

MiTEP Lesson Plan  
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## Cool Kids in the City

**Grade Level:** 4<sup>th</sup> Grade

**Purpose:** TLW use CER to uncover and correct misconceptions about roofing materials and their effect on temperature in an area.

**Big Idea 7:** Humans depend on Earth for resources.

**Essential Question/Directed Inquiry Stimulus:** Do different colors and materials absorb heat better?

**GLCEs:**

**S.IP.E.1 Inquiry involves generating questions, conducting investigations, and developing solutions to problems through reasoning and observation.**

**S.IP.04.11** Make purposeful observation of the natural world using the appropriate senses.

**S.IP.04.12** Generate questions based on observations.

**S.IP.04.13** Plan and conduct simple and fair investigations.

**S.IP.04.14** Manipulate simple tools that aid observation and data collection (for example: hand lens, balance, ruler, meter stick, measuring cup, thermometer, spring scale, stop watch/timer, graduated cylinder/beaker).

**S.IP.04.15** Make accurate measurements with appropriate units (millimeters centimeters, meters, milliliters, liters, Celsius, grams, seconds, minutes) for the measurement tool.

**S.IP.04.16** Construct simple charts and graphs from data and observations.

**S.IA.E.1 Inquiry includes an analysis and presentation of findings that lead to future questions, research, and investigations.**

**S.IA.04.11** Summarize information from charts and graphs to answer scientific questions.

**S.IA.04.12** Share ideas about science through purposeful conversation in collaborative groups.

**S.IA.04.13** Communicate and present findings of observations and investigations.

**S.RS.E.1 Reflecting on knowledge is the application of scientific knowledge to new and different situations. Reflecting on knowledge requires careful analysis of evidence that guides decision-making and the application of science throughout history and within society.**

**S.RS.04.11** Demonstrate scientific concepts through various illustrations, performances, models, exhibits, and activities.

**S.RS.04.14** Use data/samples as evidence to separate fact from opinion.

**S.RS.04.15** Use evidence when communicating scientific ideas.

**S.RS.04.16** Identify technology used in everyday life.

**S.RS.04.17** Identify current problems that may be solved through the use of technology.

**S.RS.04.18** Describe the effect humans and other organisms have on the balance of the natural world.

**P.EN.E.1 Forms of Energy- Heat, electricity, light, and sound are forms of energy.**

**P.EN.04.12** Identify heat and electricity as forms of energy.

**P.EN.E.4 Energy and Temperature- Increasing the temperature of any substance requires the addition of energy.**

**P.EN.04.41** Demonstrate how temperature can be increased in a substance by adding energy.

**P.PM.E.5 Conductive and Reflective Properties- Objects vary to the extent they absorb and reflect light energy and conduct heat and electricity.**

**P.PM.04.53** Identify objects that are good conductors or poor conductors of heat and electricity.

**Misconceptions Addressed:**

- Light can only be reflected from objects with shiny surfaces, like a mirror.
- Objects can either reflect or absorb light—not both.
- The Earth is heated by heat energy coming from the Sun directly.

**Vocabulary:**

*absorb*- sunlight is taken into an object and turned into heat energy, which raises the object's temperature

*reflect*- sunlight bounces off of an object and is not absorbed. The temperature of the object is not changed

*Urban heat island*- a city area where the air temperature is higher because trees and grass have been replaced with buildings and roads which absorb heat.

*Green roof* – a rooftop planted with trees and other plants in a thick layer of soil.

*Cool roof*- roofing material that reflects a high amount of the sun's light. This keeps the heat from being absorbed and transferred to the indoors.

*Albedo* - A measure of the amount of light reflected by a surface on a scale of 0 to 1. 1 means that all of the light is reflected. Snow has an albedo of almost 1. Coal has an albedo of .05 and sand has an albedo of .35. The higher the number, the more light is reflected.

### **Materials:**

Access to the internet (computers, ipods, ipads)

12-15 shoeboxes (one for each pair of partners)

12-15 thermometers

Heat probe

Glue

Graph paper

Possible roofing materials, chosen by students: grass, paint (3-4 colors including white and black), clay pot pieces, asphalt crumbles, gravel, shingles, cedar shakes (or thin wood pieces), slate pieces, tar paper, aluminum foil (or other metal—small piece of metal roofing is best), Styrofoam, dry grass

Timer

A sunny day

### **Knowledge Needed/Background Information:**

#### ▪ **Videos:**

- **Light:** <http://www.brainpop.com/science/energy/light/preview.weml>
- **Exploring: Light and Color**  
<http://player.discoveryeducation.com/index.cfm?guidAssetId=DA3000F8-3BBC-4903-82FA-8E66F872B2C7&blnFromSearch=1&productcode=US>
- **Out of Darkness: an Introduction to Light**  
<http://search.discoveryeducation.com/>

#### ▪ **Websites:**

- **Absorption** <http://www.kidsgeo.com/geography-for-kids/0066-heat-absorption.php>
- **Reflection:** <http://www.kidsgeo.com/geography-for-kids/0067-heat-reflection.php>
- **Light:** <http://www.howstuffworks.com/light.htm>
- **The sun** <http://www.howstuffworks.com/sun.htm>

## The Lesson

**1. Background Information/Review:** How does the Sun warm the Earth? Students will watch two video segments and participate in a discussion to cover background information about light from the Sun and how it is absorbed and reflected by objects and surfaces on Earth.

**2. Prompt:** We know that objects on the Earth absorb and reflect sunlight. Let's say that you want to build a house that is energy efficient. It has to stay as cool as possible in the sun. Does it matter what materials or colors you use to build and cover it with? Think about roofing and siding materials. Should your materials absorb or reflect more light? Draw and label a picture of your house and write a claim describing what you would use to build this house.

- Ask students write out their claims
- Group students in fours to discuss these
- Share out with the whole group

### 3. Collect Evidence:

- Brainstorm key words for internet searches for colors and materials that reflect and absorb light, and have students research whether the materials they choose should absorb or reflect the light.
- Assign each pair of students a computer or iPod and give them time to search the internet for evidence that one material or color is a better choice for your house than another.
- Ask pairs of students to list the evidence they locate on a poster and hang it up.

### 4. Reason:

Groups share out and revisit claims. Partners need to change claims if necessary, using the evidence collected to support their reasoning.

### Round 2:

**Discussion:** Introduce information about urban heat islands using website and graphic resources. Discuss: What do you think causes higher air temperatures in urban areas? How do you think these higher temperatures affect summer cooling costs and energy consumption? Why is this important?

**1. Prompt:** If we want to design buildings that can reduce the urban heat island effect, we need to choose our materials wisely. Rank the materials (which are materials used all over the world for roofing) you see numbered at the front table from 1 to 12, from the one that you think absorbs the least sunlight to the one you think absorbs the most.

- Ask students write out their claims
- Group students in fours to discuss these
- Share out with the whole group

### 2. Collect Evidence:

- Students will assemble in groups of two. They will assemble a "house" using a shoebox, glue, and one of the materials ranked above by gluing a layer on the top cover and waiting for it to dry.

- When houses have been assembled and are fully dry, teams will exit the building to conduct an experiment. Each team will place a thermometer inside the box and place it in the sun. Every five minutes, a time keeper will tell teams to record the temperature on the thermometer inside the house and to check the temperature on the top of the house. These measurements will be recorded on two separate tables. Each team will record indoor and surface temperatures for their houses 9 times.
- After evidence has been collected, student groups will generate graphs from their data on two transparencies—one documenting the temperature inside the house, one the temperature outside the house. They will then present their findings to the whole group and compare them to other groups by placing their transparent graphs on top of each other's.
- A student volunteer will enter the data in an excel file and generate a graph comparing all of the group's results. This will be projected for group discussion.

**3. Reason:** Which type of roof would work best to decrease temperatures in urban heat islands? Have students revisit their claims, rewriting them if necessary, and providing evidence that supports their reasoning.

**Extension Ideas:**

- Introduce green roofs and cool roofs using photos and literature from websites. Discuss benefits of each.

**References:**

**Websites**

<http://heatisland.lbl.gov/coolscience/cool-science-urban-heat-island>

[http://www.teachengineering.org/view\\_activity.php?url=collection/wpi /activities/wpi\\_colors\\_absorb\\_heat\\_better/colors\\_absorb\\_heat\\_better.xml](http://www.teachengineering.org/view_activity.php?url=collection/wpi /activities/wpi_colors_absorb_heat_better/colors_absorb_heat_better.xml)

[http://files.earthday.net/lessonplanspdf/Green%20Roofs\\_Lesson%20Plan.pdf](http://files.earthday.net/lessonplanspdf/Green%20Roofs_Lesson%20Plan.pdf)

<http://beyondpenguins.ehe.osu.edu/issue/energy-and-the-polar-environment/common-misconceptions-about-light-heat-and-the-sun>

Heat island graphic <http://heatisland.lbl.gov/>





