Hot Spot Investigators

Flood:ED School Greening Simulator

Grades 5 - 9
Activity

Main Objective

In this hands-on STEM activity, students become environmental scientists, exploring how solar radiation impacts their local surroundings. Through data collection, analysis, and design, they will better understand how surface properties influence heat absorption and propose innovative, real-world cooling solutions for urban environments. As an optional extension, students could share their findings in an eCard, or test their results by building and placing solar ovens in optimal locations.

Learning Outcomes

((Suggested level: Grades 5–9)

- Explain how solar radiation affects surface temperature
- Analyze how surface colour, material, and sun exposure influence heat absorption
- Collect, graph, and analyze temperature data using scientific methods
- Develop and propose solutions for urban heat problems
- Build and test a solar oven based on scientific observations

Materials Required

- Internet enabled device(s)
- Attached Worksheet as a Google Doc (or printed handout)
- Infrared or surface thermometers (digital preferred)
- Clipboards and data sheets
- Stopwatch or clock
- Graph paper or devices for digital graphing
- **Flood:ED School Greening Simulator**

Length of Activity: 4-8 hours

⏱️ We recommend planning for each step to take at least one hour-long class.

- **Step 1:** *Urban Heat Solutions* ~1 hour
- **Step 2:** *Surface Temperature Investigation* ~1–2 hours
- **Step 3:** *Graphing & Analysis* ~1-2 hours
- **Step 4:** *Community Cooling Plans* ~1 hour
- **Step 5** (Optional): *Solar Oven Design Challenge* ~1–2 hours

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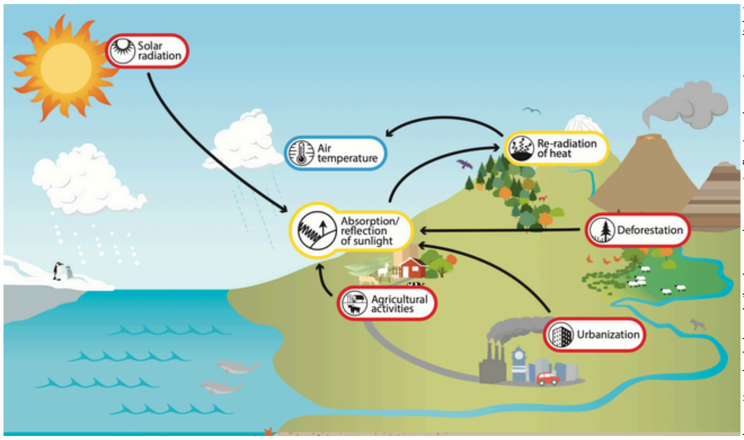
Exploring Earth’s Absorption and Reflection of Solar Radiation

Background Information



https://ugc.berkeley.edu/background-content/reflection-absorption-sunlight/

The Journey of Sunlight: Reaching Earth

Sunlight races through space at 300,000 kilometres per second. When it reaches Earth, it is either absorbed by the surface and atmosphere or reflected back into space, influencing the planet's climate and ecosystems.

How Sunlight Is Absorbed and Heats Our Planet

The Sun is more than just a distant star; it is the heartbeat of our planet. About 71% of sunlight that reaches Earth is absorbed, transforming into heat. This energy warms the land, oceans, and air, setting molecules into motion and increasing their temperature. The Earth then releases this energy as infrared radiation—what we feel as heat. Surfaces that absorb more sunlight, like dark-coloured ones, become warmer and release more heat, driving our weather systems.

For example, on a winter day, you can feel the warmth of the Sun on your face while the air remains chilly, as Earth’s surfaces absorb and release sunlight in distinct ways. A black jacket, for instance, absorbs more sunlight than a white one, leaving you feeling warmer.

What Is Reflection, and How Does It Affect Us?

Not all sunlight is absorbed; some is reflected back into space. This is called Earth's albedo, which measures how much light is bounced back. Earth's average albedo is 0.29, meaning nearly a third of sunlight is reflected away (University of California Museum of Paleontology, 2020).

Reflective surfaces, like snow, ice, and certain gases, send sunlight back into space, while thick clouds can block sunlight from reaching Earth. Lighter clouds, however, allow sunlight through while trapping some heat, intensifying the greenhouse effect. These interactions play a key role in shaping weather patterns and global temperatures.

The Human Impact: How Our Actions Alter Sunlight's Path

Human activities have impacted this delicate balance. Cities, with their dark streets, rooftops, and expansive concrete surfaces, trap sunlight, creating urban heat islands. In these areas, temperatures soar higher than in surrounding rural or natural environments. Concrete and asphalt absorb more sunlight, transforming once-cool places into heat traps.

Additionally, human actions like deforestation and agriculture change how land absorbs and reflects sunlight. While some activities increase reflection, overall, they contribute to rising global temperatures. Deforestation, in particular, disrupts the balance of absorption and reflection, altering local climates and accelerating the warming of the planet.

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Activity

Step 1: Urban Heat Solutions: How Cities Are Fighting Extreme Heat 🔥🏙️

- Begin by introducing the concept of urban heat islands and the science of solar radiation absorption using the video:

Urban Heat Solutions Video
https://www.youtube.com/watch?v=ZQ6fSHr5TJg

This video explores how Phoenix, Arizona is tackling extreme heat. Using drone footage and thermal cameras, it shows how surface material, colour, shade, and vegetation impact temperature—especially in lower-income neighbourhoods.

- Distribute the Step 1: Guided Notes Worksheet for students to answer the questions.
- Lead a short class discussion or think-pair-share on:
  - What types of surfaces were hottest or coolest
  - How trees and shade made a difference
  - Why some neighbourhoods are more affected by heat than others

Step 2: Surface Temperature Investigation 🌡️

Students will conduct an outdoor investigation using surface thermometers to measure the temperatures of different surfaces to help them identify the "hot spots" that may need cooling solutions — and the best locations for solar oven testing.

They will:

- Choose five different surfaces to test
- Record material type, surface colour, and sun exposure level
- Record surface temperature at 3 different times

Encourage students to:

- Predict which surface will be hottest and why.
- Use the Step 2 student worksheet to track their data

> 💡 **Teacher Tip:**
>
> Try splitting the investigation across classes or over multiple days. Take temperature readings every 2 hours to track how surface heat changes!

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💡 **Teacher Tip:**

Here's a sample chart to help guide students and clarify expectations. You can share this with the class as a reference or use it to model how to record their data.

Data	**Surface 1** Sidewalk	**Surface 2** Grass	**Surface 3** Asphalt	**Surface 4** Bench	**Surface 5** Woodchips
Temp. Outside (°C)	20 °C	20 °C	20 °C	20 °C	20 °C
Surface Material & Colour	Concrete, Light Grey	Grass, Green	Asphalt, Black	Metal, Silver	Wood, Brown
Surface Temp. (°C) Morning	20 °C	20 °C	26 °C	24 °C	21 °C
Surface Temp. (°C) Midday	31 °C	26 °C	38 °C	39 °C	28 °C
Surface Temp. (°C) Afternoon	29 °C	25 °C	28 °C	35 °C	27 °C

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Step 3: Graphing and Analyzing Data 📊

📊 Graphing the Data

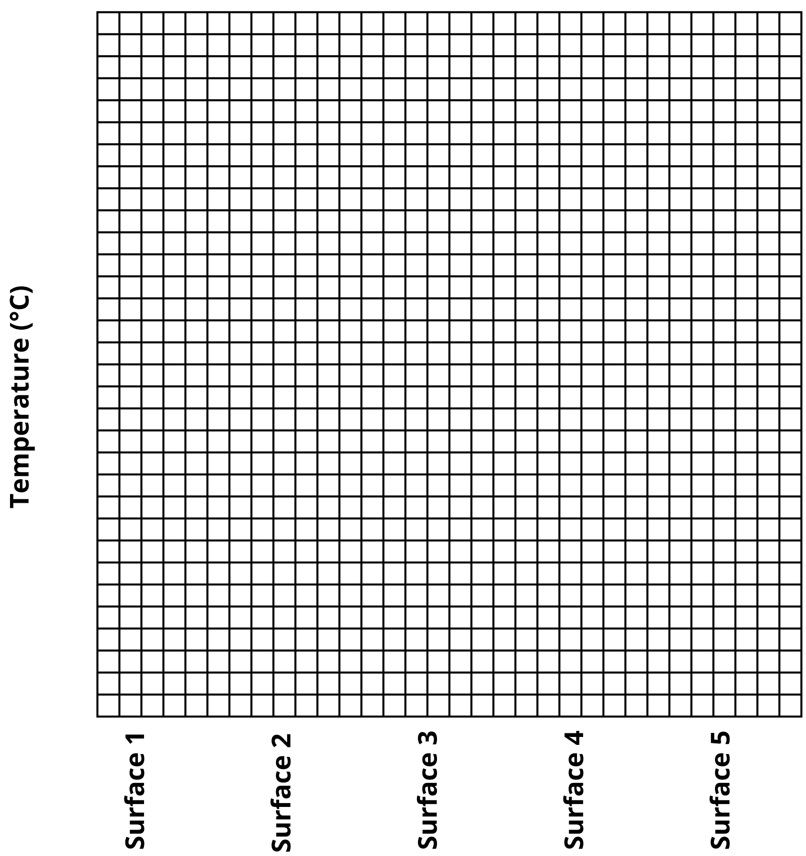
Model an example clustered bar graph with the class before students work independently or in small groups.

- **Clustered Bar Graph**: Students will compare the temperatures of all surfaces at three different times of day (morning, midday, and afternoon). Each surface will have a set of three bars, representing the different times of day. The bars should be grouped by surface, so each surface has a cluster of three bars.

Here are some ideas on how to format the clustered bar graph:

- X-axis: Surfaces (e.g., Asphalt, Grass, Concrete, etc.)
- Y-axis: Temperature (°C)
- Each surface will have three bars representing the temperatures taken at different times of the day: morning, midday, and afternoon.
- Bar Colours: Use different colours for each time of day (e.g., morning = light blue, midday = dark blue, afternoon = orange).

Graph 1: Comparing Heat: Different Surfaces at Different Times



💡 **Teacher Tips**

- Show an example of a clustered bar graph: Display a completed graph and point out labels, axes, colour-coding, and clusters.
- Focus on labelling: Ensure surfaces are labeled on the X-axis and the Y-axis is scaled for temperature. Use colour-coding for morning, midday, and afternoon.
- Encourage annotations: Have students add symbols or notes to highlight “hot spots” 🔥 and “cool zones” ❄️

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🗣️ Analyzing the Data: General Discussion & Reflection

🔄 *Think-Pair-Share:*

Prompt: "What's one thing you noticed from your graph?"

- Let students discuss with a partner before sharing with the class.

💬 *Small Group / Whole Class Discussion*

Use the Student Reflection Questions (below) as open-ended prompts to guide discussion.

- Encourage students to observe, interpret, and apply their data.
- Draw Out Key Concepts:
  - Trends: (e.g., sun vs. shade, dark vs. light colours)
  - Outliers or Surprises: What stood out in the data?
  - Real-World Connections: How could this data be used in real life?

Suggested prompts:

- Which surface stayed the hottest all day?
- What role did shade or sunlight play?
- Did the colour of the surface seem to matter?
- Were any results surprising or different from your predictions?
- Which surface had the biggest temperature change?
- What would the results be like in winter? In early morning? At night?
- Could these results help us build cooler spaces in the summer?
- Why might a city care about this kind of data?
- What could be done to cool down the hottest surfaces?

➕ *Math Integration*

Invite students to apply math concepts relevant to their grade focus:

- Mean (Average): Have students calculate the average temp of each surface.
  - "Which surface had the highest average?"
- Range: Find the difference between highest and lowest temps.
  - "Which surface had the biggest temperature change?"
- Comparison: Discuss which surfaces were most similar/different.
  - "What might explain those similarities?"
- Units & Scale: Talk about using Celsius/Fahrenheit and appropriate intervals on axes.

🌎 *Wrap Up with a "Big Idea" Question:*

- Prompt: "What could we do with this information in real life?"
  - Connect to climate adaptation, design thinking, or environmental science.

💡 Teacher Tips:

- Encourage students to back up their ideas with data from their graphs or charts.
- Record key ideas or patterns on the board for shared learning.
- Allow flexibility in discussions — some groups may dive deeper into the math, others into real-world applications.

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Optional Extension: Take Learning Further!

💡 **Explore the Simulator!**
Check out GreenLearning's Flood:ED School Greening Simulator to learn more about possible solutions to help reduce the local impact of extreme heat.

🔗 ***https://programs.greenlearning.ca/course/schoolgreeningsim***

💭 ***Real-World Action Projects***
Have your students identified an area in your school or community that could benefit from a cooling solution? Are they eager to turn their learning into real change? These optional extensions give students the chance to explore climate action and advocacy in creative, hands-on ways.

💌 **Create an eCard!**
Invite students to turn their cooling solution ideas into a digital eCard they can send to decision-makers. This creative format blends art, writing, and advocacy — perfect for outreach to school leaders, local officials, or environmental groups!

✓ Share their learning
✓ Practice persuasive communication
✓ Take meaningful climate action

🌐 Explore the activity:

🔗 ***https://programs.greenlearning.ca/ecards***

☀️ **Build a Solar Oven!**
Take learning further with a real-world extension that combines science, design thinking, and climate solutions — and lets students harness the sun's power! Consider submitting an entry to the Re-Energy Challenge if you make these ovens or something similar!

✓ Use recycled materials to build a functional solar oven
✓ Apply their temperature data to choose the best testing location & time
✓ Observe how design affects performance — and cook a simple treat!

🌐 Explore the activity, and consider submitting a challenge entry:

🔗 ***https://programs.greenlearning.ca/course/build-a-solar-oven***

🔗 ***https://programs.greenlearning.ca/re-energy***

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References

Environmental Protection Agency. (2025). Heat Island Effect. EPA. https://www.epa.gov/heatislands

University of California Museum of Paleontology. (2020). Absorption / reflection of sunlight. Understanding Global Change. https://ugc.berkeley.edu/background-content/reflection-absorption-sunlight/

Vox. (2021). How America's hottest city is trying to cool down [Video]. YouTube. https://www.youtube.com/watch?v=ZQ6fSHr5TJg

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