# How clean is the air near me?

# Lesson 1 - Volunteer guidance (KS4)

## Key Stages

* Key Stage 4 comprises Years 10 and 11, with students aged between 14 and 16

### Introductions

1. Introduce yourself and your team to the group. You can talk briefly about the university and what you all do there. You could choose to display the PowerPoint slide of the campus. Begin by asking the students what they know about universities. This would also be a useful way to break the ice. Based upon their responses, you could discuss the following:

* People normally go to university when they are 18, after they have completed their A-levels.
* At secondary school you study biology, chemistry and physics. You can study these at university too, but there are a huge number of other STEM-related courses on offer (give some examples – such as the ones which you do. This could also be a way of introducing the people on the team).
* You can then introduce the other members of the team so that they can tell the students about the particular areas which they are involved with.

1. If the survey of students’ attitudes towards science is being conducted, this can either be done now or during a later stage of the lesson.

### Pollution and particles

### Introduce the project by saying that we are going to investigate how clean the air

### around us is. You should use the PowerPoint to assist you here.

At this point, volunteers can begin to get equipment ready (there may also be a school technician who can help).

* Clipboards (2 per group of 2/3 pupils)
* Graph paper (1 sheet for each clipboard)
* Garden twine – each clipboard should have a length of about 25 cm attached

2. Continue by asking the pupils about pollution – what is it and where does it come

from? Tell them that we are going to be trapping pollution **particles** and ask them

what this word means (they will certainly have encountered it during their KS3

studies).

The PowerPoint features some examples of particles which can be found in the air. There are some additional guidance notes with the slides.

3. You could ask pupils to look at their rulers, as the next slide shows the comparative approximate sizes of a strand of hair, a pollen grain and particles of soot. The width of the hair is given as 0.1 mm (this is an average, as some people have thicker or thinner hair). Students should be able to tell you that microscopes can be used to investigate objects of this size.

### Particles and Breathing

### Tell the students that we are going to start by learning about breathing. This will

### help us understand why particles can cause health problems. They will have studied the lungs and gas exchange during KS3 and may also be aware of the role of the alveoli. These topics are also studied in greater detail at KS4, though year 10 students may not yet have covered them.

You can ascertain background knowledge via some questions:

* Which parts of the body do we use when we breathe?
* What happens in our lungs when we breathe?
* What names are given to the different parts of the lungs?

A close-up of a medical device

Description automatically generated

Some models are available to assist with your discussion. You may not have time to use all three, so consider using (a) and one of (b) or (c).

1. Diaphragm and lungs model (one available)

This consists of two small balloons, representing the lungs, and a rubber sheet, representing the diaphragm. When the sheet is pulled down then pushed up, the lungs inflate and deflate, simulating the action of the diaphragm.

A model of a human body

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1. Torso models (3 available)

Volunteers could use these with smaller groups of students. KS4 students should be familiar with the location of the various organs, but this would still be useful for lower ability classes.

1. A model of human lungs

   Description automatically generatedLungs and trachea models (3 available)

Probably more suitable for KS4 students, this shows the circulatory system, bronchi and bronchioles a little more clearly than model (b).

Describe what happens to large and small particles when you breathe in (see notes section on slide). You could perhaps discuss large particles, then ask the pupils to think what might happen to particles are too small to be trapped by mucus. These may pass through the alveoli into the bloodstream and cause health issues. The particles produced when diesel burns, for example, can damage blood vessels and increase the chances of blood clots forming in arteries, leading to a heart attack or stroke.

### Introducing the experiment

Tell the pupils that we are going to set some traps for particles, so that we can see which areas of the school have the most pollution. You can ask them (in large or small groups) to think about where most pollution might be found. Depending on class size, each student can make their own trap, or there could be two traps per group.

### Variables and controls

Students should be familiar with the concept of variables, though may not be so secure about the meaning of independent, dependent and control variables.

Ask the pupils to think about:

* Independent variable - what we are going to change (location of trap)
* Dependent variable - what we are going to measure (how many particles are ‘trapped’)
* Control variables – what we are going to keep the same (size of grid, size of squares)

This would be ideal for discussion in small groups with your help and prompting. Having the apparatus there in front of them is helpful.

Mention that you need to think about exactly the same things when you are planning and carrying out experiments at university! It’s a vital part of ‘working scientifically’.

### Predictions

Pupils can be asked to predict which areas in and around the school might have the most / least pollution.

**Aim and method**

Discuss what these words mean. Pupils can begin to write about them on their worksheets.

**Carrying out the experiment**

1. Show / discuss the experimental set up, with a labelled piece of graph paper attached to a clipboard. There will be examples of these provided, so that you can show the pupils.
2. Pupils should fold a piece of graph paper in half (landscape orientation), then draw a grid on it.

If they start the grid about 4 cm squares from the left-hand side, and about 7 from the top, it should be fairly central.

Ask them how we can use this to trap particles – you could mention fly paper here!

The students should label their trap to indicate where it will be placed. Their class teacher(s) should be able to name some potential locations.

1. Supervise the pupils as they apply a thin layer of petroleum jelly to their grid area. There’s no need to cover the entire piece of graph paper! This is best done by asking the pupils to bring their grids to a particular area of the room where a few pots of petroleum jelly and the spreaders will be located – you don’t want them wandering round with spreaders covered in Vaseline! Make sure that there’s plenty of room for the students; placing the pots and spreaders along the back bench of a lab is ideal.

Pupils can continue to write about their aim and method while they are waiting.

**Finishing off**

1. Congratulate the pupils on their attitude and tell them how much you’ve enjoyed working with them (hopefully you have!)
2. Give a brief description of what you will be doing next time – looking at the different particle traps and using magnifying glasses and microscopes to count how many particles were trapped in different places around the school.
3. It’s unlikely that there will be enough time to help students place the traps around the school; indeed, their teachers may prefer to do this themselves!

If the follow-up visit is more than a week or so after the initial one, the traps will need to be stored securely in the plastic boxes provided.