BCSM: AP Environmental Science Mr. Callahan: Fall 2018

Student Name: Date:



**Air Quality Experiment: Particulate Matter, Ozone, and Temperature**

**Background:**

The term "[heat island](https://www.epa.gov/heat-islands/learn-about-heat-islands)" describes built up areas that are hotter than nearby rural areas. The annual mean air temperature of a city with 1 million people or more can be 1.8–5.4°F (1–3°C) warmer than its surroundings. In the evening, the difference can be as high as 22°F (12°C). Heat islands can affect communities by increasing summertime peak energy demand, air conditioning costs, air pollution and greenhouse gas emissions, heat-related illness and mortality, and water quality.

One particular pollutant that can generate significant human health risk in heat islands is particulate matter (PM). [PM](https://www.epa.gov/pm-pollution/particulate-matter-pm-basics) is a term for the mixture of solid particles and liquid droplets found in the air. Some particles, such as dust, dirt, soot, or smoke, are large or dark enough to be seen with the naked eye. Others are so small they can only be detected using an electron microscope. NYC has been particularly concerned by PM 2.5, which are fine particles with diameters that are generally 2.5 micrometers and smaller.

Where does PM come from? Some are emitted directly from a source, such as construction sites, unpaved roads, fields, smokestacks or fires. Most particles form in the atmosphere as a result of complex reactions of chemicals such as sulfur dioxide and nitrogen oxides, which are pollutants emitted from power plants, industries and automobiles.

Why are we concerned about PM? Particulate matter contains microscopic solids or liquid droplets that are so small that they can be inhaled and cause serious health problems. Particles less than 10 micrometers in diameter pose the greatest problems, because they can get deep into your lungs, and some may even get into your bloodstream.

**Hypothesis:**

You form a hypothesis on whether or not PM contributes to the formation of heat islands. Alternatively, you can form a hypothesis on the relationship between PM and ozone (e.g. does more PM lead to more surface level ozone).

**Plan the Experiment:**

Use the Science Inquiry Lab Notebook template as a guide and follow the below steps:

1. After an initial research study, decide on a research question.
2. Develop a hypothesis based on your research question - use supporting evidence and your knowledge of scientific concepts to ensure you have a strong hypothesis.
3. List the materials you will need and then give them details of your procedure - \*note that every team will receive the same data gathering kit, but if there are additional materials you’ll need, develop a list.
4. Identify the conditions you will hold constant and name a single independent variable. Decide which dependent variable you will measure and how you will know if your data supports your hypothesis.
5. Devise your experimental procedures.

**Check the Plan:**

Review the “Scientific Method” to make sure you have included all the pertinent steps.

1. Does your plan test only one variable?
2. Have you determined the location of your experiment? Also, have you decided how often you will take measurements?
3. Did you make a data table that compares the observations you made on the control and experimental groups? Did you include a set-up for a graph of your data?

**Materials:**

|  |  |
| --- | --- |
| **Materials Required for This Lesson/Activity** | |
| **Quantity** | **Description** |
| 6 | Raspberry Pi computers |
| 6 | Gravity surface temperature sensor |
| 6 | Gravity air temperature sensor |
| 6 | Gravity air quality sensor for Arduino |
| 6 | Gas Sensor Ozone Module |
| 6 | Vernier Surface Temperature Sensor |
| 6 | Vernier Go Direct Temperature Probe |

**Carry Out the Experiment**

This is intended to be a long term study (winter through spring). We will examine seasonal variation. Therefore, it’s imperative that lab groups develop a data collection schedule. Each Friday we will collect data and check-in on experimental progress.

**Write a Formal Lab Report**

See page 6 of the Scientific Inquiry Notebook Template for the format of the lab report

**Extension**

Similar to our heat island and temperature experiment, If time allows in May, each team will be required to develop a heat island reduction/mitigation strategy. Your teams will also examine the environmental and public health impact of heat islands on New York City.

We will present your findings to the school’s PA as well as Community Board 3 to advocate for more park space as a means of reducing the heat island effect.