School Guide to Smart Surfaces

American Lung Association.

In collaboration with:

SMART SURFACES COALITION

Introduction

Schools across the U.S. regularly experience extreme heat, floods and other disasters each year due to a changing climate. The American Lung Association is promoting practical solutions, such as Smart Surfaces, to address the impacts of excessive heat and improve the health of people across America. Smart Surfaces encompass a suite of proven, cost-effective solutions designed to mitigate heat, enhance air quality and improve health.

Many schools lack adequate infrastructure to remain cool during extreme heat events. The Government Accountability Office found in 2020 that 41% of public-school districts urgently need upgrades to HVAC systems in at least half of their buildings, totaling 36,000 buildings nationally. Spending time in the schoolyard may only compound the problem. Unshaded playgrounds and asphalt quickly heat up and are hotter than the surrounding areas, with surface temperatures that can cause burns.

The goal of this Guide is to:

- Emphasize how excessive heat impacts student learning
- Provide schools with actionable steps to mitigate excessive heat
- Provide examples of Smart Surfaces at Schools
- Overview funding options to support Smart Surface adoption

Excessive heat impact on student learning

Children are more vulnerable to the effects of heat than adults; academically and physically. Children are less able to self-regulate in extreme temperatures and can get dehydrated more quickly. Children also face a heightened risk of some health conditions, including asthma, when they experience extremely high temperatures.

Each school day over 80 F lowers test scores. The National Center for Education Statistics' (NCES) most recent survey of the Condition of America's Public School Facilities (2012–2013 school year) found 30% of school buildings did not have adequate air-conditioning. The impact on learning disproportionately affects students in low-income districts, often correlated with race due to historic redlining, as these districts have fewer funds available for school improvement projects and are more likely to have school buildings that lack sufficient cooling mechanisms. These disproportionate impacts foster increasing academic and economic inequity between students in low- and high-income school districts.

Heat Indoors

- When schools cannot maintain comfortable indoor temperatures, students' ability to learn suffers.
- For each 1°F increase in temperature there is a 1% reduction in learning.
- The projected increase in the number of districts that experience more than 32 school days a year over 80°F suggests the impact of heat on learning could be substantial, whether it is from school closure or from learning in overheated classrooms.

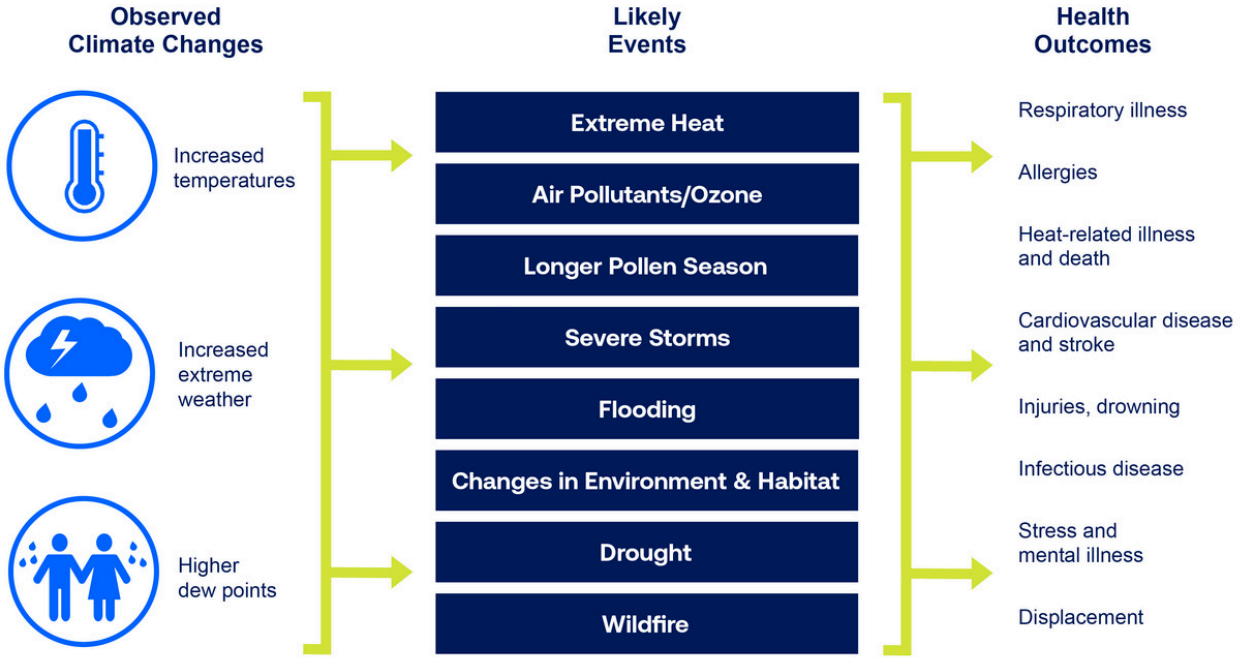
Heat Outdoors

- Outdoor recreation is important for kids' physical and mental health, but schools weren't designed to protect students from dangerous heat.
- In the sun, a person's heat burden is up to 70°F hotter than in the shade.
- Asphalt can get over 160°F to the touch – hot enough to cause 3rd degree burns in 5 seconds.
- Artificial turf surfaces are even hotter, reaching nearly 160°F - hot enough to melt cleats.

How ‘Smart Surfaces’ can Reduce Heat and Improve Health

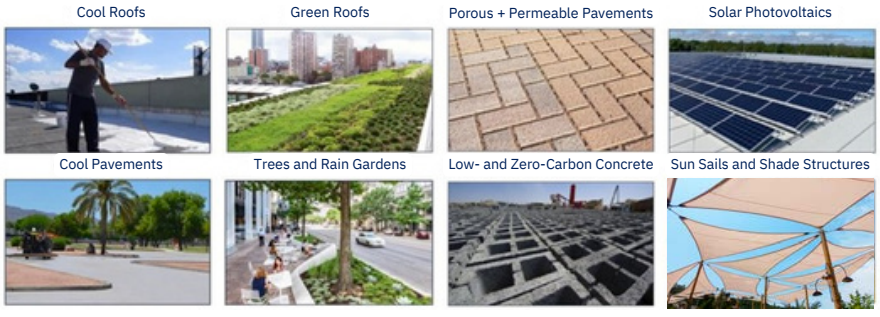
Many school campuses across the U.S. are made up of dark and non-porous roads, parking spaces, sidewalks and roofs. These surfaces contribute to increased heat, flooding, increased air pollution and poor health.

Excessive Heat Impacts Health



The ‘Smart Surfaces’ Solution

Smart Surfaces encompass a suite of proven, cost-effective solutions, including reflective (cool) roofs and pavements, green roofs, trees, solar photovoltaics (PV) and rain gardens. These features are designed to mitigate urban heat, enhance air quality and improve health.



Roofing, Solar, and Reflective Surfaces:

Green and cool roofs are living, breathing entities that absorb rainwater, reduce heat absorption, and improve air quality. With green and light-colored roofs, less heat is transferred into buildings and the air. Cool roofs reduce energy consumption and costs. The plants on a green roof reduce carbon dioxide, nitrogen dioxide, and particulate matter in the air. Another benefit of a green roof is that they have a longer effective life span than traditional dark and impervious roofs.

Solar photovoltaic cells, also known as solar PV, convert sunlight into renewable energy, helping cities reduce their reliance on fossil fuels. Solar reduces energy demand from non-renewable power plants, reducing greenhouse gas emissions and improving air quality. Solar panels also provide shade for buildings, sidewalks, and other public areas.

Reflective windows, walls and roofs are light-colored and engineered to reflect most sunlight, reducing the heating of outdoor air. Traditional dark-colored roofs absorb more of the light that falls on them, radiating heat into the building and the surrounding air, which increases cooling costs and energy consumption while decreasing comfort.

Greenspace and Bioswales

Increasing green space involves planting trees, shrubs, and native grasses, including on parking lots, along streets, and around playgrounds. Increased green space provides shade, which reduces temperature and also reduces water pollution caused by runoff during heavy rains. Trees reduce the flood risk because they absorb water during heavy rains.

Planting trees is a reliable way to turn CO_2 into oxygen, remove pollutants from the air and reduce flood risk. Trees also reduce ambient temperature through shading and evapotranspiration, lowering reliance on energy-intensive air conditioning.

Rain gardens and bioswales both collect rainwater runoff, filter stormwater pollutants from the water and allow water to be reabsorbed into the soil. Bioswales are similar to rain gardens, but they are much larger and can capture more runoff from larger surfaces, such as streets and parking lots. Rain gardens and bioswales help cool the air temperature and provide habitats for native plants and wildlife.

Porous Pavement and Walkways

Porous pavements allow rain to absorb into the ground, reducing pollution, stormwater runoff, and flood risk. Porous pavements can lower temperatures through evaporative cooling. Porous pavements act as a filter for water, being cleaned as it passes through the soil into the groundwater. Porous pavements decrease the likelihood of stormwater overflowing into sewers and bodies of water. Types of porous pavements include porous asphalt, concrete, permeable pavers, and porous grid pavers with turf or gravel.

Limiting paved areas improves drainage and lowers surface-level heat. Additionally, concrete is responsible for 8% of global carbon emissions. New concrete materials are available that make it carbon-neutral or even carbon-negative. When pavement is needed, use a low or zero-carbon concrete.

Light colored roads reflect more sunlight than dark asphalt. This leads to reduced pavement temperature, cooler streets and neighborhoods, and greater pedestrian and resident comfort. Light-colored, cool roads increase pavement lifespan, reduce street lighting requirements, and provide greater visibility, which can result in fewer car accidents.

Other Indoor/Building Solutions

Curtains can help prevent heat from accumulating inside. White and light-colored curtains are better at reflecting sunlight and heat than darker curtains. Thermal curtains with a liner can help reduce heat loss in colder months. Layering curtains can increase insulation. Studies demonstrate that medium-colored draperies with white-plastic backings can reduce heat gains by 33%.

Improve Building Envelope by focusing on air-sealing, utilizing high-performance insulation materials, and minimizing thermal bridging. Thermal bridging occurs when structural elements like studs conduct heat through insulation. Thermal breaks are materials that interrupt the flow of heat; which can be accomplished by placing insulation on the exterior of the framing.

Ceiling Fans can be used to improve comfort all year long by effectively circulating air. In the Summer, ceiling fans can be run counterclockwise to create a cooling breeze. In the Winter, reverse the direction to clockwise and use a slower speed to circulate warmer air downward.

Other Outdoor Solutions

Shade Structures and Sun Sails effectively prevent heat by blocking direct sunlight. Shade structures near buildings can also reduce indoor temperatures by providing shade over windows, reducing the need for air conditioning. Shade structures over outdoor playgrounds and recreation areas can create a more comfortable environment.

Misting Stations spray a fine mist of water into the air. Misting stations are an effective method for preventing heat-related problems. As the water evaporates, it absorbs heat from the surrounding air, thereby lowering the overall temperature of the air. Misting stations can be effective in large areas such as athletic fields and playgrounds.

Engaging Student Voices

Fresh Perspectives. Fresh Voices. Youth from around the country are leading the way in the fight for lung health. It's essential to listen to and empower youth to lead in improving their school environment. This includes engaging students in the planning process, elevating their voices to better understand the impact of heat on their learning, and equipping them with the tools and opportunities to advocate for change. To learn more about youth empowerment opportunities, click here.

Air Quality Activities for Students

Grades PreK-2

- "Catching" Air Pollution
- Keep Indoor Air Clean
- Indoor Air Quality Coloring Sheet

Middle School

- Indoor Air Quality Dilemmas
- Indoor Air Quality Matching Game
- Rubber Band Air Test

Grades 3-5

- Where Does the Dust Hide?
- How Indoor Air Pollution Happens
- Indoor Air Quality Coloring Sheet

High School

- Smart Surfaces Environmental Scan
  - Make a list and take photos of all "Smart Surfaces" already existing on your school campus.


American
Lung
Association.
When you can’t breathe, nothing else matters.®
Lung.org/Smart-Surfaces

Funding Smart Surfaces

When it comes to incorporating Smart Surfaces into schools, many short-term and long-term solutions come with a range of costs. **When your school undertakes a capital improvement project, such as replacing a roof or repaving a parking lot, incorporate comparatively priced, lighter-colored, reflective, or porous materials.** These small changes, over time, can have a compounding positive impact, resulting in lower overall heat, combating poor air quality, and ultimately improving student health.

Short Term Solutions

- Plant trees
- Install shade structures such as sun sails
- Place a water misting station in outdoor recreation areas
- Install light-colored curtains to reduce heat in classrooms

Long Term Solutions

- Fully grown trees provide shade to playgrounds and school buildings
- Upgrade surfaces such as roofs and pavement to be lighter and reflective
- Install rooftop solar and green roofs
- Install permeable pavers
- Install solar panels that can also provide canopy shade