



Sunshade

The Society of Automotive Engineers (SAE) needs your help in designing a sunshade for screening the harmful effects of the summer sun from the interior of an automobile. The goal of this project is to reduce the dangerous internal temperatures that can develop in a parked car during the summer months. A secondary consideration is to reduce the amount of fading and brittleness that damages the car's upholstery from excessive exposure to UV radiation.

DESIGN REQUIREMENTS

- Must expand to cover the windshield on a typical mid-size car
- Must compress small enough to allow for easy storage
- When not in use, no part of the sunshade can block any windows
- Construction materials should not emit any noxious fumes when heated
- Temperature and UV radiation reduction: $\geq 25\%$

TESTING EQUIPMENT

- Vernier Interface
- Stainless Steel Temperature Probe
- UVA or UVB Sensor

DELIVERABLES

- Prototype
- Detailed design specifications (so the unit can be replicated exactly)
- Temperature and UVA/UVB log (4 hours)
- Impact statement on the benefit of your design to the environment

CONSTRAINTS

- Construction materials must be readily available from a local hardware store
- Budget limited to \$10

JUDGING CRITERIA

- Ease of construction
- Ease of installation and removal
- Placement profile (size; location)
- Method of storage
- Durability
- Aesthetics
- Percentage reduction in temperature and UVA/UVB

Teacher Tips

OBJECTIVE

Students will build a sunshade for screening the summer sun from the interior of an automobile.

BACKGROUND

A sunshade is a reflective shield that can protect the interior of a car from the adverse and sometimes lethal effects of the sun's UV radiation. According to NOAA's National Weather Service, extreme heat, direct sunlight, and closed windows can increase interior temperatures to nearly 200°F in just 15 minutes. Every year children, adults, and pets die from hyperthermia, a condition that occurs when the body absorbs more heat than it can dissipate. Vinyl upholstery and metal seatbelt buckles can burn your skin even through clothing. Even on a winter day, sunlight passing through the windshield of a car can significantly increase interior temperatures.

On a sunny day, an automobile experiences what is commonly called "the greenhouse effect." Sunlight passes through automobile windows as shortwave radiation; however, since most surfaces inside a car aren't reflective, they absorb most of the radiant energy from sun. The hot dashboard, steering wheel and seats heat the interior air through conduction and convection; but the same glass that allowed the transmission of visible light, blocks infrared thermal radiation from escaping. If the windows are up, air is unable to flow amplifying the heat-trapping effect.

UV radiation also causes noticeable damage to the interior in as little as 2-3 years. Cracks in vinyl and leather, faded upholstery, and dull plastic parts are just some of the adverse side effects.

TEACHER PROCEDURE

1. Instruct the class on the purpose of a sunshade. Students should be able to discuss the long and short-term effects of UV radiation on the interior of an automobile.
2. Conduct preliminary tests to determine the temperature and UV profiles for a car parked in the sun for an entire day.
3. Have students design and build a sunshade.
4. Create a second temperature and UV profile after installing the sunshade. Try to make the second profile in the same car parked in the same location with a similar weather forecast.
5. Calculate the percentage reduction in temperature and UV readings when using the sunshade.

TIME ALLOTMENT

Moderate: 1–2 class periods

This activity requires 1–2 class periods to design and build the sunshade. Additional time will be needed for pre- and post-data collection, as well as discussion of the results.

CONSTRUCTION TIPS

There are actually quite a number of sunshades readily available for purchase, but encourage students to be creative in the design process and go beyond the typical roll-up, folding, or accordion styles. The sunshade does not have to be completely removable from the windshield when not in use, but it must not obstruct the driver's view. While temperature and UV reduction are the primary goals, students must also be aware of placement, storage, durability, and aesthetics.

This project will have the most impact if it is conducted during the summer; however, in some locations, you may get very sunny days all year long.

RE-ENGINEERING OPTION

There are a number of ready-made sunshades available on the market. As an option to having your students design their own, you can ask them to make one or more modifications to an existing product. Make sure that you impress upon your students that any design changes must exhibit a measureable reduction in temperature and/or UV data values compared to using the unaltered sunshade.

RESOURCES

- <http://www.weather.gov/om/heat/index.shtml>