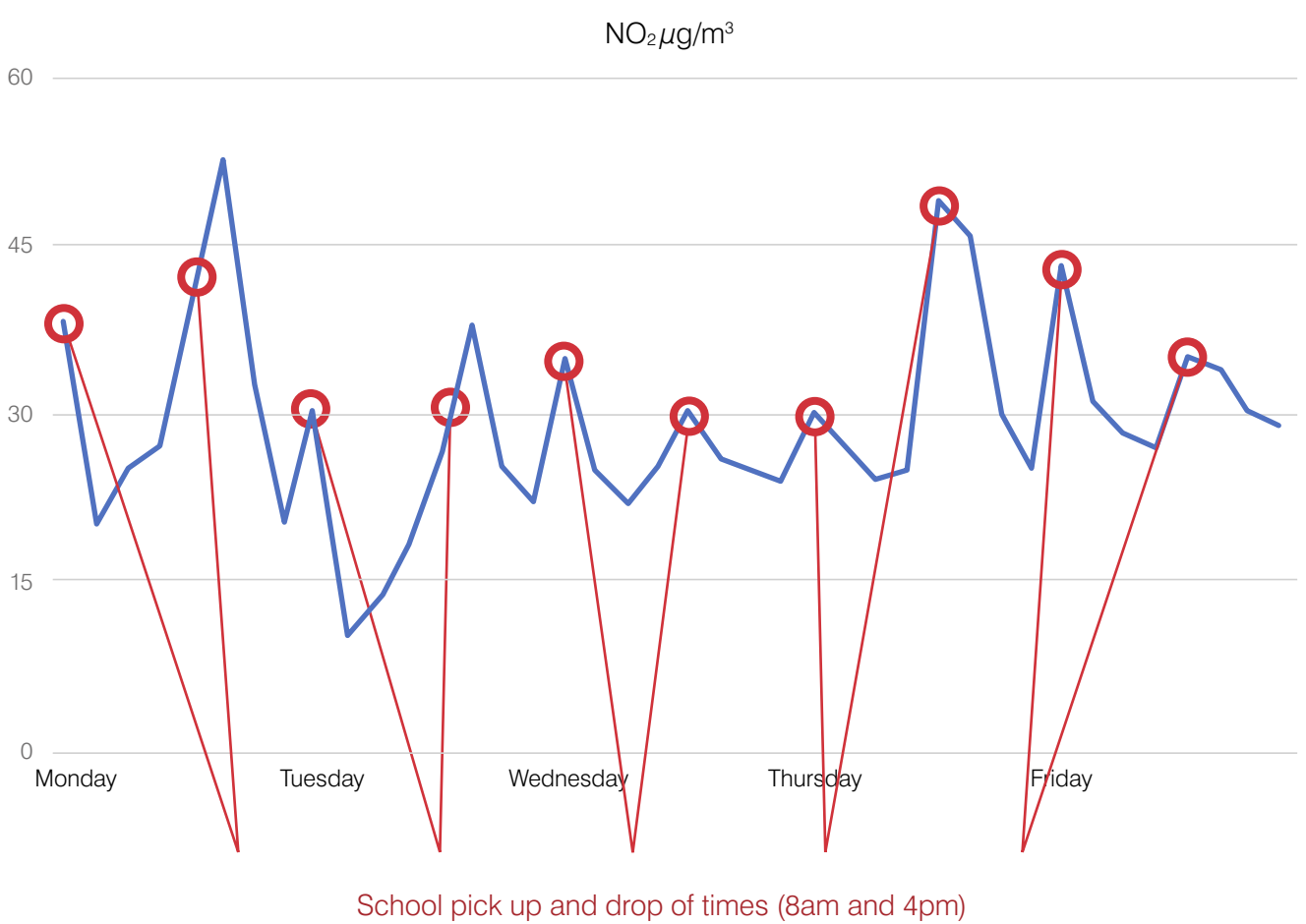
Looking at data

Looking at an example of air quality data (NO₂) from schools in Southampton from Monday to Thursday in April 2023.

Activity: Get the students to draw a line graph, copying the data provided but adding labels, axes, times and also adding a prediction for the weekend of this school week.

What times is the pollution highest, why is this? Is there a trend?

This is an example of what the graph should look like.



1. Ask the students if they saw any trends or ask them to point out the highest and lowest levels.
2. Show the students the main trend of the graph and make them aware and allow them to see that there are peaks in air pollution around the times that they come and leave school. The lowest pollution being during the school day.
3. There is often a peak at 6pm when people leave work.
4. Ask the students why they think there is higher air pollution at school pick up and drop off times?

How can we help air pollution at the school?

Helping the air quality at school is about getting everyone at school involved and working to make the changes. Making school a green and clean area. Education is a big way to change behaviour.

Activity: What can we all do to try to reduce air pollution? First get the students to write down their thoughts and then get a few to share their ideas.

Let them also think about how they propose the school can improve their air quality and then how the city of Southampton could improve air quality. What is the difference?

Go on to tell them any ideas they hadn't thought about.

Walk	Public transport	Plant trees	Learn about air pollution in lessons
Cycle	Stop idling	Switch off lights	Tell others how to protect the air
Scoot	Park and stride to school	Use electric cars	Campaigning
Eat less meat	Buy less products	Reuse, recycle	Grow your own food

Discussion: What is the one thing each student is going to do as a result of learning about air pollution?

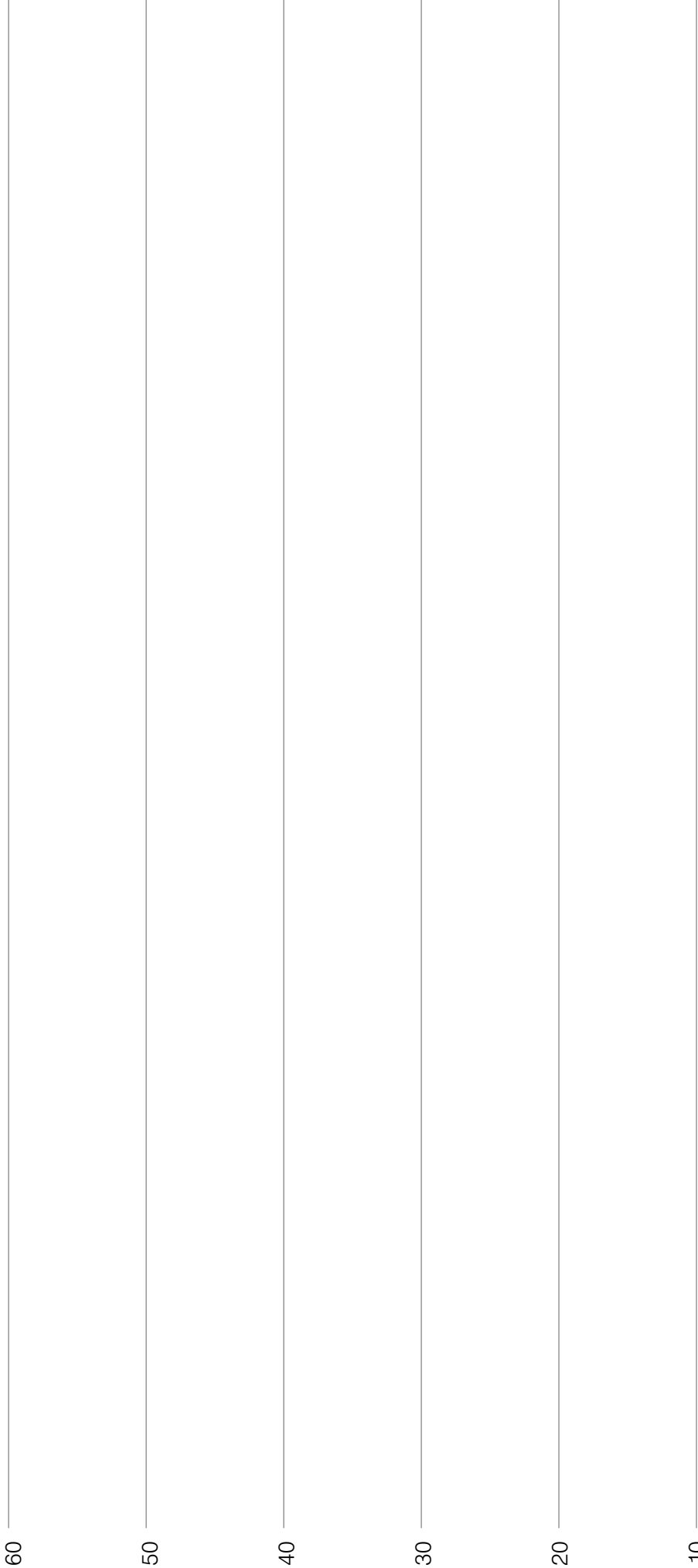
Student workbook

Plot the points and connect the dots to create a line graph with annotation and labels to display the data.

NO ₂ µg/m ³	Monday	Tuesday	Wednesday	Thursday
08:00 am	38	30	35	30
10:00 am	20	10	25	27
12:00 pm	25	13	22	24
14:00 pm	27	18	25	25
16:00 pm	39	26	30	49
18:00 pm	53	38	26	46
20:00 pm	33	25	25	30
22:00 pm	20	22	24	25

NO ₂ µg/m ³	Friday	Saturday	Sunday
08:00 am	43		
10:00 am	31		
12:00 pm	28		
14:00 pm	27		
16:00 pm	35		
18:00 pm	34		
20:00 pm	30		
22:00 pm	29		

NO₂



Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
08:00	08:00	08:00	08:00	08:00	08:00	08:00
10:00	10:00	10:00	10:00	10:00	10:00	10:00
12:00	12:00	12:00	12:00	12:00	12:00	12:00
14:00	14:00	14:00	14:00	14:00	14:00	14:00
16:00	16:00	16:00	16:00	16:00	16:00	16:00
18:00	18:00	18:00	18:00	18:00	18:00	18:00
20:00	20:00	20:00	20:00	20:00	20:00	20:00
22:00	22:00	22:00	22:00	22:00	22:00	22:00

What types of pollution are there at school?

How can you help the school improve air quality?

How can the air quality be improved in Southampton?

Fieldwork Session
Lichen surveys

- Curriculum link:**
- Carrying out scientific experiments and fieldwork and from this identifying patterns. Use a range of equipment, present findings in a table or graph, explain the data and understand trends. Apply sampling techniques, mathematical concepts and calculate results and present these results in an appropriate table or graph.

Teacher lesson plan

- Organising the activity**
- Anticipate where the children will work in the school grounds. It is best to spread them out in different places, provided there is scope.
 - Preferably each group would look at a tree close to a road and a tree away from a road.
 - Show the PowerPoint slides with the different lichens on before the activity.
 - Some lichens change colour in the rain. This could make it more difficult for you to work out what type they are, so if possible try to do the survey when the weather is dry.
 - Try to find sites with deciduous trees, such as oak and ash, and lots of light.

Materials needed

Compass	Ruler	Printed copies of the student workbook
Pencil	Magnifying glasses if available	Camera

- Step by step for the lesson**
1. Introduce what lichens are using the information in the student workbook and pictures in PowerPoint.
 2. Before the activity explain to the class that they will be exploring lichens in the overall context of the school and how the school is next to a main road; next to a woodland etc.
 3. Discuss the variety of habitats in the school (for example, buildings, lawn, trees, walls, paths, benches) and the organisms which can live there like lichen need light and clean air (for example, birds, flowering plants, minibeasts).
 4. Organise the class into small groups – who can take it in turns to look, measure or record.
 5. Allow the students to record on a scale of little to a lot of Lichen – a lot being more than an A4 sheet.



Follow-up after the investigation
Set aside time for the whole class in small groups to discuss what they have done and to go through the questions. The findings of most activities can be pooled to see what the whole class found. Remember, the more pollution-loving lichen you saw, the more polluted the air is likely to be and the opposite for pollution hating lichen.

Can you decide what you think it’s telling you about the amount of pollution in the air around you? If your study has shown you that the air around you is probably polluted, can you think what might be causing the pollution? Refer the pupils back to the causes of pollution work done previously and allow them to look at

Student workbook

What is lichen?

Lichens are plants and they will grow on rock, tree and roofs, where other organisms cannot. Lichens are very sensitive to air pollution and are good indicators of air quality. They are sometimes used to monitor the effects of pollution in towns and around industrial development sites, this makes them a good indicator species for pollution. .

Types of Lichen

Lichen can show us how polluted the air around us is. There are lots of different types of lichen – they come in all sorts of shapes, sizes, and colours – and different types of lichen like different types of air!

- Nitrogen (NO₂)-sensitive lichens only live in clean air
- Nitrogen(NO₂)-loving lichens can live in dirty air
- Some lichens are not affected by air quality and can live anywhere

Age of lichen and pollution

Lichens on the trunks of trees have often been there for a lot longer and lichen on young trees or twigs may support lichen that’s grown in the recent years. Do trunks or twigs have more pollution-sensitive lichen?

Name of lichen	Colour of lichen	How much does it cover?	Location of trees with this lichen on?
The Pollution Gang : Nitrogen-loving			
	Orange / Red / Yellow		
			
Leafy Xanthoria			
Cushion Xanthoria			

Name of lichen	Colour of lichen	How much does it cover?	Location of trees with this lichen on?
The clean lichen: Nitrogen sensitive			
	Green / blue		
			
Unsea			
Evernia			
	Green / blue		
Hypogymnia			

Name of lichen	Colour of lichen	How much does it cover?	Location of trees with this lichen on?
The Grow-Anywhere Gang			
 Melanelixia	Grey / light green		
 Flavoparmelia			
 Parmelia	Grey / light green		

Map of survey area

Draw, annotate and make a key for a map showing the locations of the trees surveyed and what lichen they had.



Observations and analysis

Which type of lichen did you see the most?

☐ Green

☐ Grey

☐ Orange

Was there more nitrogen sensitive lichen (orange) on trunks or twigs of trees?

☐ **Trunks** of trees

☐ **Twigs** of trees

Where the trees with more nitrogen loving lichen closer or further away from the road?

☐ **Closet** to the road

☐ **Away** from the road

What does this say about the air near the school and about when pollution has been worse?

What do you think is causing the air to be polluted near the school?

Eco-Club /
Focus Group

Fieldwork and classroom
sessions section

Fieldwork session

Traffic count

- Curriculum link:**
- **Maths:** Counting; Identify, represent and estimate numbers
 - **Geography:** Use simple fieldwork to observe, study and explain the immediate environment

Teacher lesson plan

Background
This exercise should be undertaken by a focus group of students (Eco-group or Junior travel ambassadors). The aim is to get a picture of the travel habits of the school, to see how busy the road outside the school is and to see whether students change their travel choices towards the end of this project.

Idling is when people leave their car running whilst picking up or dropping off pupils at school. Idling can cause extra pollution around schools when parents pick up or drop off children.

Prior to the session
Using an Eco or JTA session a week or two before, tell the students about what they are going to be doing. Ask them to allow their parents to bring them in early for this exercise as they will need to be on the road from just before students start arriving and will need to stay until every students has left at the end of the day.

Explain the health and safety (e.g. stand away from idling vehicles to reduce pollution exposure) and run through the activity in detail. Explain why this activity is being carried out and that it can show the school how active travel can be improved.

Materials needed

Printed copy (double sided) of the student travel count record form.	High vis jackets for the pupils to wear whilst on the pavement
Clipboard to hold paper	School risk assessment to be filled in

Step by step instructions for the fieldwork

1. Gather the pupils together and explain the health and safety (e.g. stand away from idling vehicles), give each pair a record sheet and run through the basic instructions.
2. The pupils should be covering all entrances to the school. If the school has a school street covering the ends of the school street as well as any footpaths would be ideal if possible.
3. The times of the count will be over the school drop off and pick up times. Ideally covering the busiest half hour. This is usually around 08:20-08:50am but will be different for each school.

4. The pupils will work in pairs, one to count and one to record on the sheet.
5. Each student will decide which travel mode they will count and be responsible for tallying this onto their sheet.
6. A student will manage the air quality monitor and note down readings every few minutes. Air Quality officer at Southampton City Council can provide portable air quality monitor
7. Please carry this out in the morning.

Next session
After the school run time has ended pupils will come back together to collate the results into one table with totals for each travel mode. This will be done in the analysing results session.

Help the pupils calculate the percentage of total pupils for each travel mode e.g.
(number of pupils cycling / total pupils counted) x 100 = % of pupils cycling to school

Important
Please send all traffic count results to Amber at amber.titchener@southampton.gov.uk
The My Journey team and Air Quality Officer would be happy to assist in these sessions.
This data will be included in the session about analysing results and student led campaign.

Students traffic survey record form

Road name	Weather	Start time	End time		
Number of vehicles	Idling cars	Pupils in cars	Pupils cycling	Pupils walking	Pupils scooting

[illegible]

Classroom activity

Analysing results

Air quality monitoring analysis

For each school you will either use the diffusion tube results from your school or use the live Airly monitoring to analyse the air quality data.

Background information

Why is Air quality monitoring important? Improving air quality, protecting health, and ensuring compliance with regulations. The Airly can also be used to identify pollution sources, target improvements or support research and development. It can be used as an education tool like it will be today to be able to spread the message and help us make the air at school cleaner.

Set up

It is up to you and how big the focus group is, whether you treat this like a lesson and go through each exercise together with everyone working on the same activity at the same time (best option as all pupils understand all of it), or if the group is too large you could split off into groups and each group can take a different activity.

Please use the section with your type of air quality monitoring, Priority schools have an Airly sensor and focus schools have a diffusion tube.

Airly monitoring

Starter: Remind the students what the Airly is and how it works. Show the students where the Airly has been located in the school (either in person or by picture and explanation). Look at the Airly map together on a screen and look through the different pollutants (NO₂ and PM) and the past 24 hours of data. Access to the Airly map is here:

Introduce the levels of low, medium and high pollution using the Airly Air Quality Index.

Qualitative name	Index or sub-index	Pollutant (hourly) concentration in $\mu\text{g}/\text{m}^3$			
		NO ₂	PM ₁₀	O ₃	PM _{2.5} (optional)
Very low	0-25	0-50	0-25	0-60	0-15
Low	25-50	50-100	25-50	60-120	15-30
Medium	50-75	100-200	50-90	120-180	30-55
High	75-100	200-400	90-180	180-240	55-110
Very high	>100	>400	>180	>240	>110

(1.CAQI – Common Air Quality Index – Airly)

Data will be supplied which will detail monthly concentration averages for NO₂ and PM10 for the school since the Airly was installed. Students will either complete a bar graph for the air quality readings or draw the bar graph for travel count results.

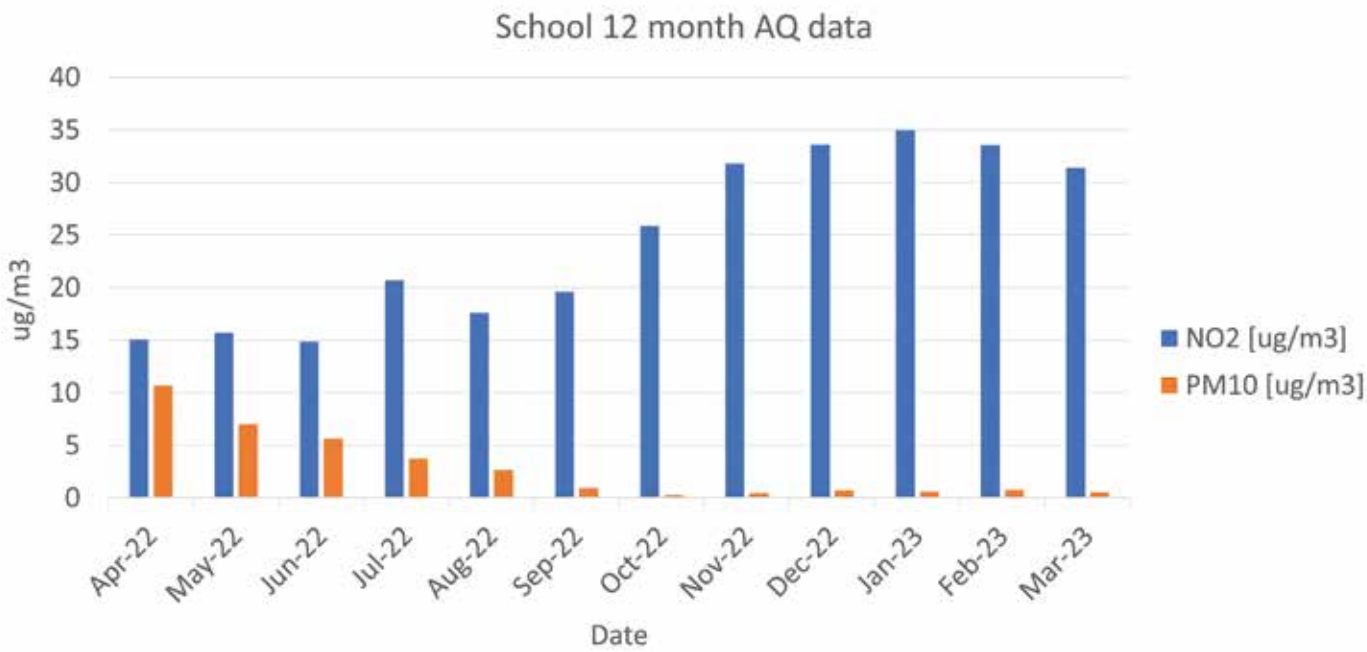
Activity: Draw a bar graph displaying the monthly NO₂ and PM10 concentrations or a line graph for the hourly concentrations for a typical school week. Do this together with the leader of the lesson showing with students copying and suggesting.

- 1. Ask students to suggest how they can present the data. See how they would suggest and then tell them they will be drawing a bar graph displaying the monthly concentrations or a line graph for the average hourly concentrations for a school day.
- 2. There will have two bars for the monthly concentrations and one line for the day concentrations. This is because of the number of concentrations being looked at in the monthly graph is both NO₂ and PM.
- 3. What do we need to decide before we start? What colour shall each pollutant be? What scale should we use up the side? Which is the x, and which is the y axis? Allow students to make suggestions.
- 4. Whilst modelling for students allow them to make suggestions and tell the class how it will be drawn and ask them to follow step by step.
- 5. Ask students what they see, what trends there are and whether they think this shows the air quality at school being good or bad. Remember air quality can always improve!
- 6. Ask students to fill in the questions on the student workbook for air quality monitoring.

Bar graph

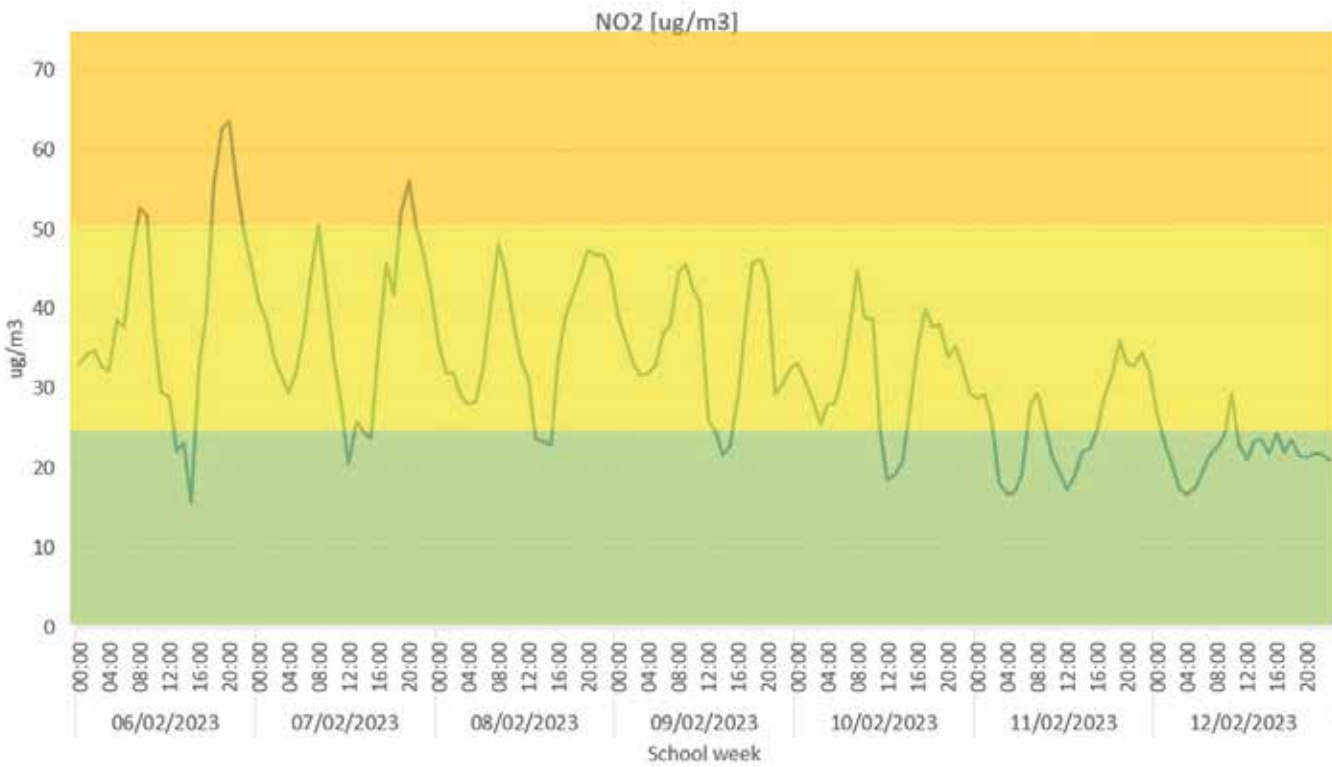
Introduce the annual mean concentration limit for NO₂ which is 40 µg/m3 and draw this onto the graph in red. Then using the annual average provided also draw this as a line on the graph.

Below is an example of what the bar graph should look like, students should be able to label the axis and understand the trend. There is likely to be higher readings in school term time than the summer holidays for example. It is also expected winter to be higher concentrations at schools with the weather being worse and more students traveling to school in the car.



Line graph

A line graph will be provided for the school for the children to look at, analyse and understand. It will show times of the day where pollution peaks, usually around school pick up and drop off.



Diffusion tubes

Starter

Remind the students what the diffusion tube is and how it works. Diffusion tubes work by a process called molecular diffusion. During molecular diffusion, compounds will move from an area of high concentration to an area of low concentration. This allows NO₂ to move into the tube and be absorbed giving us a monthly average reading.

Show the students where the diffusion tube has been located (either in person or by picture and explanation). Show the class the measurements from the NO₂ diffusion tubes.

Data will be supplied which will detail the monthly concentration averages for NO2 for the school since the tube was installed. Students will either complete a bar graph for the air quality readings or draw the bar graph for travel count results.

Activity: Draw a bar graph displaying the monthly NO₂ concentrations and answer the first 2 questions.

- 1. Ask students – How could we present these numbers? What graph could we use?
- 2. Tell the students we’re going to create a bar graph.
- 3. What do we need to decide before we start? The width of the columns? Will we include a gap between bars? What scale should we use up the side? Which is the x and which is the y axis? Allow students to make suggestions.

- 4. Whilst modelling for students allow them to make suggestions and tell the class how it will be drawn and ask them to follow step by step.
- 5. Ask students what they see, what trends there are, are there any months that are very different to others and whether they think this shows the air quality at school being good or bad? Remember air quality can always improve!
- 6. Ask students to fill in the questions on the student workbook for air quality monitoring

Refer to the bar graph above as a guide, the only difference will be there will only be 1 type of bar as only one pollutant being measured. There is likely to be higher readings in school term time than the summer holidays for example. It is also expected winter to be higher concentrations at schools with the weather being worse and more students traveling to school in the car.

Traffic count data analysis

Background information

The students will have gone out for one morning and afternoon on the same day to collect the Autumn term data on travel mode for the school. This will only be half of the data for this exercise as the follow up count will be done in the summer term after the action and campaigning part of the project has taken place.

The whole school would have done a hands up survey and asked how students would like to travel to school and whether they know what air pollution is.

Starter

Collate all of the results together for the traffic count onto one sheet. Use the sheet to fill in the maths questions surrounding totals and percentages.

Also gather all of the data for the hands up survey and draw a graph to show the difference in those who travel by each mode and students who would like to travel by each mode. This should be able to show how improvements could be made in active travel.

Activity: Draw a graph of the travel results, using the travel mode on the x-axis and number of pupils on the y-axis. With 2 bars needed for each mode for the hands up surveys. The traffic count data at the end of the year can be added to the graph later on.

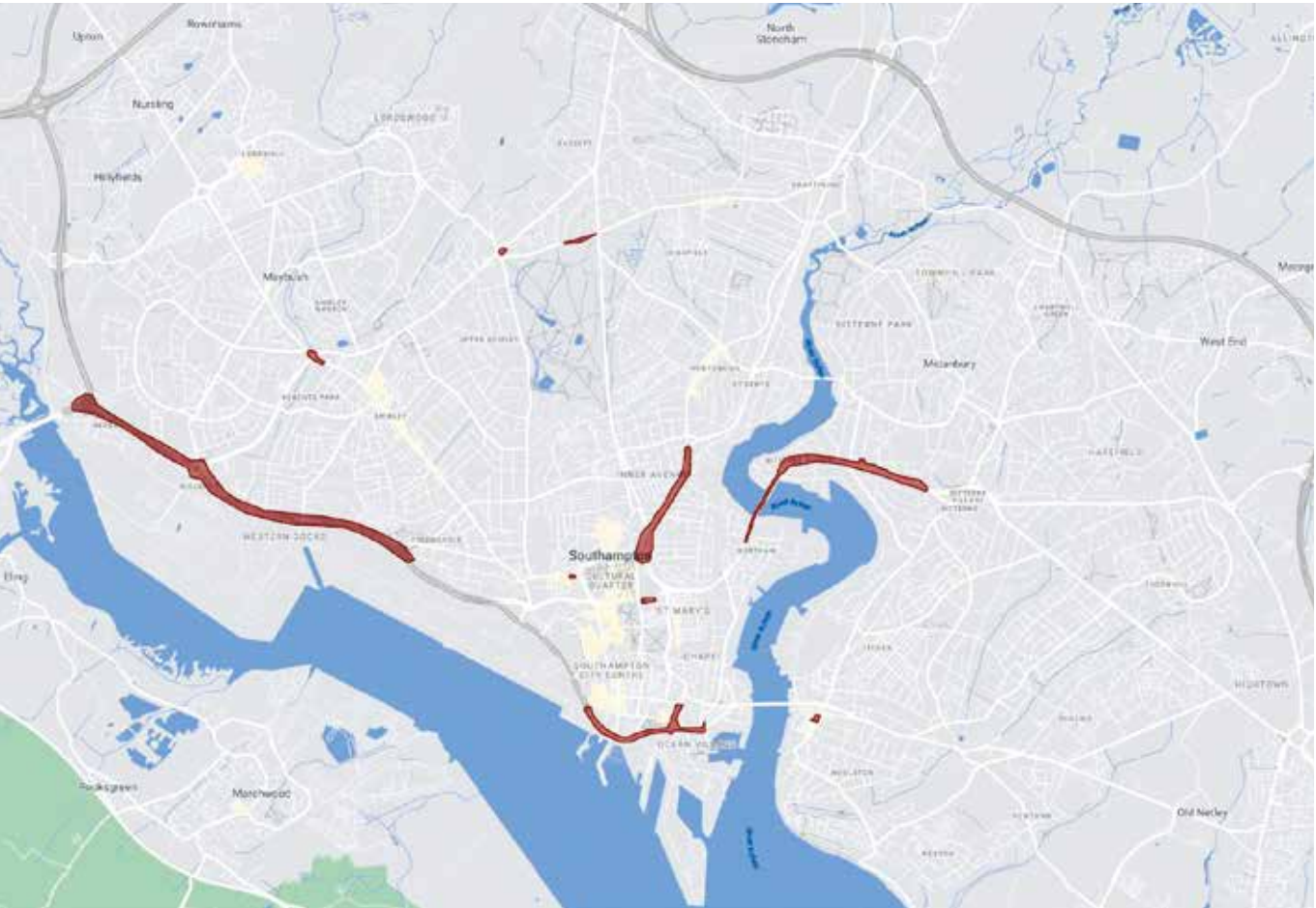
Use the student workbook and the questions to analyse and understand what the data shows about how the school is traveling currently and what this could mean for the air quality at and around the school. Answer the first 2 questions.

Overall Air Quality analysis of the school

Bring the whole group back together for the last exercise. This will look at the overall picture of air quality at the school.

Activity: Get a pupil from each group (travel count and air quality monitoring) to explain to the rest of the group what the overall decision was on the results and the air quality at the school.

Discussion: Find where the school is on a map and see how it compares to other parts of Southampton. Southampton City Council have declared specific areas where air pollution is particularly bad and where everything should be done to improve the air. Here is a website which shows the zones.



(2.Google Maps – AQMA's in Southampton)

Use the map to work out;

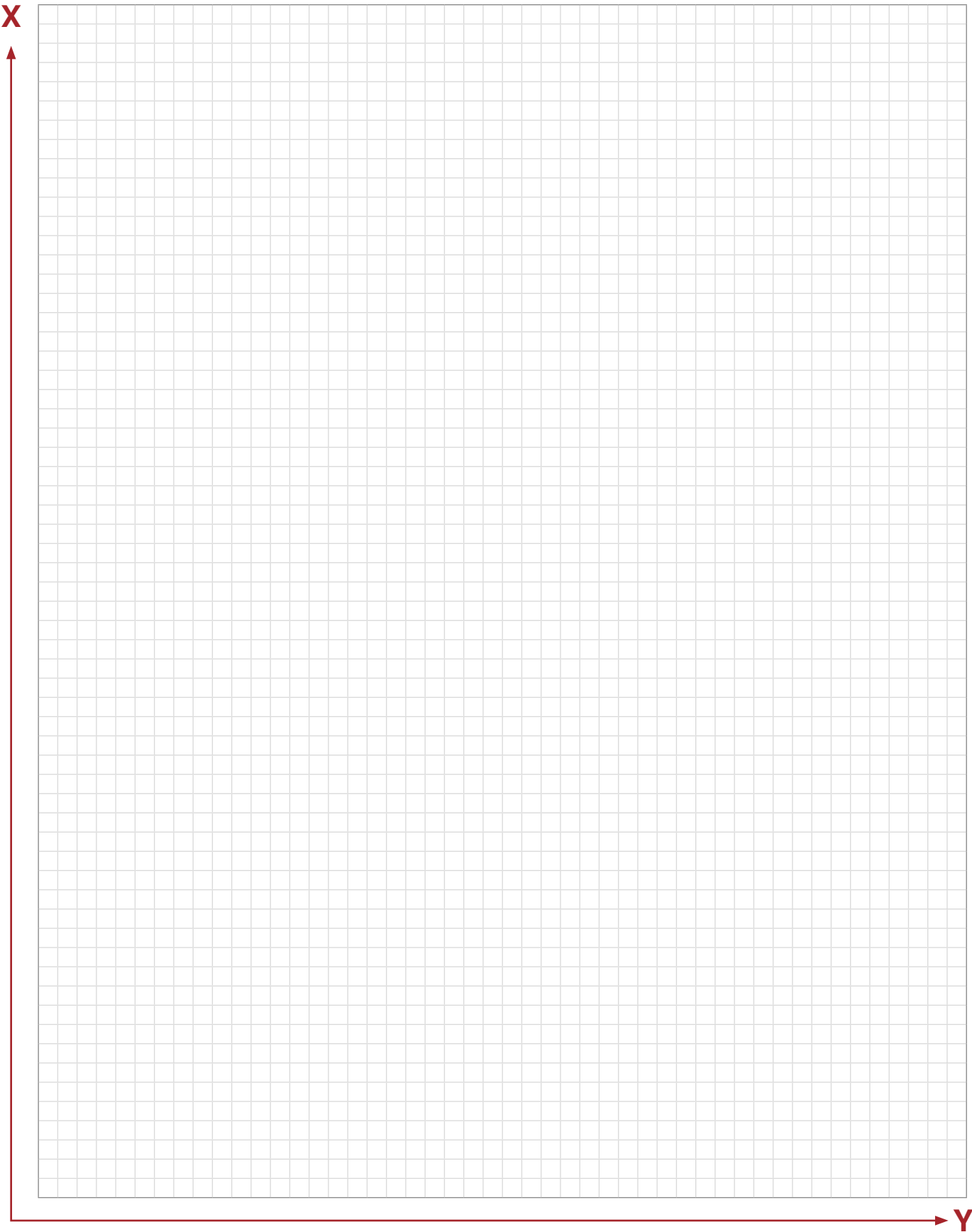
- How far you are from your nearest Air Quality Management Area?
- Are you somewhere where the air is better or worse?
- Were you surprised how close you are?
- Why do you think it is there?
- Is there a junction where traffic always queues or a busy road?

Activity: Ask the students to write down or draw and label how they feel the air may be affected by its location. Explain to the group the next session will be about improving the air quality at school.

Student workbook

Air quality analysis

Draw your graph here:



Student workbook

Travel count

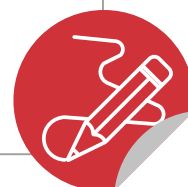
What does the travel count data show about how the school travels?

How will the travel count data impact the schools air quality?

Draw a map of the schools location and label how it impacts the air quality?



What does the Air Quality monitoring results say about the air at the school?



Classroom activity

Pupil led engagement campaign

- <https://www.gov.uk/government/publications/health-matters-air-pollution/health-matters-air-pollution>
– use this website for a lot of information for both the effects of air pollution, vulnerability and how to improve air quality.
- <https://www.gov.uk/government/case-studies/primary-school-celebrates-clean-air-day-with-street-party>
– an example of a clean air campaign by a primary school.
- https://www.actionforcleanair.org.uk/files/arup_schools_aq_intervention_toolkit_final_march_2022.pdf
– Interventions toolkit
- <https://www.surrey.ac.uk/sites/default/files/2021-01/mitigating-childrens-exposure-to-traffic-pollution-english-version.pdf> (surrey.ac.uk) – interventions toolkit
- <https://www.youtube.com/watch?v=y6XZWRhrUNY> – Clean Air for schools video

Go through with the students what they remember from the last session. Either on a whiteboard or flip pad of paper get them to say out the top things they learnt from analysing the air quality at their school; What are the current AQ issues at school, what is the main issue and what causes the air pollution at the school.

Who does air pollution affect the most? Who is most vulnerable? Why? Show students the public health image of who in society is most vulnerable.

Groups that are more affected by air pollution include:

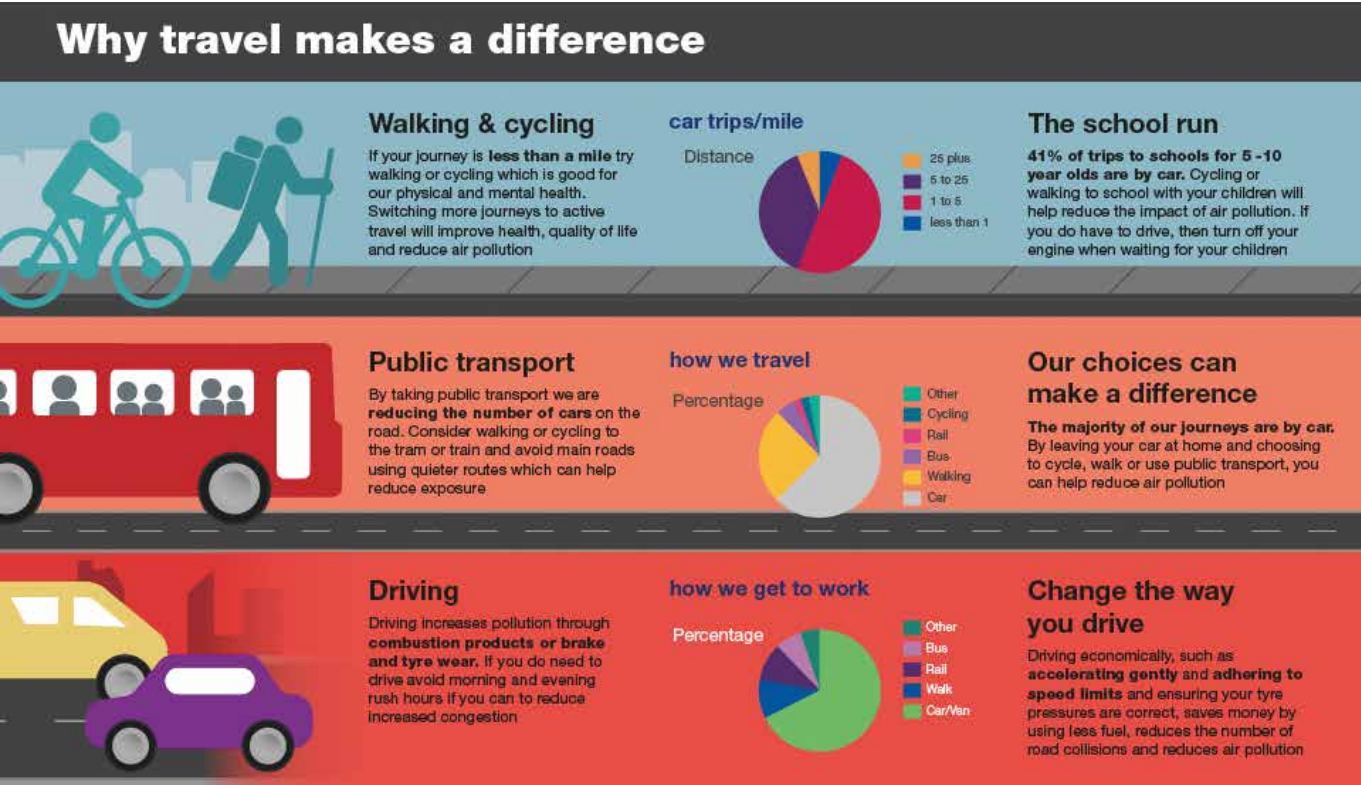
Older people	Children	Individuals with existing CVD or respiratory disease
Pregnant women	Low-income communities	Communities in areas of higher pollution, e.g. close to busy roads

How to improve air quality at school

Improving air quality

In lesson two all students should have learnt about how to improve air quality. Recap ideas of actions we can all take to improve air quality at home and school.

One idea is to tell other people how important air pollution is and that is what the pupils will be doing. Using public transport makes a difference, as it reduces the number of cars on the road. Walking or cycling to school whilst avoiding polluted routes, such as main roads, can help to improve health and reduce exposure.



(3.What makes a difference to air pollution image – Gov.uk)

Activity: Get the students to write down all of the actions to reduce air pollution and have them group them in the four boxes as below. The next stage would be to get the students to circle the ones the pupils and

Reduce traffic:

- Car sharing
- No-idling Zone
- School street

Influence traffic reduction:

- Cycle and scooter facilities
- EV charge points
- Cycle training
- Park and stride options
- Encourage active

Reduce children's exposure:

- Green infrastructure
- Indoor greening
- Clean Air routes
- Keep distance from cars
- Play areas further from the road

Physical information:

- Pollution information
- Lesson material
- Air quality monitoring
- Assembly
- Modeshift accreditation

Air quality campaign

Activity: This task will be to create an action plan together as a group. Discuss what is campaigning? Who is the audience, what is the message? Get the students to work in small groups and choose a different topic out of; engine idling / active travel / air pollution.

- What would you like to be changed
- How will you go about changing it
- What materials will need to be created
- Will there be any incentives
- How will you involve the whole school
- What can the school staff / leaders do to help

Come back together as a group and create one detailed action plan for the school.

This action plan should be used throughout more sessions as a focus group to direct and continue the campaigning over the spring and summer term.

Improvements to the school grounds

The final task will be to come up with suggestions for the senior leadership team at school to use for what the students would like to see changed at school to improve air quality. Examples include; Green walls, plant trees, cycle or scooter storage, school street etc. This can be fed back to the SLT to influence their decisions when applying for the schools air quality grant.

Activity: Get the students to use the workbook below and fill in the question with what they would like to see changed at the school to make air quality better. This should be things the students would like but need the school staff team to action (e.g. Changes to roads, greening the school).

Student workbook

Pupil led campaign

Order actions for reducing air pollution into the 4 boxes

Reduces traffic around school:

Helps traffic reduction near school:

Reduce children’s exposure:

Physical information:

What are the ways the school or council should help improve air quality around your school:

Air Quality Action Plan: _____

Topic: _____

Action to improve air quality	Priority (1 top, 5 least)	Audience	How will you achieve this?

Clean Air routes to school mapping

Cross-curricular project covering geography, art and science.
Website links:
• <https://www.cleanerairsooner.org/mapping> – an example of clean air route mapping done elsewhere.

Information prior to session:

Prior to session: Provide the sustainable Schools Officer with a rough idea of how far the students travel from and a rough catchment area. This will be the extent of the map selected.

Recap: Reducing children’s exposure to air pollution is key in improving children’s health and wellbeing.

Why choose a clean air route? It is a really simple way to reduce the amount of pollution children breathe in every day. Choosing quieter, low pollution routes to get to school, rather than busy roads with lots of pollution. Walking just one road back from a busy road can reduce your exposure by as much as 50%.

Clean Air route mapping instructions:

Materials needed
Colouring in pens or pencils (Specifically green, amber and red); blank paper; map.

Instructions
This activity will be led by the Air Quality officer at SCC. There are 2 sections, air quality monitoring on the nearby streets and then the classroom session detailed below;

- 1. Handout blank map of the school site and surrounding area.
- 2. Ask students how could we colour it to show our results? What colours could we use?
- 3. Ask students to look at the route they take to school, could they take a cleaner route?
- 4. As the students to colour the roads and routes in the colours they believe represent the air quality and safety of the route

GREEN = Good air quality and safety – Footpaths, small residential roads, parks and green spaces
RED = Bad air quality and unsafe – Large main route roads, A roads, dual carriageways or roads that are AQMAs.

- 5. Ask the students to then draw pictures representing the clean air routes and other pictures representing the dirty air routes on blank paper. These will be added onto the finished map to make it personal to the school.
- 6. The real map will now be presented to the class on a screen. This will have been created prior to this session using live air quality data and recordings. Use the Clean Air City mapping website to show a clean air route to school.
- 7. Did the students get the roads mostly right? What did they learn from this exercise.

Conclusion
The map will be sent to the school in PDF format with the students drawings attached. The map will also explain that if “red” roads cannot be avoided walking away from the curb is essential. This map should be shared via school newsletters, can be printed and given out to parents and pupils and used on the school website.

Word search

Circle the words you can find from the list below.

p d n k k r a l s y t l q l t p w b d n c j f j p
z a u o e l h l r z k k x m b p f y c i w v u a p
f g r s i d l i n g l r g v b s d e f y g w m h a
c d e t t s v a d g e w r q t y h f c n c m e l p
n h a r i t u i c v o i u h y k a b v f s l s j c
f g e r v c o f h l m u i b g r l u n g s s i r t
f l e r v x u b f s r e w j t h k l p o u b s n n
r s w e i x y l m i p y z b d r e n b e w n k j g
b g h d y u i d a f d s e v g h y a t x o b n f j
f r e e v s g j t t i o p x v k s l l i i r u a o
b r e f t h d s a e e y u b n j i m s t d n t l p
g h o t y g v s r v b s m n u t y s o l h i u i q
w a j k i n g e g h d e t y b c i l m k n a b q i
t r f d i n h g p l f v z e w m q m v e e v e y j
d e a w c p d c f s h g b b e e y k l o p g t r e
e c x p s h j k r t y u b f s d a s c c e r v s t
l k h o p g h y a q w m n x z g l i z n b u i o j
l a m f r e w d g v h j u y n v x k n o i l f a q
l t p v q g a s f t e w v h g o j e h r u n y t b
a v g y d o p s d e f t m n t l g o i y t x z s a
b g h d y u i d a f d s e v g o y a t x o v n f j
p d n k k r a l s y t l q l r p w b d n c j f j p
n h a r i t u i c v o i u t y k a b v f s l s j c
r s w e i x y l m i p y i b d r e n b e w n k j g
d w a l k i n g g t h n e w v p s y b n g d f y i

Words to find:	Atmosphere	Fumes	Nitrogen	Smoke
	Cycling	Gas	Particulates	Toxic
	Diffusion	Health	Pollution	Traffic
	Dioxide	Idling	Run	Tube
	Dust	Lungs	School	Walking
Emissions				

References

1. CAQI – Common Air Quality Index – Airly – <https://airly.org/en/air-quality-index-caqi-and-aqi-methods-of-calculation/> - Page 35
2. Google My Maps – AQMA's in Southampton - <https://www.southampton.gov.uk/our-green-city/council-commitments/clean-air/air-quality-management-areas/> - Page 39
3. What makes a difference to air pollution image – Gov.uk
<https://www.gov.uk/government/publications/health-matters-air-pollution/health-matters-air-pollution>
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All links

- <https://myjourneysouthampton.com/education/air-quality-for-schools/southampton-schools-clean-air-project/> – Clean Air schools project page
- <https://myjourneysouthampton.com/education/> – My Journey Southampton
- <https://www.eco-schools.org.uk/> – Eco Schools
- <https://www.gov.uk/government/publications/health-matters-air-pollution/health-matters-air-pollution>
- <https://www.youtube.com/watch?v=y6XZWRhrUNY> – Video on air pollution
- <https://www.youtube.com/watch?v=sAKyhfxr7s> – Video on air pollution
- <https://www.youtube.com/watch?v=e1SfXGQGRFs> – Video on air pollution
- <https://airly.org/map/en/> – Airly map
- <https://www.gov.uk/government/publications/health-matters-air-pollution/health-matters-air-pollution>
– use this website for a lot of information for both the effects of air pollution, vulnerability and how to improve air quality.
- <https://www.gov.uk/government/case-studies/primary-school-celebrates-clean-air-day-with-street-party>
– an example of a clean air campaign by a primary school.
- https://www.actionforcleanair.org.uk/files/arup_schools_aq_intervention_toolkit_final_march_2022.pdf – Interventions toolkit
- <https://www.surrey.ac.uk/sites/default/files/2021-01/mitigating-childrens-exposure-to-traffic-pollution-english-version.pdf> (surrey.ac.uk) – interventions toolkit
- <https://www.youtube.com/watch?v=y6XZWRhrUNY> – Clean Air for schools video
- <https://www.youtube.com/watch?v=kn9NWzKZoro> – Clean Air campaigning video for teacher use
- <https://www.cleanerairsooner.org/mapping>

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