What's in the Air? An Air-Quality Monitoring Lab

Created and delivered by **Ursula R. Sherrill**, Biology M.S. candidate
Prepared for Henderson Middle School, Sixth Grade Science, El Paso, Texas, May 2007

Note: During each 73-minute class period, the material for two lessons is taught.

TEKS Objectives

(6.2) Scientific processes. The student uses scientific inquiry methods during field and laboratory investigations. The student is expected to:

(A) plan and implement investigative procedures including asking questions, formulating testable hypotheses, and selecting and using equipment and technology;
(B) collect data by observing and measuring;
(C) analyze and interpret information to construct reasonable explanations from direct and indirect evidence;
(D) communicate valid conclusions; and
(E) construct graphs, tables, maps, and charts using tools including computers to organize, examine, and evaluate data.

References

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The Texas Science Center for Professional Development in Curriculum and Assessment. 1997, revised 10/3/01. *Texas Essential Knowledge & Skills, Science Grades 6-8*. Houston, Texas: The Texas Education Agency at the Region IV Education Service Center.

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Lesson Vocabulary

Particulate matter (PM), air quality, nasal passages, lungs, pollen, asthma, dust storm, wind-break, and ventilation

Materials Required

PowerPoint presentation (PPt) of 10 slides to introduce air quality topics such as effects of particulate matter on humans and other organisms in regional area, slides showing models of nasal passages and lungs, air quality chart from EPA website of ^PM and $_{v}$PM cities, a copy of the US Environmental Protection Agency's El Paso air quality data, air quality index **data sheets (DS)** and graph paper, **lab work sheets (L1)**, **pretest and post-test (A1, A2)** of matching vocabulary words, microscopes, plant leaves, flower pollen, soil/dust particles, triple-beam balance, empty can of hair spray, two home air filters: a used home filter completely sealed in plastic bag and a new filter still in package, one unused auto air filter, Petri dishes, Information on requirements for full credit.

Days 1 & 2

Primary question - What is air-borne particulate matter and how does it affect El Paso and borderland residents?

Inquiry-based Engagement

After a pre-test, students begin the lab by examining under the microscope plant leaves that, unknown to them, have been dusted with a mixture of soil particles and pollen. Students work in partnerships to draw what they see at 4x, 10x, and 40x magnification. They discuss the nature of the objects and why they may be important. Complete lab worksheet.

Exploration

When students identify "dust," or "dirt" under the microscope, I introduce the concept of particulate matter (PM) and elicit questions, such as whether all particles are identical in color, shape and size. How much airborne PM do students think is found in the El Paso area? Is the mass of PM different by location and at different times in El Paso, such as in late fall when the heat is turned on at school and at home? Why? Where does PM fall on humans? After this inquiry, I begin a brief power point presentation of enlarged common airborne particles and show a model of nasal passages and lungs where PM can lodge. PM-2.5 is composed of soot, dust and smoke from industrial and residential combustion and vehicle exhaust, and PM-10 is inhalable particles from building materials, pollen, mold spores, smelter and refinery by-products. I distribute EPA air quality index data tables for El Paso and graph paper, and I ask students to study the data sheets and construct a graph with two bars side-by-side for each month. One bar is the amount of PM 10 um and the second is the PM 2.5 um amount. Students consider what part of a meter is a micron (a micron is one millionth of a meter), and label axes and include an explanatory legend. In addition there are a series of three questions to be answered: (1) In which month(s) was recorded the most airborne PM-10 um? Which months saw the most PM-2.5 um? (2) Why do you think this pattern has arisen? (3) Can you think of a way to prevent or lessen dust storms in El Paso?

Explanation

Student groups are asked to briefly report on their graphs, data analysis and written responses to questions 1-3.

Elaboration, Extension

Students groups discuss the implications of their results and compare and critique various strategies to prevent dust storms. Another possible extension is for students to discuss and / or role-play how city officials and industry managers brainstorm ways to lower PM emissions.

Evaluation

Students are informed that their graphs and completed lab work-sheets will be evaluated to determine whether they have grasped the concepts of this lesson. A series of matching words is also given at the start of these lessons and will be re-administered at the end of Lesson 5 to assess gains in student learning.

Days 3 & 4

Primary question - What is the air quality in our science classroom at Henderson Middle School?

Engagement

Ask students to think about how particulate matter affects them. Show empty hair spray can. Ask students what is their reaction to spraying hair spray nearby. Walk around showing students a new and a used home filter and a car filter. Ask students to read what the home filters screen out of the air: pollen, pet dander, mold spores, household dust, and smog particles. Introduce the question of how much PM we would find in our science classroom.

Exploration

Introduce the scientific investigation we will undertake: answering the question of where the most PM is in the classroom. I pass out lab work sheets and ask students to make a prediction, create a hypothesis, and design an experiment to test their hypotheses. Ms. Wilson and I sing a song about the scientific process, and encourage others to join in. Students will write group number and period on slides, grease slides, weigh the slides, and place them on trays to be stationed for a week at one of five places: top of the TV, bookcase by the window, bookcase with clock, window sill, and storage closet. Clean-up and put away equipment. Turn in worksheets.

Elaboration, Extension

Students discuss the reasons why they believe the PM will be distributed to a particular place in the room.

Evaluation

Students are informed that their grade will be based on the completed lab sheets.

Day 5

Primary question - What are the results of our experiment to determine where the most PM is found in the science classroom?

Engagement

Students discuss the factors they believe influence PM build-up in the classroom.

Exploration

Greased and dusty slides are returned to student groups who will weigh each slide and complete their data table showing the locations, original weights and final weights. If there is time, students will calculate the percentage of slide mass increase. Data for each period will be compiled and shared at the next class meeting.

Explanation, Extension

Students discuss their findings by group and the dynamics behind the results as well as their conclusions about PM levels in the classroom. Students consider the implications of finding high dust levels, and consider a follow-up experiment during the coming school year. Although we did not obtain permission to study 2007 outside levels of PM at Henderson, such a study in 2008 would be feasible and of interest to the students.

Evaluation

Students are informed that their grade will be based on the completed lab sheets. Students take their post-test.

Peer Review

These lessons were reviewed by April Wilson and recommended modifications were adopted. The lessons were discussed with my Aquatic Ecology Lab associates and my advisor, Dr. Vanessa Lougheed. Ms. Jeannine Kennedy, GK-12 program manager, reviewed this design and made a number of helpful suggestions to improve its quality.