Teacher's Guide:

Air Quality Division (pages 2 -7)

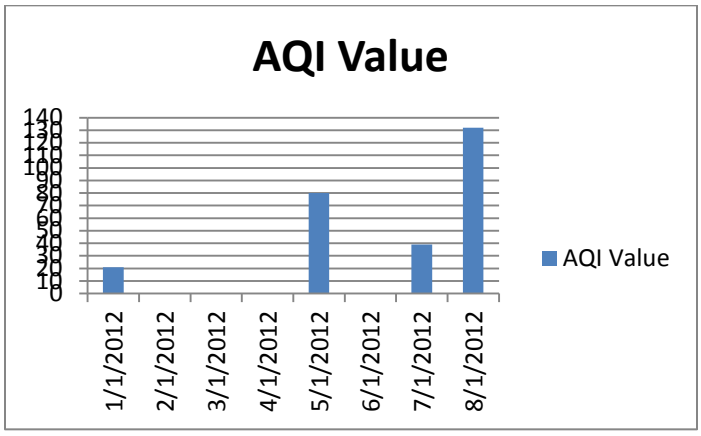
Oklahoma Department of Environmental Quality

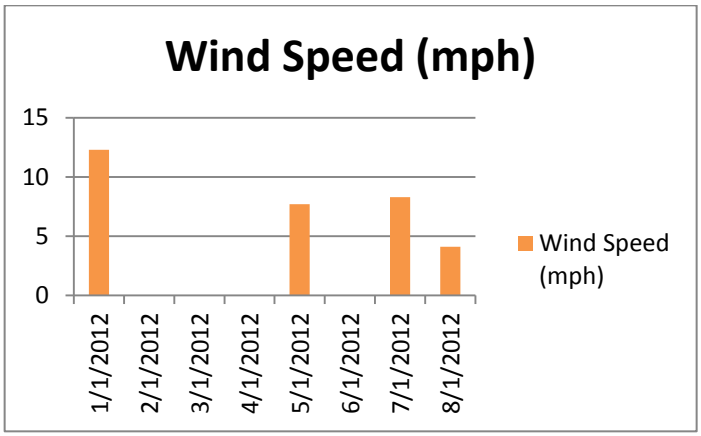
OBJECTIVE: The student workbook provides an overview of the air quality in Oklahoma, specifically in terms of ozone pollution. In addition to the student workbook, six lesson plans have been developed to supplement the information presented in the workbook. These lesson plans are available in a .pdf on both the DEQ website and Newspaper in Education website.

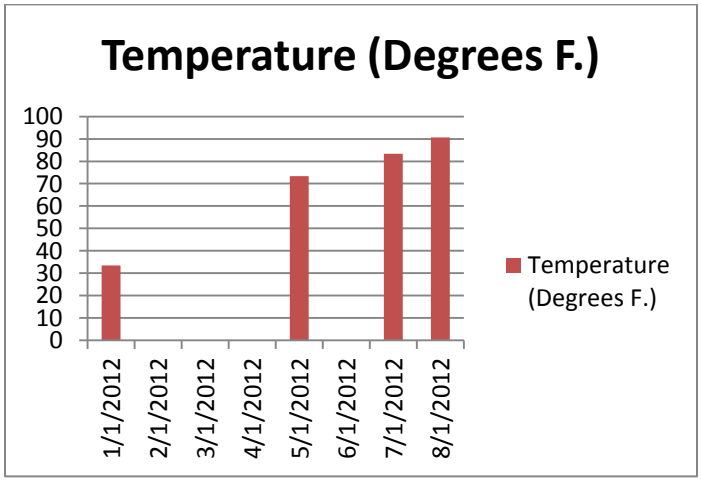
Each lesson plan includes an activity with accompanying student worksheets designed to reinforce the content. *The purpose of the workbook and the lesson plans is to inform students about ground-level ozone, more specifically, how ozone forms, how and why air pollution is monitored, how monitoring data is disseminated to the public, and what everyday choices can be made to reduce ozone emissions.*

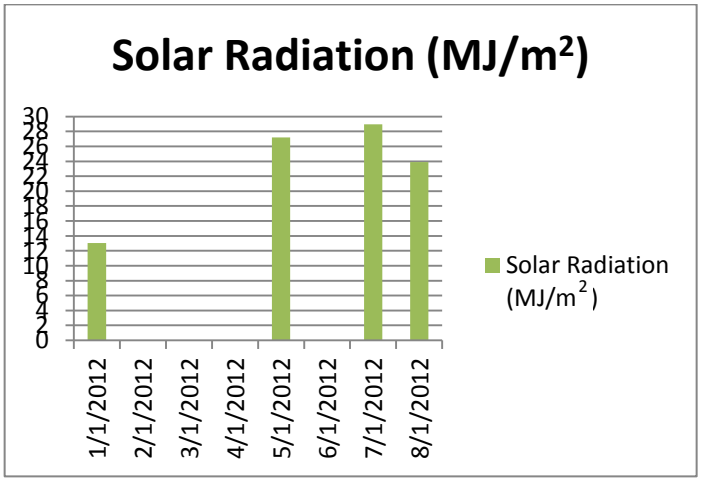
REAL-WORLD APPLICATION: A case study has also been provided in the student workbook and was designed to give students practice interpreting actual scientific data from indexes, tables, and maps. Students are also given practice displaying data in a graphic format and analyzing the information it represents.

CASE STUDY ANSWER KEY









1. Using a color-coded AQI chart and the data tables corresponding with each day, describe what the reported AQI value means in terms of air quality.

   ANSWER: The AQI score for 1/17/12 was 21, meaning the air quality was considered satisfactory, and air pollution posed little or no risk (Good = green). On 5/22/12 the AQI score was 80 which means the air quality was moderate (yellow) and acceptable; however, for some pollutants there may have been a moderate health concern for a very small number of people who are unusually sensitive to air pollution. The air quality for 07/01/12 was good and had an AQI value of 39, meaning air pollution posed little or no risk. The AQI score for 08/06/12 was 132, indicating that the air quality was unhealthy for sensitive groups (orange). Members of sensitive groups may have experienced some health effects.

2. Why are high AQI values associated with high temperatures and high solar radiation?

   ANSWER: For ground-level ozone to form there needs to be high solar radiation in addition to ample sources of NOx and VOCs. Solar radiation enables chemical reactions between NOx and VOCs to occur, which is how ground-level ozone is formed. Typically, high solar radiation correlates to high temperatures.

   When ozone forms and the concentrations are high enough, the AQI scores will usually be high as well. AQI scores are measures of how good or poor the air quality is for certain areas and when the numbers are high, so too are the concentration levels.

3. Based on the comparison provided by the graphed data, what time of the year are ozone episodes more likely to occur? Why?

   ANSWER: The highest AQI score reported in the case study occurred on August 6th followed by May 22nd. Based on those AQI values and the data displayed by the bar graphs, it can be concluded that ozone episodes typically occur in warmer months, such as spring and summer, when there is more solar radiation. The amount of solar radiation increases during the warmer months because the angle of the sun changes and it is more overhead. This conclusion can further be supported by the fact that the lowest AQI score reported in the case study occurred on January 17th when the sunlight (solar radiation) is less intense.

4. Describe the wind speeds on days with lower AQI values and the wind speeds on days with higher AQI values. What is the relationship between wind speed and AQI scores?

   ANSWER: The lowest AQI score reported in the case study occurred on January 17th and the corresponding average wind speed for that day was 12.3 miles per hour; the highest reported average out of the selected dates. Conversely, the highest AQI score reported in the case study occurred on August 6th and the corresponding average wind speed for that day was 4.1 miles per hour; the lowest reported average out of the selected dates. This being the case, higher average wind speeds typically correspond to lower AQI scores and lower average wind speeds typically correspond to higher AQI scores.

   ***Note: In the case study fact sheet it mentions that air can become stagnant when wind speeds are calm. If wind speeds are low, very little mixing occurs and the air does not circulate. As a result, pollutants are able to accumulate and settle over a particular area. If there are sufficient amounts of solar radiation and sources of NOx and VOCs, ozone is able to form. This being the case, the days with high ozone concentrations are typically associated with calm wind conditions.**

   On the other hand, higher wind speeds are indicative of lower AQI scores or lower ozone concentrations because the winds help to disperse the pollutants.

5. Based on the Air Quality Health Advisory maps and the average wind directions provided for May 22nd and August 6th, which counties or areas could have also been affected by ozone (assuming the wind continued to blow out of that direction)?

ANSWER: On May 22nd the average wind direction was out of the south/southeast meaning the areas most likely to be affected were those north and northwest of Love, Carter, Jefferson, Garvin, Murray, Johnston, and Marshall Counties (near the Texas and Oklahoma border). The southerly winds were, more than likely, transporting ozone pollution from Dallas and Houston into Oklahoma. Air pollution transport from Texas is a common occurrence since the winds in Oklahoma are predominantly out of the south.

On August 6th the average wind direction was out of the east/southeast, as a result the areas most likely to be affected were those along the northwestern border of Oklahoma. Also, the counties in southwestern Kansas could have been affected.

6. What factors may have led to a lower ozone concentration on July 1st, 2012, despite the high amounts of solar radiation?

The wind speeds were slightly higher than they were on May 22nd and could have caused more vertical mixing of the air. Climatic data indicates there was no widespread heavy rain for Oklahoma towards the end of June 2012. However, northwestern and north central Texas could have received significant rainfall during that time period that would have cleansed their air of pollutants. Therefore, any transport that may have occurred would have consisted of relatively cleaner air.

Also, there may have been an airmass change that occurred over Oklahoma during that time, which means that the pollutants in the air were transported to a different area such as Missouri, Arkansas, Kansas, etc.