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P.O.V.'S BORDERS | FOR EDUCATORS | LESSON PLAN 2: AIR

INTRODUCTION

Human activity and industrialization are rapidly altering the quality of our air, both indoors and out, and both locally and globally. The goal of this activity is for students to recognize which activities contribute to poor air quality and which contribute to good air quality. The idea behind this study is that an informed/educated student is more likely to choose activities that contribute positively to the air that we breathe over those which contribute negatively, and is more likely to talk to others about sustainable solutions.

In terms of local vs. global air quality, it should be recognized that because of global weather patterns, most air pollution is globalized, thus it does not stay in the locality where it was produced. For example, air pollution generated in the United States near the Great Lakes region travels with the jet-stream to New England, across the Atlantic Ocean to Europe, across the continent to the Middle East and Eastern Europe, and so on. Thus, air pollution is almost always a global problem.

Indoor air pollution, however, is quickly becoming an even bigger environmental problem, especially in many urban areas where housing units are densely arranged and circulation of fresh (outside) air is limited.

Indoor air quality is often measured in terms of carbon dioxide (CO₂), carbon monoxide (CO), dust, molds and ultrafine particles. Outdoor air quality is often measured in terms of sulfur dioxide (SO₂), nitrogen oxides (NO_x), carbon monoxide (CO), ozone (O₃), methane (CH₄), volatile organic compounds (VOC's), and ultrafine particles.

GRADE LEVEL

These lesson plans are written for high school level students, but can be adapted to other grade levels. (See the Extension Ideas section, below).

SUBJECT AREAS

- Science
- Social Studies
- Health

OBJECTIVES

At the end of this lesson, students will be able to:

- Identify how air quality is measured,

- Identify various human activities that negatively effect air quality,
- Identify and discuss human activities that positively effect air quality.

ESTIMATED TIME NEEDED

- Allowance for student representatives to take photos between home and school. The number of days/total time is dependent upon the number of digital cameras in use and the number of student photographers.
- In-Class Time = 2-3 class periods.

MATERIALS

- Digital Camera(s)
- Computer with printer and Internet access
- Map of the local area (to include all the communities that students come from) as appropriate
- Research resources (books, articles, online access...)

PROCEDURE

Teacher Preparation:

1. Identify student photographers to take ten photos of human activities that impact air quality. (More photos may be chosen if time/classroom conditions permit.) About half of the photos should be of activities that negatively impact air quality (i.e. cars, polluting factories, industrial agriculture, etc.), and the other half of activities that positively impact air quality (i.e. bicycle, trees, etc.).

* Depending on each specific class structure, situation and teacher's relationship with the class, teachers may want to pre-select student photographers before introducing the activity to students. Conversely, some teachers may want to ask for student volunteers. Additionally, if the class situation/logistics prohibit the facilitation of students taking their own photographs, the teacher may want to consult with students on what they would photograph if given the chance, then the teacher may take the photos him/herself for the class. However, it should be noted that the ideal situation would allow the students to take their own photos, thus taking ownership over this study and its outcomes. Another option would be for the teacher to predetermine and take his/her own photographs (being sure to include a diverse set of images) and bring them in to class for students.

Day One:

2. Introduce the lesson to students, explaining that the goals of this project/activity are to understand what measurements are used to determine the quality of air that we breathe, to identify how different human activities contribute either positively or

negatively to local and global air quality, and identify how to maximize the positive impacts and minimize the negative ones.

3. The teacher will want to explore with the class how air quality is measured, leading to a discussion of which substances are considered air pollutants (carbon dioxide, carbon monoxide, methane, ozone, sulfur dioxide, nitrogen oxides, volatile organic compounds and fine particulate matter).
4. Ask students to research the source of the above listed air pollutants (in small groups or individually as research materials and time permit).
5. For each of the air pollutants listed above, identify a human activity that occurs in the local community/environment that contributes this substance to the air.
6. Set a schedule to document these activities with a digital camera, utilizing different student photographers whenever possible based on where each human activity takes place in the community, geographically speaking.
7. Carry out the schedule for taking the photographs with the class. Once all photos have been taken, the teacher should upload them to the computer and print them out for class discussion.

Day Two:

8. With all the photos printed out, the teacher should facilitate small group work as follows:
 - Divide the class into the same small groups as before with one photo for each group of students.
 - Ask each group to prepare a presentation for the class with the following information about their photograph:
 - a. Name the human activity depicted in the photograph and which air pollutant it contributes to the air.
 - b. Identify where in the community the photograph was taken, being as specific as possible.
 - c. Do students in the group partake in the depicted activity either directly or indirectly? For example, if the photograph is of a dairy farm, does each of the students drink the milk from that farm? If the photograph is of a local factory, do the students work there/know somebody who works there/purchase the products that are produced there, etc.?
 - d. Identify what can be done to minimize emissions of that particular air pollutant to the atmosphere. What practical changes in lifestyle or personal habits can students themselves take that would minimize the impact of the activity in the photograph (i.e. what are some sustainable alternatives to that activity)? What are the barriers to

implementing those alternatives and how can the barriers be overcome?

ASSESSMENT SUGGESTIONS

- Create a grading rubric for in-class presentations by each student team. Some criteria might include "knowledge of subject" (air quality), "team work," "use of visual aids" (photos), etc.
- Have students prepare a photo exhibition for other classes/the school of human activities that contribute to air pollution and ways to minimize the environmental impact of each one (i.e. sustainable alternatives).

EXTENSION IDEAS

- If the local community is one in which personal vehicles are the primary mode of transportation of most people, teachers may want to ask students to calculate how much carbon monoxide is emitted per week/month/year during their personal travels. Have students estimate how this number would change if they took public transportation. How would it change if they rode a bicycle whenever possible — be specific with calculations of emissions and mileage that can be traveled on a bicycle.
- For younger students, teachers may want to take photographs themselves of air-quality-impacting activities that students know about and partake in (i.e. walking or riding a bike to school, traveling in a bus or car to school, local agriculture that their families may take part in, playing in a local park or green area with trees/plants, etc.). Identify which activities are positive and which are negative.
- For special needs/second language students, teachers may want to choose one or two activities that impact air quality (one positive and one negative, for example) and discuss how each one contributes to air quality. Which substance is being emitted and what is its source? Discuss alternatives to the activity that negatively contributes to air quality.
- For teachers who want to do more related to this topic, have students research how local air quality has changed over time by interviewing elders in their community or researching historical data collected by local municipalities or institutions. They can take their own air quality readings (measuring particulate matter, CO₂, methane, etc.) and compare them with current figures from other research institutions. The class may want to send in their results to those local research institutions and/or form a partnership in data collection over an extended period of time.

RELATED NATIONAL SCIENCE EDUCATION STANDARDS, GRADES 9-12

Science as Inquiry

- Abilities necessary to do scientific inquiry
- Understanding about scientific inquiry

Science in Personal and Social Perspective

- Personal and community health
- Natural resources
- Environmental quality
- Natural and Human-induced hazards
- Science and technology in local, national and global challenges

RESOURCES FOR TEACHERS AND STUDENTS

American Lung Association

<http://www.lungusa.org/air>

Includes information on various air pollutants, their sources and some alternatives, as well as a plethora of information on respiratory diseases/ailments.

United States Environmental Protection Agency

<http://www.epa.gov/ebtpages/air.html>

Includes detailed information on air quality, pollution, and alternative solutions.

Natural Resources Defense Council

<http://www.nrdc.org/air/default.asp>

Includes information and articles on clean air and energy, transportation, etc.

The Air Quality Archive

http://www.airquality.co.uk/archive/what_causes.php

A British website with concise information about the causes of air pollution, effects of air pollution and what people are doing about air pollution.