



MIDDLE SCHOOL 2021-2022

Energy Efficiency & Conservation

STEAM Activity: 6th – 8th grade



Title: Living in Heat Islands

Objective: Using Miami-Dade County as a case study, students will research the effectiveness of trees and urban rooftop designs in mitigating the effects of climate change, specifically, extreme heat and heat islands.

Materials:

- Computers/internet access
- Notes
- cardboard shoe box
- black and white paint
- materials for roof (i.e. gravel, foil, plastic wrap, plant material)

Estimated Time Needed: 120 minutes

Background Information & Vocabulary: Heat islands are urbanized areas that experience higher temperatures than outlying areas. Structures such as buildings, roads, and other infrastructure absorb, hold and re-emit the sun's heat more than natural landscapes such as forests and water bodies.

Green infrastructure encompasses a variety of water management practices, such as vegetated rooftops, roadside plantings, absorbent gardens, and other measures that capture, filter, and reduce stormwater.

Procedures:

Research -

1. Introduce the concept of the heat island effect (show [Heat Island graphic](#)) and explain how they are formed including:
 - a. relatively dense building materials that are slow to warm and cool and store a lot of energy
 - b. replacement of natural surfaces by impervious or waterproofed surfaces, leading to a drier urban area, where less water is available for evaporation, which offsets heating of the air
 - c. lower surface reflectivity to solar radiation -- dark surfaces such as asphalt roads absorb more sunlight and become much warmer than light-colored surfaces
2. Read through the [Miami-Dade County Urban Tree Canopy Assessment conducted in 2016](#).
3. Students take notes on their findings using this [Reading guided worksheet](#). Discuss observations.

Lab Activity -

1. As a class, view [Energy 101: Cool Roofs](#). Discuss how different materials on roofs in an urban setting can help to reduce the heat island effect (EPA website in Additional Resources provides additional information on additional strategies to Reduce Heat Islands.)
2. Individually or in groups students design, build and test a roof design to lessen the Urban Heat Island effect. (Activity taken in part from [Next Generation Science Common Lessons: Module 6](#) additional experiments available.)
 - a. Tell students that they will be given a cardboard shoebox that represents a building, the lid acting as the roof.
 - b. Identify the materials for the design. Possible materials for their design challenge may include: black/white paint, plastic wrap, foil, wax paper, pebbles, fish tank gravel, cotton balls, soil, live plants, newspaper, marbles, filter material, fabric, stockings, etc.)
3. Students present their models and discuss why they chose the materials they did and why they think those materials would help reduce the surface temperature.
4. As a class, discuss other ideas for adding tree canopy to urban areas.



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Guiding Questions:

- Does plant selection make a difference in mitigating the heat island effect, in home energy use, and water consumption?
- Are different neighborhoods in the county more prone to heat islands? Why?
- Have any development projects made certain neighborhoods more vulnerable to the heat island effect?
- How do energy sources impact the heat island effect? Do fossil fuels and renewable energies have the same effect on the heat island effect?
- What other shading strategies could be used for shading the roof of a building? Hint: rooftop solar systems shade the roof of a building while also reducing greenhouse gas emissions from electricity production. How can solar systems mitigate the heat island effect?
- If we are forecasted to have more heat waves, how might this impact residents of cities? What might be some possible issues? What might be some potential solutions?

Evaluation: Send pictures of rooftop designs.

Additional Resources:

- [Creation of Urban Heat Islands Story Map](#) (NASA Lesson)
- [Heat Island Cooling Strategies](#) (EPA) & [Fact Sheet: Heat Island Effect](#) (EPA)
- [Map of Miami-Dade County Urban Tree Canopy](#) (Make sure to look through layers, especially temperature measurements)
- [i-Tree tools](#)
- [Urban Heat Island Lesson](#) (Arizona State University)
- [NASA Climate Kids: What is an urban heat island?](#)
- [3 Cool Ways to Cool Our Cities](#). Video

Benchmarks:

6th Grade

Science

- SC.6.E.7.1 Heat Transfer in Earth's Systems
- SC.6.E.7.3 Sun's Influence on Atmospheric Movement

7th Grade

Science

- SC.7.N.1.1 Heat & Light Transfer in Scientific Investigations
- SC.7.P.11.1 Adding & Removing Heat using the Scientific Process
- SC.7.P.11.1 Heat and Temperature
- SC.7.N.1.2 Heat Flow
- SC.7.P.11.4 Observe and describe that heat flows in predictable ways

8th Grade:

Science

- SC.8.N.1.2 Temperature's Influence on Chemical Changes
- SC.8.N.1.6 Sun's Impact on Earth

Career & Technical Education

- CTE-ENGY.68.GNRATN.05.06 Evaluate the advantages and disadvantages of using solar energy