# How clean is the air near me?

# Lesson 2 - Volunteer guidance (KS4)

## Key Stages

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

### Introduction

1. Greet the students and tell them how well they worked last time. Give a brief reminder of what they did last time and an overview of what they’ll be doing today.

**Microscopes**

1. Slide 3 can be used to remind them of the sizes of some of the particles and prompt a discussion about how we can see them if they are so small.

Pupils are likely to suggest magnifying glasses and microscopes – probably the latter, as they will have used these at KS3 and possibly also at KS4. At this point you can hand round some of the pocket magnifiers for them to look at their worksheets through, before showing the slides about the invention and history of microscopes. There are a number of questions which students can be asked. Answers and further information can be found in the ‘notes’ section of each slide.

Slide 10 features an electron microscope image taken by Suzie Hughes, one of our Chemistry PhD students. KS4 students need to learn some of the prefixes used to express large and small quantities, so may be familiar with ‘µm’, featured in the scale on the bottom right of the picture. It’s worth asking them to look at 1 mm on their rulers, then imagine dividing that by 1000, before thinking about how small the particles in the photograph are.

Note that the magnification (50 000 x) is given on the bottom left, and several other prefixes are used. KS4 students will not yet be aware of ‘pico’ (1 ×10-12).

1. Hand out the boxes of hand-held microscopes (one per child if possible). Remind the students that these are not toys and are quite expensive\*, so need to be used and handled carefully. Ask the class to open the box and have a look at what’s inside…ask them to check that they have all the parts shown on the next PowerPoint slide.

Talk about the green and black microscope slide first and explain how we use these to inspect objects under a microscope. Remind the pupils not to touch the clear circles as this will smudge them. The slide has different parts from a grasshopper – PowerPoint slide 12 has an image of one and shows the location of the various parts. You may want to discuss how insects have a head, thorax and abdomen; students should know that insects are an example of invertebrates but may not have studied their anatomy.

Slides 13 and 14 show how to use the microscopes, but the steps are also shown below. Once the microscope has been removed from its box:

* Lower it into its base
* Press the blue button to switch it on – they should see a light come on. Explain that this will make it easier to see what they are looking at.
* Ask them to look at the pre-prepared grasshopper slides – an image of a grasshopper will appear on the PowerPoint slide. The microscope will allow us to see these much more clearly. They should then slot the slide into the base so that one of the parts is above the white circle on the base.
* They can practise adjusting the magnification. These microscopes have a range of x20 to x40. Note that the earliest microscopes had a similar magnification!
* After the pupils have practised with the grasshopper slides provided, they can remove the base to inspect some of their writing! Ask them to place the base and slide into the box for safekeeping, as they won’t need these when analysing their particle traps.

The pocket magnifiers can be collected in whilst the students are using their microscopes.

\*Someone will almost inevitably ask *how* expensive they are! They’re about £6 each.

### Results

1. At this point the pupils can collect their particle traps – remind them to take care not to touch the petroleum jelly, as they might inadvertently add or remove some particles!

They can then begin to inspect each square and record the number of particles on their worksheets. Slide 15 can be used to help explain this. The ‘x20’ magnification will probably be the easiest to use. If a group of students is sharing a particle trap, they can check each other’s results for each square before recording them.

Students may also spot some droplets of moisture on their traps, particularly if they have been placed outside.

It’s unlikely that there will be time for them to count the number of particles in every square, but as they will be calculating a mean value anyway, this isn’t too problematic.

1. If the follow-up survey about students’ attitudes to science is being conducted, this could take place whilst they are collating their results.

**Conclusions**

1. Students should calculate a value for the mean number of particles per square. They can compare this to the results of other groups before a general feedback session where the areas of school with the largest and smallest number of particles can be identified. It’s probably easiest just to ask the class as a whole about their results – e.g. “Did anyone have a mean value lower than 5?” etc.
2. Volunteers should provide students with paper towels (schools should have these in their labs) so that students can clean the residual petroleum jelly from the lower sections of their microscopes. These can then be slotted back into their bases. Please check each box to ensure that the microscope, base and slide are all there before collecting them in.

If there is some time left, there are a couple of additional activities which can be used. It’s unlikely you’ll have time for all four. The animation in (c) would be my top choice, but the activity in (a) is very short and could easily be included. Activity (d) provides a nice link to how air quality is monitored in ‘the real world’.

1. One of the first things you’ll see on the page is a section entitled ‘Magnifying a grain of salt’, which shows how large it would appear if magnified by various amounts.

For your information, the Eiffel Tower is 330 m high (Old Joe is roughly 100 m high) and Mt Everest is 8850 m high. You could possibly find the school on Google Maps and use the scale at the bottom right to indicate this approximate distance from it.

1. There is a hyperlink on the PowerPoint (slide 8) to the University of Oxford’s Natural History Museum webpage on electron microscopes. This features a quiz where students are asked to link a series of microscope images to their descriptions. Answers appear after 15 seconds; it’s probably easiest to name each option in turn and ask students for a show of hands. Note that:
2. ‘Tongue’ is spelt incorrectly in question 1!
3. In question 2, a spider’s spinneret is the organ which produces silk.
4. In question 3, a trilobite is a type of extinct marine arthropod. Most were just a few cm long and first appeared over 500 million years ago. They existed for over 250 million years. Fossils of thousands of different species have been discovered.
5. Slide 11 has a hyperlink to an interactive animation showing the scale of different objects. Once you have selected ‘English (British)’ and clicked ‘Start’, drag the slider to the left to observe smaller and smaller objects. The circles which appear indicate the sizes of the objects; these can be related to the earlier discussion of mm, µm etc. Clicking on any object provides information about it.

You could literally spend half the lesson showing this fascinating resource, so it’s definitely worth setting aside some time at the end of the lesson for it.

d) ‘Airly’ is a company which provides real-time air quality monitoring data. A huge number of organisations across the world utilise it, including a large number of schools. The relevant hyperlink on the final PowerPoint slide takes you to a map of the Birmingham region. Each dot represents a school or business. Data is provided on the left of the screen for Woodthorpe Junior and Infant School, but you can select any dot in the UK or worldwide.

Information is provided about the percentages and concentrations in µg / cm3 of 3 particulate types and 2 gases and includes recommended WHO values. There are some areas of very high pollution (red or purple dots) in Europe and Asia.

**Finishing off**

Volunteers should ensure that all the microscope boxes are collected in. The graph paper particle traps can be disposed of (either by the students or by volunteers whilst the quiz / animation is being shown. The lengths of garden twine can be left attached to the clipboards for future use.

Finally, thank the students for their hard work and co-operation!