AIR LESSON 3
MEASURE SCHOOLYARD AIR TEMPERATURES

Objective: Students will measure the air temperature from the schoolyard for comparison to reference sites to determine if the schoolyard exhibits characteristics of an UHI.

Curriculum Standards:

- NGSS ESS3.C Human Impacts on Earths Systems
- MD E-Lit Standard 1 Topic A: Environmental Issue Investigation
  - Indicator 4: Design and conduct research

Materials Needed:

- Temperature logger for deployment at schoolyard
- Logger housing and installation supplies (cable ties)
- Temperature logger for deployment at a reference site
- HOOD-CCWS logger data website (http://ccwsscience.org)

Option: Measure Air Temp Manually

- Thermometers
- Access to local weather station(s) such as a school station or CoCoRaHS (Community Collaborative Rain, Hail and Snow Network)

Maryland Weather Station Network

CoCoRaHS is a community-based network of volunteers working together to measure and map precipitation (rain, hail and snow). https://www.cocorahs.org/state.aspx?state=md

Background:

Information primarily taken from the USEPA Reducing Urban Heat Islands: compendium of Strategies. USPEA Urban Heat Island Compendium – Chapter 1 Urban Heat Island Basics. October 2008. https://www.epa.gov/heat-islands/heat-island-compendium

The increase in temperature in developed and urban areas as compared to rural areas is known as the Urban Heat Island. The annual mean air temperature of a city with one million or more people can be 1.8 to 5.4°F (1 to 3°C) warmer than its surroundings, and on a clear, calm night, this temperature difference can be as much as 22°F (12°C). Even smaller cities and towns will produce heat islands, though the effect often decreases as city size decreases.[1]

UHIs can be measured with **surface temperatures** or **atmospheric temperatures**. This lesson focuses on atmospheric temperatures. Heat Island intensity is most pronounced on clear calm nights when night time temperatures from urban areas as compared to rural can differ from 12.6 to 21.6F (7 to 12C).

[1] USPEA Urban Heat Island Compendium – Chapter 1 Urban Heat Island Basics. October 2008. https://www.epa.gov/heat-islands/heat-island-compendium

Logger Site Selection:

Devices to measure air temperature can be influenced by many factors, such as weather, shade and placement by heat-generating sources. Select a site on the school grounds that:

- Is not prone to vandalism
- Can be easily accessed by teachers to download data.
- Mounted on a fence, pole or similar.
- Not shaded by buildings or other structures.
- Ideally facing north.

Table 1: Basic Characteristics of Surface and Atmospheric Urban Heat Islands. [1]

Feature	Surface UHI	Atmospheric UHI
Temporal Development	• Present at all times of the day and night • Most intense during the day and in the summer	• May be small or non-existent during the day • Most intense at night or predawn and in the winter
Peak Intensity (Most intense UHI conditions)	• More spatial and temporal variation: ▪ Day: 18 to 27°F (10 to 15°C) ▪ Night: 9 to 18°F (5 to 10°C)	• Less variation: ▪ Day: -1.8 to 5.4°F (-1 to 3°C) ▪ Night: 12.6 to 21.6°F (7 to 12°C)
Typical Identification Method	• Indirect measurement: ▪ Remote sensing	• Direct measurement: ▪ Fixed weather stations ▪ Mobile traverses
Typical Depiction	• Thermal image	• Isotherm map • Temperature graph

DIRECTIONS:

Coordinate the deployment of the schoolyard logger with the deployment of a logger at a reference site at the same time for comparison purposes.

1. Program the temperature logger to record temperature every 10 minutes.
2. Ensure the logger is recording in Celsius
3. Install the logger inside a protective housing.
4. Deploy the logger outside in the schoolyard in a location that minimizes vandalism or tampering.
5. Periodically check logger to ensure no damage from weather or vandalism.
6. After the specified period of time as lapse (~4 weeks), retrieve the logger from the schoolyard and download the data file.
7. Upload the CSV data file to the Hood-CCWS data website (http://ccwsscience.org)

(Option) Compare Student Manual Air Temp Measurement to local Weather Station?

Can be collected during logger deployment or separate activity.

- Divide students into groups and provide each group a thermometer.
- Have students go outside and record the location (land cover) weather, cloud cover, and air temperature.
- Students can compare their temperature measurement to a local weather station measure at the same time of day.
- Are the temperatures the same? What would cause the temperatures to be different?