SUSTAINABLE
FUTURES

EDUCATOR ACTIVITY | GRADE RANGE: 6–8

Urban Heat Islands

OBJECTIVES

Students will:

- Learn about the urban heat index and why it is important.
- Analyze heat index results.
- Identify local heat islands.
- Explore personal actions that can be taken towards a stated purpose.

OVERVIEW

Students will learn about the urban heat index and why it is important. They will analyze index results against energy consumption before determining if they live in or near an urban heat island. The session will end with a discussion of steps cities can take to reduce heat index numbers as well as personal actions that can be taken on a smaller scale.

TIMING

1 session (approximately 45 minutes)

MATERIALS NEEDED

- Device with internet access, one per student or pair of students
- Article: Heat Island Impacts, one printed copy per student or electronic access
- Heat Island Impacts Note-taking handout, one per student
- Urban Heat Island Data student handout, one per student
- Exit Ticket student handout, one half-sheet per student

ESSENTIAL QUESTION

- How do urban heat islands affect people?

SUGGESTED PREPARATION

- Familiarize yourself with the urban heat index, the concept of urban heat islands, and the websites and resources referenced throughout the activity.

PROCEDURE

Engage

1. Introduce the activity's essential question. Consider having it written on a board or a poster.. Reinforce that, even if they do not understand it now, the goal of today's lesson is for students to feel confident discussing the question by the end of the session.
2. Facilitate students' engagement with the upcoming concepts by creating a word map on the board. Invite volunteers to tell you everything they know or have heard about the words that make up the phrase "urban heat island." Reinforce that there are no wrong answers. Help students begin to connect an idea of what an "urban heat island" might mean.

Learn

3. Begin by telling students that an urban heat island is an area, usually near or consisting of a city, that experiences higher temperatures than its surrounding areas. The large numbers of buildings, roads, and other pieces of infrastructure absorb and re-emit more of the sun's heat than natural and open landscapes, causing these "islands" to be, on average, 1–7° F higher than more open areas[1]. Reinforce with students that our environment often has a big impact on our overall health.
4. Provide students with an explanation of some of the causes of the urban heat island effect[2]:
   - Fewer trees, plants, and water sources
   - hard, dry surfaces
   - less reflective urban construction materials
   - close spacing between buildings, allowing for less wind flow
   - condensed population increasing human-generated heat
   - increased number of vehicles, air conditioning units, etc.
5. Describe how organizations such as Climate Central[3] and state governments[4] utilize the urban heat island (UHI) index to use census data within a city to estimate how much hotter it is in certain areas than others. They associate that data with various characteristics of the areas, such as human effects or elements of the built environment. For reference, a built environment means any human-made structures, features, and facilities that together are an environment where people live and work.
6. Maps are created to show the "hot spots," and the UHI index shows the temperature difference over time between an urban area and a nearby rural area.

1 https://www.epa.gov/heatislands

2 https://www.epa.gov/heatislands/learn-about-heat-islands

3 https://www.climatecentral.org/climate-matters/urban-heat-islands-2023

4 https://calepa.ca.gov/climate/urban-heat-island-index-for-california/understanding-the-urban-heat-island-index/

Explore

7. Provide students with a printed copy of **Heat Island Impacts** or have them navigate to the URL on an internet connected device.
8. Distribute a copy of the **Heat Island Impacts Note-taking** handout to each student. Provide 5–10 minutes for students, independently or with a partner, to read the article and write down important details and questions on their handout.

Apply

9. Direct students to the Urban Heat Island Map website and distribute a copy of the Urban Heat Island Data student handout to each student. Guide students through analyzing the information included in each resource.
10. Help students determine the listed city to which they live closest so they can access the map. Based on their distance from the city proper and using both resources, students should work to determine whether they live in a "hot spot" and, if they do, how much warmer their area is than surrounding areas.

Discuss

11. Based on what they have learned and the resources they have explored, facilitate a discussion in which students begin to think about realistic actions that can be taken by cities to decrease the environmental impact of urban heat islands.
    - What small steps could they take personally to address the issue?
    - What goals might need to be set?
    - Where are the opportunities to reduce the impacts of heat in urban areas?
    - What might be some barriers to implementing these actions? How could you overcome or work around these barriers?
    - What data or information would you need to have to help?

Reflect

12. Distribute an **Exit Ticket** student handout to each student and ask them to reflect on the activity's essential question. Collect them as students leave and use responses to determine their level of understanding. Consider taking time in a future session to address misconceptions, highlight key takeaways, or share interesting insights brought up on the tickets.

EXTENSION IDEAS

- Distribute the Family Connection activity for students to bring home to extend their learning and include their families in a meaningful action.
- Heating and cooling buildings accounts for approximately 15% of global greenhouse gas emissions, and food waste accounts for another 10%.[5] Trane Technologies is a company that's creating innovative new equipment and technology to help reduce the carbon footprint of buildings and the things that safely haul food and other perishable items. Consider guiding students through the activity The Decarbonization Puzzle to make a connection between this initiative and urban heat islands. Or invite a Trane Technologies employee to volunteer to facilitate the activity for your students!

NATIONAL CONTENT STANDARDS:

Next Generation Science Standards:

- **MS-LS1-4.** Construct an argument supported by empirical evidence that changes to physical or biological components of an ecosystem affect populations.
- **MS-ESS3-3.** Apply scientific principles to design a method for minimizing human impact on the environment.
- **MS-ESS3-5.** Ask questions to clarify evidence of the factors that have caused the rise in global temperatures over the past century.

Science and Engineering Practices:

- Asking Questions and Defining Problems
- Analyzing and Interpreting Data

5 https://energy5.com/greenhouse-gas-emissions-from-different-hvac-refrigerants

Increased Energy Consumption	Elevated Emissions of Air Pollution and Greenhouse Gases
Compromised Human Health and Comfort	Impaired Water Quality

Urban Heat Island Data

City	Total population (2020 U.S. Census)	Citywide urban heat island effect (in degrees F)
New York	9,163,205	9.5
Houston	5,820,645	7.9
Los Angeles	7,195,330	8.1
Dallas	2,952,414	7.9
Chicago	4,002,922	8.3
San Antonio	2,179,657	7.7
San Diego	2,493,403	7.9
Phoenix	2,920,410	7.4
Detroit	1,185,288	8
Austin	1,520,357	7.7
Philadelphia	2,476,827	8
Denver	1,818,506	7.6
San Jose	1,650,389	7.9
Portland	1,252,000	7.9
Kansas City	1,465,518	7.6
Sacramento	1,000,474	7.8
Louisville	1,088,898	7.6
Seattle	968,801	8.2
Atlanta	971,649	7.7
Miami	861,520	8.3
San Francisco	977,157	8.8
Oklahoma City	1,127,021	7.4

City	Total population (2020 U.S. Census)	Citywide urban heat island effect (in degrees F)
Nashville	1,135,807	7.6
Las Vegas	1,197,322	7.4
Indianapolis	1,225,287	7.5
Washington	1,170,546	8
New Orleans	607,620	8
Memphis	907,382	7.6
Boston	1,356,482	8
Charlotte	1,169,925	7.5
Omaha	616,468	7.7
Tucson	766,051	7.5
Fresno	731,086	7.6
Baltimore	896,423	8
Jacksonville	1,248,887	7.5
Milwaukee	951,401	7.6
Tulsa	744,212	7.5
Albuquerque	698,216	7.4
Bakersfield	631,593	7.4
Minneapolis	573,359	7.8
Colorado Springs	665,572	7.3
Raleigh	832,358	7.4
Newark	705,936	8
Wichita	554,064	7.2

Source: https://assets.ctfassets.net/cxgxgstp8r5d/7M8SY2GFH6k7diN7foRBZp/0a2b4d9cb430ce0e5f81b353f78ca6ab/Climate_Central_Urban_heat_islands_city_rankings_____UHI_by_census_tract.xlsx

How do urban heat islands affect people?

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