

Chemistry at the Crosswalk

Engineering Daylighting Treatments for New York City

Teacher: Pravesh Shiwnarain	Date: 8.6.2026
Class Type: 10th Grade Chemistry	Time Frame: 90 minutes
Unit: Matter and Energy	

Lesson Overview

Unit/ Overarching Focus of Lesson:

Students will use scientific investigation and engineering design to determine how the color of an NYC daylighting treatment affects surface temperature and visibility. They will apply their experimental evidence to develop a proposal that improves intersection safety while helping reduce the urban heat island effect and addressing accessibility, durability, and community needs.

Aim: How can we use experimental evidence about surface temperature and visibility to propose an appropriate color for an NYC daylighting treatment that improves intersection safety and helps reduce the urban heat island effect?

Objectives

1. Measure and record surface temperature of six colored panels under a heat lamp.
2. Construct a temperature-versus-time graph for all surfaces.
3. Compare the visibility and temperature change of different surface colors.
4. Explain results using the concepts of absorption, reflection, and energy transfer.
5. Make an engineering recommendation supported by evidence using a CER framework.

Aligned Standards:

New York State P–12 Science Learning Standards

- HS-PS1-3: Plan and conduct an investigation to compare the properties of substances and materials.
- HS-PS4-4: Evaluate the validity and reliability of claims about the effects of electromagnetic radiation when absorbed by matter.
- HS-ETS1-1: Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants.
- HS-ETS1-2: Design a solution to a complex real-world problem by breaking it into manageable criteria and constraints.
- HS-ETS1-3: Evaluate a solution using prioritized criteria and tradeoffs.

NYSSLS/NGSS Standard: HS-PS4-4

Students evaluate claims about the effects of electromagnetic radiation when absorbed by matter using experimental surface-temperature data and information about solar reflectance.

Engineering Standards: HS-ETS1-1, HS-ETS1-2, and HS-ETS1-3

Students establish criteria and constraints, examine parts of the daylighting design problem, and evaluate colored street-surface treatments using evidence and tradeoffs.

Prerequisite Connection: MS-PS4-2

Students apply the model that waves may be reflected, absorbed, or transmitted when interacting with matter.

Key Vocabulary and Concepts:

- Electromagnetic radiation
- Visible light
- Wavelength
- Frequency
- Absorption
- Reflection
- Transmission
- Thermal energy
- Temperature
- Energy transfer
- Pigment
- Albedo
- Solar reflectance
- Absorptivity
- Surface temperature
- Temperature change ΔT
- Contrast
- Visibility
- Daylighting
- Independent variable
- Dependent variable
- Controlled variable
- Control group
- Criteria
- Constraints
- Tradeoff

Materials & Resources:

NYC Heat Map: <https://shivchem901.github.io/Heat-Map-of-NYC/>

NYC Traffic Data: <https://shivchem901.github.io/NYC-Traffic-Data/map.html>

Virtual Lab Simulation: <https://shivchem901.github.io/Daylighting-Vitruual-Lab/>

Complete Lab: Virtual Lab: <https://shivchem901.github.io/Chemistry-for-Safer-Streets/>

Per group

- Six identical surface samples:
 - Black
 - White
 - Yellow
 - Green
 - Red
 - Unpainted control
- One heat lamp or high-intensity lamp
- Six temperature probes or digital thermometers
- Stopwatch
- Meterstick
- Heat-resistant mat
- Dark-gray roadway background card
- Visibility-rating scale
- Student worksheet
- Graph paper
- Safety goggles

Teacher materials

- Photograph of a familiar NYC intersection
- Example of an intersection before and after daylighting
- Light-matter interaction diagram
- Published claim or technical source about reflective pavement
- Projected class data table
- Spare probes and samples

Teacher Preparation

Before class:

1. Prepare identical samples of equal dimensions and thickness.
2. Apply the same type, amount, and number of paint coats to each painted sample.
3. Allow all coatings to dry completely.
4. Confirm that all lamps and electrical cords are undamaged.
5. Mark equal sample positions around each lamp.
6. Test temperature probes for consistency.
7. Place samples in the same classroom so they begin near the same temperature.
8. Prepare a published-claim card concerning solar reflectance and surface heating.
9. Select a familiar intersection near YECA or another community location.
10. Place heat-resistant mats beneath the testing areas.

Contact probes attached consistently to the underside of each sample are preferable. Infrared thermometers can produce inconsistent readings when surfaces differ in glossiness or emissivity.

Safety Practices:

- Wear safety goggles throughout the investigation.
- Do not touch the lamp bulb, housing, or heated surfaces.
- Place samples on a heat-resistant mat.
- Keep paper, hair, loose clothing, and flammable materials away from the lamp.
- Keep electrical cords away from water and walking paths.
- Do not move the lamp while it is turned on or hot.
- Turn off and unplug the lamp before moving or storing it.
- Allow the lamp and samples to cool before cleanup.
- Report damaged equipment, exposed wires, spills, or injuries immediately.
- Follow all teacher instructions.

Differentiation

- Provide labeled visuals illustrating absorption, reflection, transmission, albedo, and thermal-energy transfer.
- Introduce key vocabulary with student-friendly definitions and examples.
- Provide sentence starters for the hypothesis, data analysis, and CER response.
- Use partially completed data tables with headings and units included.
- Provide a pre-labeled temperature-versus-time graph with established scales.
- Color-code temperature probes and data-table columns to match each surface.
- Model how to use/read IR thermometer and calculate temperature change before the investigation.
- Assign structured group roles, such as materials manager, temperature technician, timekeeper, recorder, and reporter.
- Allow students to discuss observations orally before completing written responses.
- Pair multilingual learners with supportive peers and provide a bilingual vocabulary resource when available.
- Offer enlarged-print materials and digital copies for students requiring visual or accessibility support.
- Reduce the number of surfaces or data intervals for students requiring a modified task while preserving the learning goal.
- Provide teacher check-ins at the prediction, data-collection, graphing, and CER stages.
- Allow students to demonstrate understanding through writing, speaking, a labeled diagram, or a recorded explanation.
- Challenge advanced students to calculate average heating rates and compare temperature change with visibility ratings.
- Ask advanced students to evaluate how pigment composition, glossiness, emissivity, conductivity, and heat capacity could influence the results.
- Extend the investigation by having students evaluate the reliability of a published claim about a reflective or “cool pavement” coating.

Cultural Context

The lesson will be grounded in students' lived experiences as pedestrians, cyclists, passengers, and community members navigating NYC intersections. Culture, relationships, collaboration, and familiar community experiences will support rigorous scientific thinking and increasing student independence.

Specific ideas and practices include:

- Students use their knowledge of neighborhood intersections, crosswalks, parked cars, traffic, street colors, and summer heat.
- Students examine an intersection near school or another location familiar to their community.
- Students' personal observations and community experiences are treated as valuable sources of knowledge.
- Students work in interdependent laboratory teams with defined roles and shared responsibility.
- The teacher establishes a supportive learning partnership and communicates confidence in every student's ability to complete rigorous scientific work.
- Students connect new concepts to familiar experiences, such as dark clothing or pavement becoming hot in sunlight.
- Photographs, diagrams, color samples, demonstrations, and neighborhood examples support information processing.
- Students discuss and rehearse scientific explanations with peers before writing independently.
- Instruction follows an input–elaboration–application sequence:
 1. Observe the phenomenon and learn the scientific concepts.
 2. Conduct the investigation, analyze data, and discuss patterns.
 3. Apply the evidence to recommend an NYC daylighting treatment.
- Students engage in productive struggle by analyzing unexpected results, resolving disagreements, and evaluating engineering tradeoffs.
- Teacher modeling, sentence frames, and guided questioning are gradually reduced as students become more independent.
- Students consider how street-design decisions affect children, older adults, people with disabilities, cyclists, drivers, and public-transit users.
- Students examine whether street-safety and heat-reduction improvements are distributed equitably among NYC neighborhoods.
- Groups receive choices in selecting an intersection, prioritizing design criteria, or presenting their conclusions.
- Students communicate their recommendations through a CER response, letter, poster, presentation, or community-board testimony.
- Students present their findings to an authentic or simulated audience, such as NYC DOT representatives, a community board, classmates, families, or local stakeholders.

Prior Knowledge

Students should be able to:

- Recognize visible light as part of the electromagnetic spectrum.
- Understand that light transfers energy.
- Explain that light may be absorbed, reflected, or transmitted when it strikes matter.
- Recognize that the color observed is related to the wavelengths of light reflected by a surface.
- Understand that absorbed electromagnetic radiation can be converted into thermal energy.
- Distinguish between thermal energy and temperature.
- Read a thermometer or digital temperature probe in degrees Celsius.
- Calculate temperature change using:
$$\Delta T = T_{\text{final}} - T_{\text{initial}}$$
- Identify independent, dependent, and controlled variables.
- Explain why controlled variables are necessary for a fair test.
- Record measurements accurately in a data table with units.
- Construct or interpret a temperature-versus-time line graph.
- Identify patterns and compare data sets.
- Support a scientific claim using evidence and reasoning.
- Understand that engineering solutions are evaluated using criteria, constraints, and tradeoffs.

Students do not need prior knowledge of **albedo**. It can be introduced during this lesson as the fraction of incoming electromagnetic radiation reflected by a surface.

Prior Lesson: Energy	Follow-up Lesson:
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Lesson Overview/Abstract

In this inquiry-based chemistry lesson, students investigate how surface color affects the absorption and reflection of electromagnetic radiation and the resulting surface temperature.

Working as materials scientists advising New York City, student teams expose identical black, white, yellow, green, red, and unpainted surfaces to equal light intensity and measure their temperatures at regular time intervals.

Students calculate temperature changes, construct temperature-versus-time graphs, compare visibility and contrast, and use albedo, absorption, reflection, and thermal-energy transfer to explain observed patterns.

They then evaluate engineering criteria and tradeoffs which includes visibility, heat, durability, safety, and community needs in order to recommend an appropriate color for a daylighting treatment at an NYC intersection.

The lesson connects chemistry concepts to students' experiences with local streets while developing collaborative investigation, data-analysis, scientific reasoning, and evidence-based decision-making skills.

CS3 Smart Streets Connection:

This lesson connects to the Center for Smart Streetscapes (CS3) by engaging students in a community-based street-safety problem. Students collect local data, evaluate how daylighting surface colors influence visibility and heat, and recommend a design that considers safety, accessibility, equity, and community needs. This reflects CS3's broader mission of using hyper-local evidence, engineering, and community input to create safer, more livable streets.

Lesson Activities		
Time [90 min]	Activities	Rationale
00-15 15 min	<i>Do Now:</i> 1. Community Connection and Phenomenon Teacher Will • Display a photograph of a familiar NYC intersection with vehicles parked close to the crosswalk. • Present a daylighted version of the same or similar intersection. • Introduce the scenario: NYC is considering a colored treatment for a daylighted space near a school. The treatment must attract attention and remain visible, but it should not become unnecessarily hot in sunlight. • Invite students to share experiences with visibility, hot pavement, crosswalks, traffic, and street colors in their neighborhoods. Introduce students to 'Urban Heat Islands' and have them explore the heat map website: https://shivchem901.github.io/Heat-Map-of-NYC/ • Record students' observations without immediately evaluating them as correct or incorrect. Student Will • Observe and compare the intersection images. • Share relevant neighborhood experiences. • Identify people who may be affected by the design.	Using a familiar NYC intersection activates students' prior knowledge and connects the scientific concepts to their everyday experiences. The opening images and predictions create curiosity while introducing the real-world problem of balancing pedestrian visibility, street safety, and surface temperature.

	- Predict which surface will be most visible and which will become hottest. Differentiation - Provide before-and-after photographs with labeled features. - Allow students to discuss observations before writing. - Accept responses through speaking, writing, pointing, or sketching. - Provide the sentence frame: I notice _____. This could affect pedestrian safety because _____. Check for Understanding Students complete: Notice: What do you observe? Wonder: What question do you have? Predict: Which color would you recommend initially? Teacher Questions Remember: What happens when sunlight strikes a surface? Understand: Why might color matter at an intersection? Analyze: Who might be most affected by poor visibility? Evaluate: Should NYC select a color based only on appearance?	
16-25 10 min	<i>Mini-Lecture:</i> Teacher Will Use a simple energy model: $E_{\text{incoming}} = E_{\text{reflected}} + E_{\text{absorbed}} + E_{\text{Transmitted}}$ Explain that the samples are opaque, so transmission is small: $E_{\text{incoming}} = E_{\text{reflected}} + E_{\text{absorbed}}$ Introduce: - Reflection - Absorption - Observed color - Pigments - Conversion of absorbed radiation into thermal energy	This section provides the scientific background students need before conducting the investigation. Students learn how electromagnetic radiation can be reflected or absorbed and how absorbed energy can be converted into thermal energy, causing a surface's temperature to increase.

	• Albedo as the fraction of incoming radiation reflected Clarify that color and albedo are related but are not identical. Student Will • Annotate a light-matter interaction diagram. • Identify the reflected and absorbed portions of incoming radiation. • Explain why an opaque sample transmits little visible light. • Make an initial prediction about surface heating. Differentiation • Use arrows and color coding to distinguish incoming, reflected, and absorbed energy. • Provide vocabulary cards with words, definitions, and illustrations. • Use the familiar example of dark and light clothing in sunlight. • Challenge advanced students to explain why two paints of the same color might reach different temperatures. Check for Understanding Ask students to complete: When electromagnetic radiation is absorbed by matter, some of that energy may be converted into _____ energy, causing the temperature to _____. Expected response: thermal; increase Teacher Questions • Remember: What is reflection? • Understand: Why does a red surface appear red? • Apply: Which surface would probably have a higher relative albedo: white or black? • Analyze: Why is observed color not an exact measurement of albedo?	
26-35 10 min	Experimental Design and Safety Laboratory Question. How does the color of a daylighting treatment affect its visibility and surface temperature? Teacher Will	Reviewing variables, controls, procedures, and safety expectations prepares students to conduct a fair and safe investigation. Assigning laboratory roles also

- Review the testing setup and safety expectations.
- Model the correct placement of probes and samples.
- Establish the variables.

Variable type	Variable
Independent	Surface color
Dependent	Temperature, temperature change, and visibility score
Controlled	Material, dimensions, lamp distance, exposure time, probe placement, paint type, and initial temperature
Control	Unpainted sample

promotes participation, collaboration, accountability, and responsible use of equipment.

Groupings & Roles

Assign or allow groups to assign laboratory roles.

Suggested Roles

- Safety and materials manager
- Temperature technician
- Timekeeper
- Data recorder
- Visibility evaluator
- Evidence reporter

Student Will

- Identify variables.
- Write a hypothesis.
- Assign roles.
- Inspect the setup for safety.
- Confirm that all samples are equally distant from the lamp.

Hypothesis Frame

If the surface color is changed from _____ to _____,
then the temperature will _____ because _____.

A scientifically structured hypothesis is acceptable even if the experimental evidence does not support its prediction.

Differentiation

	• Provide a partially completed variables chart. • Mark sample locations on the heat-resistant mat. • Color-code probes to match surface samples. • Allow students to state their hypothesis orally before writing it. • Ask advanced students to identify possible confounding variables. Check for Understanding Why must the samples be made from the same material and placed the same distance from the lamp? Expected response: These variables must be controlled so temperature differences can be connected more confidently to surface color.	
35-60 25 min	Laboratory Investigation Procedure 1. Put on safety goggles. 2. Place the six samples at the marked locations. 3. Confirm that every sample is the same distance from the lamp. 4. Position each probe in the same location relative to its sample. 5. Record the initial temperature of every sample. 6. Turn on the lamp and start the timer. 7. Record temperature at 2-minute intervals for 12 minutes. 8. Do not move the samples, probes, or lamp(s). 9. During the heating period, evaluate each sample's visibility against the same dark-gray background. 10. After 12 minutes, record the final temperatures. 11. Turn off the lamp. 12. Calculate the temperature change for each surface. $\Delta T = T_f - T_i$	Students collect firsthand temperature and visibility data for the different surface colors. Measuring temperature at regular intervals allows them to observe patterns over time and gather evidence for their final engineering recommendation.

Data Table

Time (min)	Black (°C)	White (°C)	Yellow (°C)	Green (°C)	Red (°C)	Unpainted (°C)
0						
2						
4						
6						
8						
10						
12						

Visibility Scale

Score	Description
1	Very difficult to distinguish
2	Difficult to see
3	Moderately visible
4	Easy to see
5	Very easy to see; strong contrast

For increased reliability, several students should rate each surface and calculate or agree upon a group score.

Teacher Will

- Monitor heat and electrical safety.
- Check probe position and sample distance.
- Confer with groups about emerging patterns.
- Encourage students to explain observations to one another.
- Avoid telling students which color “should” become hottest.

Student Will

- Measure and record temperatures.
- Evaluate visibility consistently.
- Maintain assigned laboratory roles.
- Discuss patterns and unexpected results.

	- Record qualitative observations. Differentiation - Provide a data table with units already included. - Use an audible timer for each interval. - Pair a reader with a recorder. - Reduce the number of samples or readings when required by an individual accommodation while preserving the comparison. - Provide frequent teacher check-ins. - Ask advanced students to calculate average heating rate: Average heating rate = $\Delta T/\Delta t$ Formative Checks Teacher verifies: - Accurate units - Consistent probe placement - Correct recording interval - Equal lamp distance - Participation by every group member Teacher Questions Apply: Which surface currently has the greatest temperature increase? Analyze: What pattern is developing? Evaluate: Is one unusual measurement enough to reject the overall pattern? Create: What procedural change would make the evidence more reliable?	
60-65 5 min	Shutdown and Cleanup Teacher Will - Direct students to turn off the lamps. - Confirm that lamps remain stationary while cooling. - Inspect each station. - Collect or secure electrical equipment.	A structured shutdown procedure protects students from hot lamps, heated samples, and electrical hazards. It also reinforces laboratory responsibility and provides an orderly transition from experimentation to data analysis.

	Student Will • Turn off the lamp without touching the bulb or housing. • Leave hot samples in the cooling area. • Return probes and unused materials. • Clear the work area. • Wash hands if directed. Differentiation • Display a visual cleanup checklist. • Assign one cleanup responsibility to each role. • Provide verbal and written instructions. Check for Understanding The materials manager receives teacher approval before the group moves to data analysis.	
65-75 minute	Data Analysis and Graphing Teacher Will Model one temperature-change calculation: $\Delta T = T_f - T_i$ Model the graph structure: • Time on the x-axis • Temperature on the y-axis • Units on both axes • One line for each color • Title and key Student Will • Calculate (ΔT) for each surface. • Construct a temperature-versus-time graph. • Rank surfaces by temperature change. • Compare temperature change with visibility. • Identify patterns and anomalies.	Students calculate temperature change, organize their results, and construct a graph to make patterns easier to identify. Comparing temperature and visibility data helps students understand that an effective daylighting treatment must satisfy more than one design criterion.

Summary Table

Surface	Initial temperature (°C)	Final temperature (°C)	(Δ T) (°C)	Visibility score
Black				
White				
Yellow				
Green				
Red				
Unpainted				

Differentiation

- Provide a pre-labeled graph for students who need graphing support.
- Allow students to graph digitally when appropriate.
- Provide calculation frames:

$$\Delta T = \text{____ } ^\circ\text{C} - \text{____ } ^\circ\text{C} = \text{____ } ^\circ\text{C}$$

- Ask students to explain their graph verbally before writing.
- Challenge advanced students to compare slopes or average heating rates.

Teacher Questions

- **Remember:** Which variable belongs on the x-axis?
- **Apply:** How do you calculate temperature change?
- **Analyze:** Which sample heated most rapidly?
- **Evaluate:** Does the most visible surface also have the lowest temperature increase?
- **Create:** How could the data be displayed to make the engineering tradeoff clear?

75-85
10 min

Engineering Recommendation and CER

Design Criteria

Criterion	Suggested priority
Visibility and contrast	40%
Limited temperature increase	30%
Durability	15%
Safety and community suitability	10%
Cost and maintenance	5%

The class may revise the priorities after discussing community needs.

CER Prompt

Which color should NYC use for a daylighting treatment near a school?

Claim

Identify the recommended color.

Evidence

Include:

- Final temperature or temperature change
- Visibility score
- A comparison with at least one other color
- Information from the published source

Reasoning

Explain:

- How absorption and reflection affected temperature
- How albedo relates to the observed pattern
- Why the evidence supports the selected color
- At least one engineering tradeoff
- One limitation of the investigation

Students use their experimental data and scientific understanding to recommend a surface color for an NYC daylighting treatment. The CER requires them to support their decision with quantitative evidence while addressing visibility, heating, community needs, and engineering tradeoffs.

	Student Will • Discuss possible recommendations with the group. • Write an individual CER response. • Use scientific vocabulary and numerical evidence. • Explain why the selected color provides the best balance of criteria. Teacher Will • Conference with groups without selecting the answer for them. • Press students to use quantitative evidence. • Reinforce that more than one recommendation may be defensible. • Gradually remove sentence frames as students demonstrate independence. Differentiation Provide the frame: NYC should use _____. This surface had a temperature change of _____ °C and a visibility score of _____. Compared with _____, it _____. These results suggest that the surface reflected _____ and absorbed _____. Although _____ is a limitation or tradeoff, this color provides the best balance of _____ and _____. Additional options: • Oral rehearsal before writing • CER organizer • Speech-to-text • Labeled diagram with written explanation • Extension requiring rebuttal of an alternative recommendation	
85-90 min	<i>Group Debrief & Reflection:</i> Exit Ticket A black surface increased from 22° to 41°C. A yellow surface increased from 22°C to 32°C. 1. Calculate (ΔT) for each surface. 2. Which surface absorbed more radiation under the test conditions?	The exit ticket provides a quick individual check of students' ability to calculate temperature change and connect radiation absorption to surface heating. It also assesses whether they understand why the coolest surface may not automatically be the best engineering

	3. Give one reason NYC might choose a color other than the coolest surface. Expected Responses 1. Black: $41-22=19^{\circ}\text{C}$ and Yellow: $32-22=10^{\circ}\text{C}$ 2. The black surface likely absorbed more incoming radiation under the test conditions. 3. Acceptable considerations include visibility, contrast, durability, glare, fading, cost, maintenance, or community preference.	solution.
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Lesson Assessments	
Methods of Assessment: Formative Assessment • Community observation and prediction • Light–matter diagram • Variables identification • Safety check • Temperature data • Teacher questioning • Graph and calculations • Published-claim evaluation • Group discussion Summative Evidence • Experimental Design: Hypothesis & Variables • Completed data table • Temperature-versus-time graph • Individual CER recommendation • Exit ticket Evidence of Mastery A successful student response: • Uses accurate measurements and calculations. • Identifies a meaningful pattern. • Explains the pattern using absorption and reflection. • Recognizes temperature as indirect evidence of relative energy absorption. • Evaluates the strength and limitations of a published claim.	

- Recommends a color using quantitative data and engineering tradeoffs.

Anticipated Misconceptions

Misconception	Planned teacher response
Black surfaces create heat.	Explain that they absorb a greater fraction of incoming radiation, which may be converted into thermal energy.
White surfaces absorb no radiation.	Clarify that white surfaces generally reflect more radiation but still absorb some.
Color and albedo are identical.	Explain that albedo also depends on pigment composition, texture, gloss, moisture, and wavelength range.
Temperature change directly measures albedo.	Clarify that it provides indirect evidence because heat capacity, conductivity, emissivity, and heat loss also affect temperature.
The coolest color is automatically the best solution.	Revisit visibility, glare, durability, cost, maintenance, and community needs.
One trial proves the claim.	Discuss replication, outdoor testing, weather conditions, and measurement uncertainty.
An unsupported hypothesis is incorrect work.	Reinforce that a hypothesis is evaluated by evidence and does not have to predict the observed result.

Lesson Vocabulary

Term	Student-friendly definition
Electromagnetic radiation	Energy that travels through space as electromagnetic waves, including visible light.
Visible light	The portion of the electromagnetic spectrum that humans can see.
Wavelength	The distance between corresponding points on consecutive waves. Different visible-light wavelengths are perceived as different colors.
Frequency	The number of wave cycles that pass a point each second.

Absorption	The process in which matter takes in electromagnetic radiation. Absorbed light energy can be converted into thermal energy.
Reflection	The process in which electromagnetic radiation bounces off a surface.
Transmission	The passage of electromagnetic radiation through a material.
Thermal energy	Energy associated with the motion of particles in matter.
Temperature	A measurement related to the average kinetic energy of particles in a substance.
Energy transfer	The movement of energy from one object, material, or system to another.
Pigment	A substance that gives a material its color by selectively absorbing and reflecting different wavelengths of light.
Albedo	The fraction or percentage of incoming electromagnetic radiation reflected by a surface.
Solar reflectance	The fraction of incoming solar radiation reflected by a surface.
Absorptivity	The fraction of incoming radiation absorbed by a material.
Surface temperature	The temperature measured at or near the outside surface of a material.
Temperature change (ΔT)	The difference between the final and initial temperatures: ($\Delta T = T_f - T_i$).
Contrast	The visible difference between a surface and its background. Greater contrast generally improves visibility.
Visibility	How easily an object or surface can be detected or distinguished from its surroundings.
Daylighting	An intersection-safety treatment that removes visual obstructions near crosswalks so drivers, cyclists, and pedestrians can see one another more clearly.
Independent variable	The factor intentionally changed - in this investigation, surface color.
Dependent variable	The factor measured in response - in this investigation, surface temperature or temperature change.
Controlled variable	A factor kept constant to ensure a fair comparison, such as material, lamp distance, exposure time, or sample size.
Control group	The comparison condition that does not receive the tested treatment - in this investigation, the unpainted sample.

Criteria	The qualities a successful engineering solution should have, such as high visibility and limited heating.
Constraints	Limitations placed on an engineering solution, such as cost, durability, safety, and available materials.
Tradeoff	A compromise in which improving one feature may reduce performance in another.