Urban Heat Island Audit

Introduction:

Different surfaces and materials absorb and reflect different amounts of light. The more light a surface or material absorbs, the faster it heats up. Darker colors and heavier materials tend to absorb more light and, therefore, heat up faster than lighter materials. A completely black surface will absorb 100% of the light that strikes it and a completely white surface will reflect 100% of the light. Surfaces that absorb light will feel warm or even hot to the touch. Surfaces that reflect light feel cool in comparison.

As surfaces absorb light and heat up, they also radiate, or give off, increasing amounts of heat causing the air right above the surface to heat up. This phenomenon, referred to in cities as the urban heat island, has become a big problem in densely populated cities. Urban centers use a large amount of dark colored paving and roofing materials, like asphalt and tar. These materials absorb and radiate large amounts of heat. For example, a conventional tar roof can reach 169°F on a 90°F day. Therefore, temperatures in a city can be 6-10 degrees Fahrenheit warmer than in rural areas. The urban heat island effect is particularly noticeable at night. While the temperatures in non-urban areas decrease as the sun goes down, the temperatures in cities can remain significantly higher as materials that absorbed the sun's heat during the day continue to release it at night.

Urban heat islands have several significant consequences. Because they cause an increase in daily temperatures, they can increase the strength and duration of heat waves in cities. This can lead to an increase in heat related health problems and even deaths. Urban heat islands cause an increase in energy usage for air conditioning and refrigeration, especially at night. Urban heat islands can also change the local weather. For example, they can alter wind patterns, increase the development of clouds, cause the formation of thunderstorms, and increase the amount of lightning, especially heat lightning.

Increasing the use of white and reflective materials to cover roofs and for roads and other paved surfaces can reduce the heat island effect. These materials reflect more of the sun's light out into space. The urban heat island effect can also be reduced by increasing the amount of vegetation in a city through parks, gardens, and other plantings and by installing green roofs, roofs that are partially or completely covered by some form of vegetation.

Materials:

Students will work in pairs to conduct temperature tests at the major surfaces on the school grounds. Each surface should be sampled by at least 3 teams to get more accurate data.

- Ruler
- Thermometer
- Data sheet #1 and #2

Procedure:

1. The sampling for this audit works best on a sunny day.

2. Measure the temperature of each major surface on the school grounds from at least 2 different heights: 12 inches above the surface and directly on top of the surface. If time allows, the temperature can also be taken at other heights, for example, 6 inches above the surface or at waist height.

3. Once all data has been collected return to the classroom.

4. Combine the data collected by all teams for each surface and calculate the averages to get a more accurate temperature for the surface.

5. Answer and discuss the questions about the temperatures of these surfaces and their potential contribution to the urban heat island.

Discussion:

1. Which surfaces were the warmest? Which are the coolest? Why?

2. Was it only warm at the top of the surface or did heat radiate above the surface? Why or why not?

3. What was the average temperature for the day you recorded data? Were the surfaces warmer or cooler than this temperature? Why or why not? If the surfaces that you measured were spread out everywhere, how might they have affected the average temperature in the entire city?

4. What other factors might have influenced how warm the surfaces in the school yard got on the day you collected data? Hint: Think about factors like the season, time of day, and cloud cover.

Urban Heat Island Audit Data Sheet #1

Club member names: _____

Surface type	**Temperature (°F) on surface or 0in**	Temperature (°F) at 6in above surface *(optional)*	**Temperature (°F) at 12in above surface**	Temperature (°F) at waist height *(optional)*

Urban Heat Island Audit Data Sheet #2

	Surface:		Surface:		Surface:		Surface:		Surface:		Surface:	
Group	Temp at 0in	Temp at 12in	Temp at 0in	Temp at 12in	Temp at 0in	Temp at 12in	Temp at 0in	Temp at 12in	Temp at 0in	Temp at 12in	Temp at 0in	Temp at 12in
A												
B												
C												
Average												