

Photo Description



This image shows a city skyline with tall buildings of different shapes and sizes. The sun is shining brightly between the buildings, creating shadows and bright reflections on the glass windows. You can see trees and green spaces in the front, with roads and bridges connecting different parts of the city.

Scientific Phenomena

The anchoring phenomenon here is urban heat island effect - cities being warmer than surrounding rural areas. This happens because concrete, asphalt, and buildings absorb and store more heat energy from the sun than natural surfaces like grass and trees. The materials used in construction have different properties for absorbing, reflecting, and releasing thermal energy. Additionally, human activities like transportation and air conditioning release extra heat into the environment, while the lack of vegetation reduces natural cooling through evapotranspiration.

Core Science Concepts

1. Energy Transfer and Heat Absorption: Different materials absorb, reflect, and release heat energy at different rates. Dark surfaces like asphalt absorb more solar energy than light-colored surfaces.
2. Human Impact on Environment: Cities modify natural systems through construction, transportation, and energy use, creating measurable changes in local temperature and air quality.
3. Matter and Its Properties: Building materials (concrete, glass, metal) have specific thermal properties that affect how they interact with solar radiation and store heat energy.
4. Systems and System Models: Cities function as complex systems where human activities, built structures, and remaining natural elements interact to create unique environmental conditions.

Pedagogical Tip:

Use a simple experiment with different colored paper in sunlight to help students feel how different materials absorb heat differently. This concrete experience will help them understand the abstract concept of urban heat islands.

UDL Suggestions:

Provide multiple ways for students to explore this concept: tactile experiences (touching different surfaces on a sunny day), visual representations (thermal imaging photos), and auditory explanations (videos with narration) to support diverse learning needs.

Zoom In / Zoom Out

Zoom In: At the molecular level, when sunlight hits concrete and asphalt, the energy causes molecules to vibrate faster, increasing their kinetic energy and temperature. These materials store this thermal energy and release it slowly, keeping cities warm even after sunset.

Zoom Out: Urban heat islands are part of larger climate systems that affect regional weather patterns, energy consumption across entire metropolitan areas, and contribute to global climate change as more people move to cities worldwide.

Discussion Questions

- How might the temperature difference between this city and a nearby forest affect the plants and animals living in each place? (Bloom's: Analyze | DOK: 3)
- What solutions could city planners use to reduce the heat island effect while still meeting people's needs for housing and transportation? (Bloom's: Evaluate | DOK: 4)
- Why do you think the glass buildings in this photo might reflect more heat than brick buildings? (Bloom's: Apply | DOK: 2)
- How does the urban heat island effect demonstrate that human activities can change natural systems? (Bloom's: Understand | DOK: 2)

Potential Student Misconceptions

- Misconception: "Cities are hot just because there are more people breathing and making body heat."
Reality: While human activity contributes, the main cause is building materials absorbing and storing solar energy differently than natural surfaces.
- Misconception: "All buildings make cities hotter."
Reality: Green buildings with reflective surfaces, green roofs, and energy-efficient designs can actually help reduce urban heat.
- Misconception: "The heat island effect only happens in summer."
Reality: Urban heat islands exist year-round, though they're most noticeable during warm weather.

Cross-Curricular Ideas

- Mathematics - Data Analysis & Graphing: Have students collect temperature data from different surfaces around your school (concrete, grass, asphalt, shade) throughout the day and create line graphs showing how temperatures change. Students can compare their data to temperature readings from a nearby rural area, practicing data collection, organization, and interpretation skills.
- ELA - Persuasive Writing: Students write persuasive letters to their city council or school board proposing solutions to reduce the urban heat island effect (like planting more trees, painting roofs white, or creating green spaces). This connects science communication with writing standards and civic engagement.
- Social Studies - Urban Planning & Community: Explore how city planners make decisions about where to build parks, plant trees, and design neighborhoods. Students can research their own city's layout and discuss how geography, population needs, and environmental concerns influence community development and sustainability.

4. Art - Color & Light Exploration: Create mixed-media artwork showing how different colors and materials reflect or absorb light and heat. Students can use reflective materials (aluminum foil, mirrors), dark papers, and light papers to create collages that demonstrate heat absorption concepts while developing artistic skills.

STEM Career Connection

1. Urban Planner/City Designer - These professionals design how cities grow and develop. They decide where buildings, parks, roads, and green spaces go to make cities more livable, sustainable, and cooler. Urban planners work with architects, engineers, and community members to solve problems like the urban heat island effect. Average Annual Salary: \$70,000-\$85,000

2. Environmental Engineer - Environmental engineers find solutions to protect nature and human health in cities. They design systems to reduce pollution, manage water, and create cooler urban spaces through green infrastructure like rain gardens, green roofs, and cool pavements. Average Annual Salary: \$75,000-\$95,000

3. Climate Scientist/Meteorologist - These scientists study weather patterns and climate change, including how cities affect local temperature and weather. They use special equipment and computer models to measure and predict how the urban heat island effect impacts communities and help develop solutions. Average Annual Salary: \$80,000-\$105,000

NGSS Connections

Performance Expectation: 5-ESS3-1 - Obtain and combine information about ways individual communities use science ideas to protect the Earth's resources and environment.

Disciplinary Core Ideas:

- 5-ESS3.C - Human activities in agriculture, industry, and everyday life have major effects on the land, vegetation, streams, ocean, air, and even outer space.
- 5-PS1.A - Matter of any type can be subdivided into particles that are too small to see, but even then the matter still exists and can be detected by other means.

Crosscutting Concepts:

- Cause and Effect - Cause and effect relationships are routinely identified and used to explain change.
- Systems and System Models - A system can be described in terms of its components and their interactions.

Science Vocabulary

- * Urban Heat Island: A city area that is significantly warmer than surrounding rural areas due to human activities and building materials.
- * Thermal Energy: The energy that comes from heat, which makes molecules move faster.
- * Absorption: When a material takes in energy, like how dark surfaces soak up sunlight.
- * Reflection: When energy bounces off a surface, like sunlight bouncing off a mirror.
- * Evapotranspiration: The process where plants release water vapor that helps cool the air naturally.
- * Infrastructure: The basic systems a city needs, like roads, buildings, and power lines.

External Resources

Children's Books:

- The Magic School Bus and the Climate Challenge by Joanna Cole
- The Great Kapok Tree by Lynne Cherry

- The Watcher: Jane Goodall's Life in the Wild by Jeanette Winter