Overview

In this activity, students will explore ways cities can mitigate the heat island effect while considering urban planning. Students build a "block" or "neighborhood" using materials provided. They then test the heat capacity of their neighborhood. Students then [1]draw cards that prompt them to make changes to their neighborhoods and test the impact these changes have on the temperature. Students also track the costs and profits of these changes.

Objectives

Upon completing this lesson, students will be able to:

• use the engineering design process to create a sustainable city to combat the heat island effect. • combine real-world science and equity issues for a nuanced discussion about the future of city living

Materials

Each group/pair of students should be provided with:

- 2 ice cube trays to form the urban grid
- Asphalt cubes to build streets (7 total). It is possible to also use black fishbowl gravel to as a representation of asphalt.
- Sand to go under buildings or to make parks
- Turkey baster for making lakes and ponds
- 3 types of buildings
    - 1-inch wood cubes, 10 per group
    - 1-inch glass cubes, 8 per group
    - 1-inch metal cubes, 5 per group
- *Cool Cities Cards*
- Infrared temperature gun

Additional items you will need to supply:

- 1 Liter of water in a sturdy container
- Leafy twigs to represent plants
- Heat source – options include
    - Hairdryer (best with children 8 and under)
    - Space Heater – May use too much power if working in an outdoor/communal space
    - Heat Lamp – Best for heating but can easily cause burns
- Play money or another way to track each group's profits and losses.
- Extra wood, glass, and metal cubes students may request.

Teacher Prep

Before the Investigation

Prior to class, determine the maximum temperature. Students need this measurement in order to know when their city has become too hot. This will vary depending on the air temperature, humidity, heat source and set up. Fill a 3x3 square with all asphalt blocks and heat it for 3 minutes consistently. Let it cool for 1 minute and assess the temperature. We suggest setting the fail temperature at 5-10 degrees cooler than this or at 105, whichever is cooler.

[1] This activity was developed by NCSE Teacher Ambassadors Melissa Lau and Amelia Cook.

Organize each group's supplies. Use the guide above to ensure each group has enough supplies to create then alter their model. Set up the heat source; keep it on the opposite side of the table from where the students will be working.

Work with students to set expectations for using the materials respectfully and safely handling the heat source. This may look different based on the age and experience of students. Expectations may include the following:

- Materials must remain at your table (to prevent mixing up of supplies).
- One person is in charge of turning on and off the heat source (to prevent potential burns).
- Ice cube trays must be set in the middle of the table (to prevent potential spills).

Students may want to model their neighborhood after one found in their community. Allow them to use GPS to investigate the buildings on their street.

It is important that students keep track of which buildings are residential and how many families live there. An easy way to track this

During the Investigation
Prompt students to follow the instructions and fill out the data tables completely. If their city's temperature does not reach the maximum temperature you set, then they should begin drawing cards and making changes to their city.

Students may need direct instruction on filling out Data Table 2: Costs and Profits. See the example below.

SAMPLE Data Table 2: Costs and Profits

Description of Card Drawn	Changes Made to Neighborhood	Balance Adjustment		Balance	Neighborhood Temperature
		Cost	Profit		
	Neighborhood Built		+$200	$200	100 F
Eco Friendly – Concert a parking lot into a square of your choice.	Turned a parking lot into a park.	-$10		$190	99 F
Zoning – Approved LEED certified building.	No change		+$2	$192	99 F
Roads and Parking – Install cooling pavement for $10 per square.	Covered the black asphalt with white paper.	-$100	+$2	$94	95 F
Lake – Create a 2x1 lake for $10	Removed two commercial buildings and added a lake.	-$10	+$2	$86	95F

Post-Investigation

Once the activity has ended, bring the students back together for a discussion. Allow students time to go through the analysis questions on page for the student handout. Then use the following questions to drive class discussion: • What architectural solutions did they find effective at decreasing the overall temperature of their neighborhood?

• What impact did energy absorption and reflection have on the temperature of the neighborhood? Which aspects do they think absorb energy and which do they think reflected energy? How do they know this? • What impacts could climate change bring, and how could urban planners change their designs to accommodate these impacts?

• How could the city accommodate a growing population?

• What types of equity problems do we see in modern cities?