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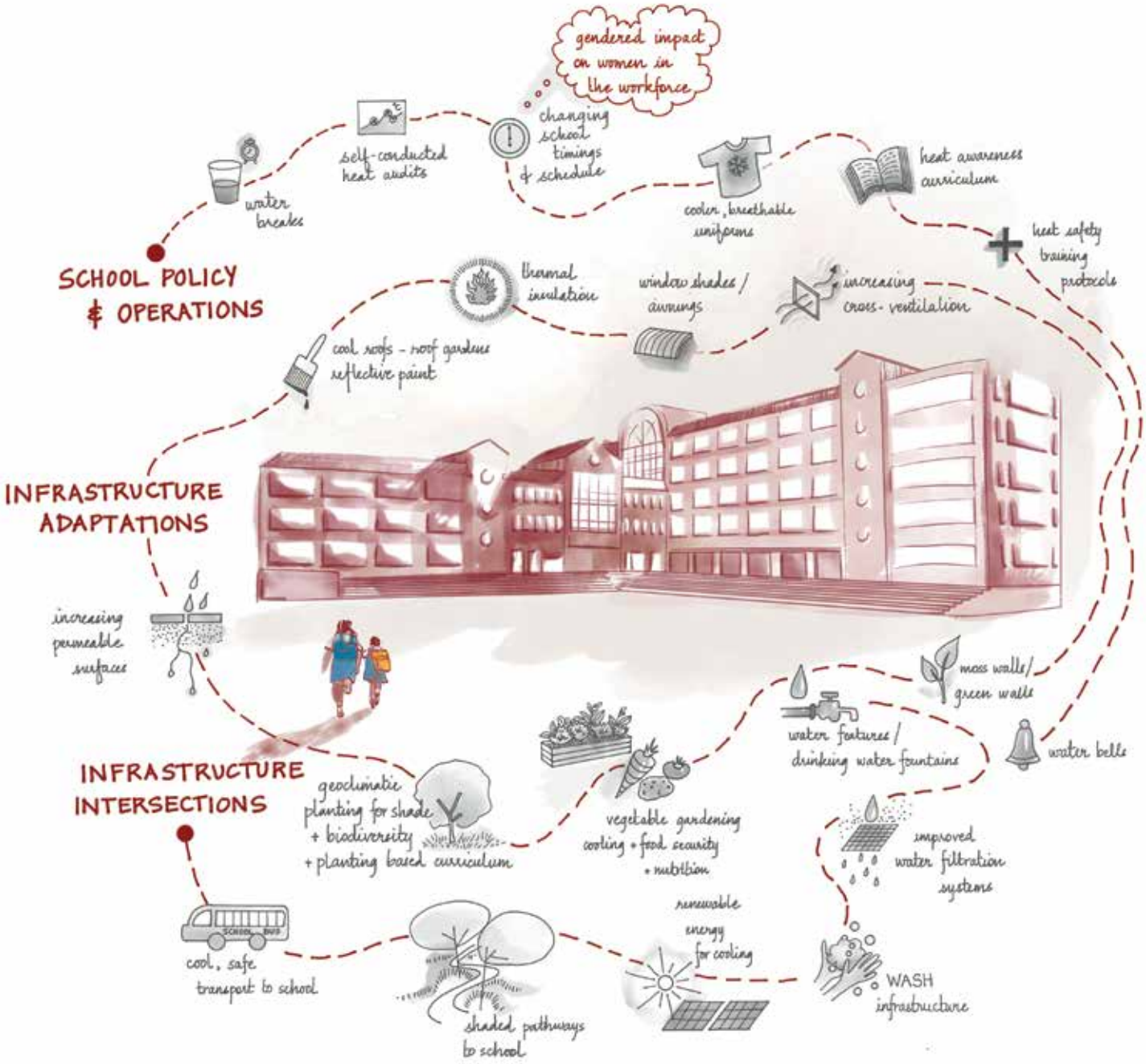

Heat Smart Schools

Guidance for Building Resilience to Extreme Heat

Community of Practice on Extreme Heat Management in Education Infrastructure

October 2025

Heat Smart Schools:
Community of Practice for Extreme Heat Management in Urban Educational Infrastructure

Guidance Document

Urban Infrastructure Resilience Programme, Coalition for Disaster Resilient Infrastructure

Information about CDRI is available on the website: *https://cdri.world/*

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Preface

This guidance document is the product of the Community of Practice (CoP) on Heat Smart Schools, convened by the Coalition for Disaster Resilient Infrastructure (CDRI). The CoP brings together experts in school education, architecture, public health, climate science, disaster risk reduction, and municipal governance. Over the course of eight meetings between June and August 2025, more than 150 professionals from over 70 organizations contributed to a collective understanding of the risks of extreme heat in schools and the solutions available.

The purpose of this document is to provide practical guidance for school administrators on managing extreme heat, but it also contains nuggets of information and advice to offer to teachers, parents, students, and officials in education departments, municipalities, disaster management agencies and finance authorities.

This conversation supports CDRI's goal of promoting resilient infrastructure, through increased capacity to absorb shocks and stresses, respond to disasters, and recover from them. This can be achieved through structural and non-structural measures, as demonstrated through the CoP's deliberations and this guidance document.

For a policy level actor, the guidance offers a practice-oriented roadmap that can be used to create an enabling environment for resilience building in schools, including opening of funding opportunities to support frugal yet impactful actions at scale.

The advice offered in this document is particularly aimed at practitioners in geographies with vulnerable communities and schools facing extreme heat. This does not, however, necessarily mean that it is only for the Global South. While developing economies are facing the greatest challenges from extreme heat and limited resources to manage it, the rapid emergence of extreme heat as a threat is equally impacting vulnerable groups in developed parts of the world.

The recommendations are grounded in evidence and field practice and are intended to be of use to school communities exposed to extreme heat everywhere, now and in the foreseeable future. Since children are everybody's business, this guidance is relevant to everyone. It spells out specific roles for a range of identified stakeholders which should be used as a trigger for further thought and actions, and will certainly evolve significantly in the times to come.

The document and several related resources are available on CDRI's platform DRI Connect. We invite you to engage with community members on this platform and keep this conversation going forward and growing. A society that ensures its children's resilience will be resilient for everyone.

Schools are among the most vital parts of a city's infrastructure. At CDRI, we see resilience not only in power grids and highways but also in hospitals and schools where communities grow stronger. This Community of Practice on Heat Smart Schools shows that social infrastructure is critical infrastructure. By helping schools adapt to extreme heat, we protect children's futures and strengthen societies worldwide.

Amit Prothi

Director General, Coalition for Disaster Resilient Infrastructure

Our schools must be more than places of both safety and learning. As climate extremes intensify, heat threatens the health and education of millions of children. The goal of building 100,000 heat-resilient schools in the next five years is both acheivable and essential. This guidance supports that vision, by helping communities design schools that can absorb shocks, respond swiftly, and recover stronger in a warming world.

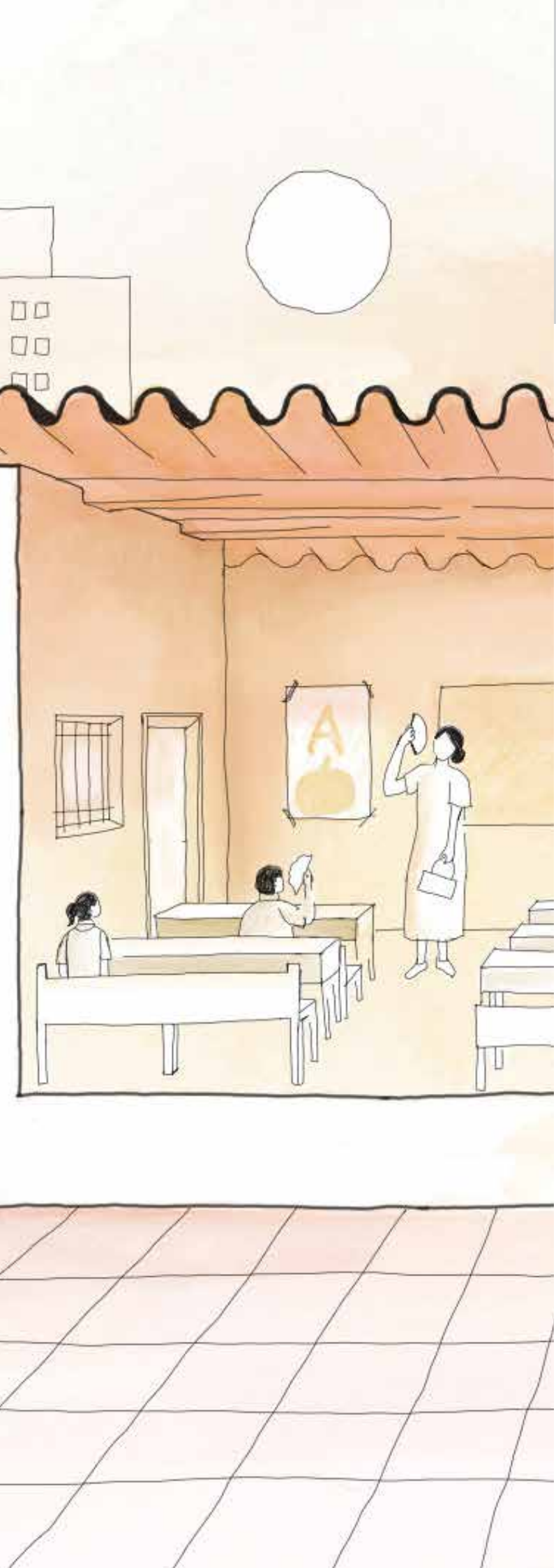
Kamal Kishore

Special Representative of the UN Secretary-General for Disaster Risk Reduction

Around the world, teachers, parents, and students are ready to rise to the challenge of extreme heat impacts on learning and student well-being at school. This momentum drives the power to protect critical learning and health from heat with practical solutions found in this timely guide by CDRI and our Community of Practice on Heat Smart Schools.It makes the case for collective problem solving and maps out a clear vision showing that together, we can make every school a safe and cool place to learn.

Kathy Baughman McLeod

Founder and CEO, Climate Resilience for All / CoP Member and Advisor



Executive Summary

Extreme heat is one of the fastest-growing climate-related risks that affects children. According to United Nations Children's Fund (UNICEF, 2024), by 2050, almost every child on Earth, over two billion, will be exposed to frequent heatwaves. In 2024 alone, heat-related school closures affected around 171 million children worldwide. The Intergovernmental Panel on Climate Change (IPCC, 2023) warns that rising global temperatures will intensify both the frequency and severity of heatwaves, making them longer and more lethal.

Children are uniquely vulnerable to heat. Physiologically, they absorb heat faster and regulate it less efficiently than adults (WHO, 2024). Even moderate heat stress can impair cognitive performance, reduce memory retention, and lower test scores (Park et al., 2020). For many schools in the Global South, often built with metal roofs, poor ventilation, and limited water access, the risks are magnified. Teachers also face heat-related fatigue, affecting the quality of education delivered.

The consequences extend beyond health and learning. Heatwaves exacerbate inequality: children in low-income and rural communities often lack access to cooling measures, heat appropriate food, or healthcare. Girls and children with disabilities face additional barriers, such as restrictive clothing or lack of accessible infrastructure. Without proactive action, extreme heat will widen educational disparities.

The Coalition for Disaster Resilient Infrastructure (CDRI) established the Community of Practice (CoP) on Heat-Smart Schools to respond to this urgent challenge, bringing together global experts to identify and document best practices, innovative solutions and essential first-hand experience.

This document distils the CoP's findings into seven actionable steps that build heat-smart schools:

01 **Set Up Governance:**
Establish inclusive schools and administrative structures with clear accountability for disaster resilience, ensuring adequate focus on extreme heat.

02 **Use the Science:**
Harness forecasts, local data, and school-level diagnostics to guide actions on heat resilience.

03 **Implement Adaptation Actions:**
Retrofit, design, and green schools using codes and nature-based cooling solutions.

04 **Educate:**
Empower students, teachers, and parents with heat literacy.

05 **Address Underlying Risks:**
Ensure access to water, nutrition, health services and heat safe environments when they are outside school.

06 **Invest in Risk Reduction:**
Mobilize finance for heat resilience from education, public works, health, urban and climate budgets.

07 **Prepare for the Future:**
Integrate heat resilience into school disaster management, response, and recovery. Integrate schools into city heat action plans.

Each section of this guidance provides a call for action, shares facts and good practices, and provides key recommendations tailored for multiple stakeholders, including school administrators, teachers, students, parents, and municipal, health and finance officials, disaster management authorities, and policymakers.

While this guidance document focuses primarily on schools, the Community of Practice also discussed heat resilience across the wider spectrum of education infrastructure. This includes school buses and other modes of travel, the daily walk to and from school, as well as crèches, pre-schools, higher education institutions, and coaching centres. Each of these settings faces distinct challenges, and much remains to be done to strengthen their resilience. The principles outlined in this document can be extended through the continued work of the community and others to cover these and additional dimensions of the education ecosystem in the future.

Schools must become heat smart. With foresight and practical steps, they can be safe havens that protect children's right to learn and thrive, even in the face of rising heat.

Adopting the Comprehensive School Safety Framework guides schools and education authorities to combine safe learning facilities, school disaster management, risk reduction and resilience education into a single multi-hazard plan. Heat can be addressed within this using a deliberate focus, and tools such as UHeat, a digital solution from ARUP, UCL and the University of Reading, that uses satellite imagery and open data to find urban heat hotspots. Such tools can support targeted strategies to identify and prioritise the most vulnerable schools for heat resilience action.

– Hayley Gryc

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Abbreviations

ADB	Asian Development Bank
ADPC	Asian Disaster Preparedness Center
ADRA	Adventist Development and Relief Agency
AI	All India Disaster Mitigation Institute
AIDMI	Artificial Intelligence
AIIMS	All India Institute of Medical Sciences
ANSI	American National Standards Institute
ASHRAE	American Society of Heating, Refrigerating and Air-Conditioning Engineers
BNCA	Dr. Bhanuben Nanavati College of Architecture
CDKN	Climate and Development Knowledge Network
CDRI	Coalition for Disaster Resilient Infrastructure
CEEW	Council on Energy, Environment and Water
CEPT	Center for Planning and Technology, now known as CEPT University
CoP	Community of Practice
CRA	Climate Resilience for All
GADRRRES	Global Alliance for Disaster Risk Reduction and Resilience in the Education Sector
GETI	Global Education and Training Institute
GIFT City	Gujarat International Finance Tec-City
HAP	Heat Action Plan
ICF	Inner City Fund
ICSI	International Coalition for Sustainable Infrastructure
IFRC	International Federation of Red Cross and Red Crescent Societies
IPCC	Intergovernmental Panel on Climate Change

IRADe	Integrated Research and Action for Development
ISET	Institute for Social and Environmental Transition
NDMA	National Disaster Management Authority (India)
NGO	Non-Governmental Organization
ORS	Oral Rehydration Solution
PATH	People's Association for Training and Health
PESO	Petroleum and Explosives Safety Organisation
PwC	Pricewaterhouse Coopers, now known only as PwC
RIKA	Resilience Innovation Knowledge Academy
RIMES	Regional Integrated Multi-Hazard Early Warning System for Africa and Asia Heat Action
RMSI	Risk Management Solutions Inc
SEEDS	Sustainable Environment and Ecological Development Society
SHAC	School Heat Action Committee
SOP	Standard Operating Procedure
UCL	University College London
UCLA	University of California, Los Angeles
UN	United Nations
UNDP	United Nations Development Programme
UNDRR	United Nations Office for Disaster Risk Reduction
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNICEF	United Nations Children's Fund
US EPA	United States Environmental Protection Agency
WHO	World Health Organization

The Heat Challenge in Schools

Extreme heat events have increased in intensity and frequency in recent years, although the hazard and its impacts often remain unseen. It is anticipated that in the years to come the extreme heat crisis will worsen in all parts of the world. Understanding and anticipating the risk adequately to be able to act against it is our first challenge.

Extreme heat has become a structural risk to education. The IPCC (2023) highlights that heatwaves are now more frequent, longer, and more intense. In 2022, Europe recorded over 61,000 excess deaths linked to heat (Ballester et al., 2023), underscoring its lethality. For schools, the challenge is unique: classrooms concentrate children at times of day when temperatures peak, often in buildings designed without thermal comfort in mind. Metal roofs, sealed windows, and concrete yards amplify the urban heat island effect, especially in dense cities of the Global South.

Children's vulnerability is multifaceted. Physiological factors make them less able to regulate body temperature. Behavioural aspects, such as high activity levels and dependence on adults, compound risk. Socio-economic disparities determine access to cooling and healthcare. Girls may face cultural barriers to hydration and cooler clothing choices. Children with disabilities may lack access to shaded, ventilated spaces.

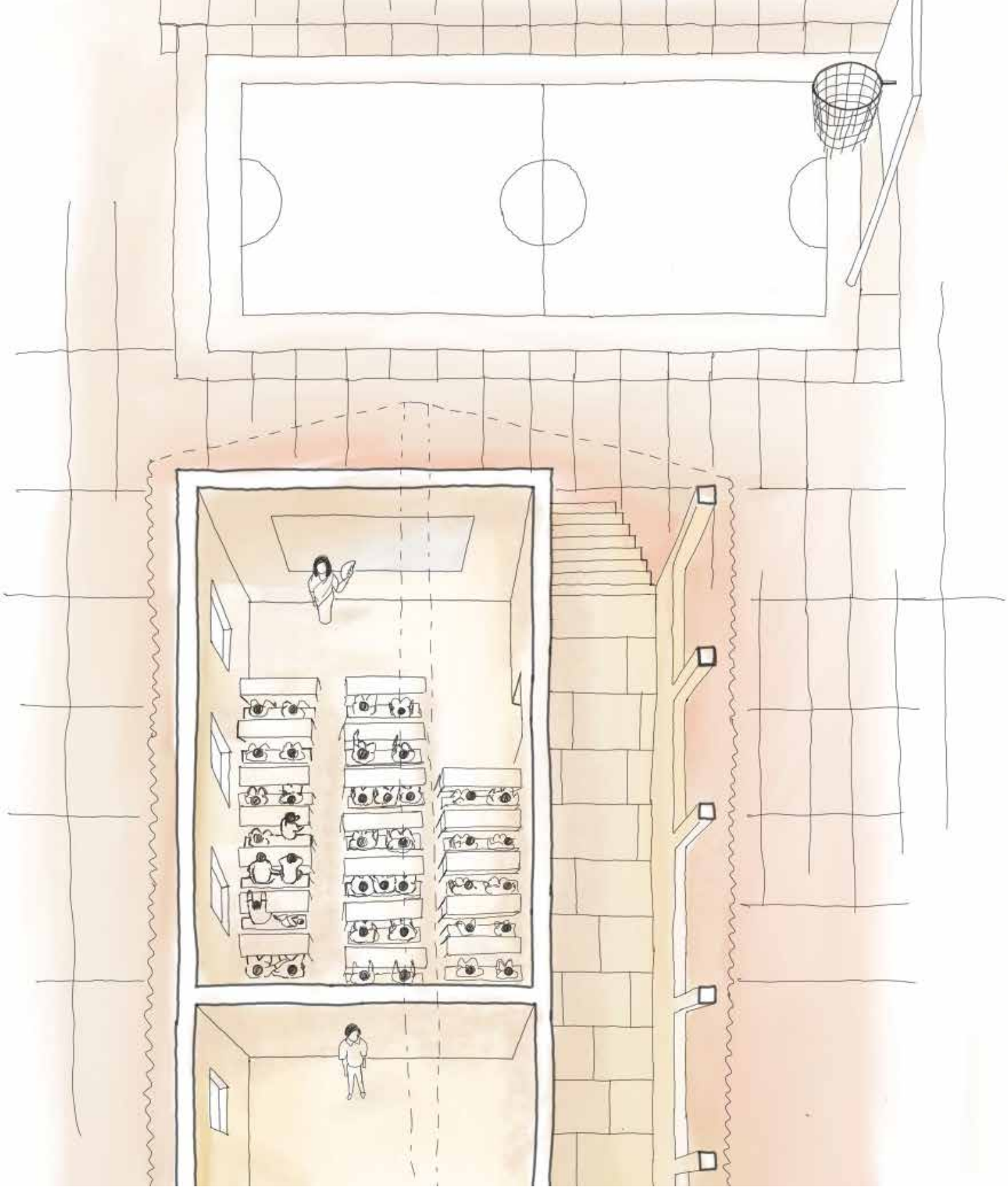
The educational impacts are severe. Studies in the United States of America and India demonstrate that hot school days directly reduce test performance (Park et al., 2020). In South Asia, early school closures due to heat have become commonplace. Beyond lost instructional time, cumulative heat exposure leads to fatigue, irritability, reduced concentration, and in extreme cases, fainting, and hospitalization.

Recognize extreme heat as a systemic threat to education, health, and equity, requiring urgent integration into school planning and governance.

> *Heat smart schools can serve as intergenerational summer learning hubs under cool roofs—providing comfort for both children W the elderly, while creating space for traditional wisdom to blend with modern learning. Such spaces remain valuable even in regions where schools close during the summer.*
>
> **– Hari Krishna Nibanupudi**

The Day the School Corridor Became a Thermometer – Bangladesh

A severe 2024 heatwave shut every primary and many secondary schools in Bangladesh, sending 35 million children home. The Ministry of Primary and Mass Education, backed by UNICEF, ordered closures and emergency communication with parents. The episode exposed how heat can paralyze learning overnight and underlined the need for thresholds, shade, and hydration in all school safety plans. The lessons drawn and action taken treated school-based heat as a trigger for adaptation and response action in an organized manner. (UNICEF, 2025)



Heat action plans can often end up being reactive, while many school buildings remain heat traps. A lasting solution lies in public procurement. By embedding heat resilience into bidding documents and developing a model template, every new construction, retrofit, or maintenance tender can include thermal comfort features. This approach can make schools heat-resilient faster and more effectively than guidance notes, code revisions, or training alone.

– Abhas Jha

Ongoing Practices and Actions

Various initiatives across the globe are already demonstrating practices that are emerging as evidence of how small acts can have large impacts for reducing heat stress in schools. Some of the actions already known to us include the following:

Actions Being Taken by Administrators

- Heat audits have been conducted across classrooms, playgrounds, transport vehicles, and kitchens.
- Shaded waiting and play areas that avoid black asphalt and metal surfaces have been created.
- Hydration stations have been set up close to classrooms.
- Heat index thresholds have been adopted to guide timetable adjustments and exam schedules.
- Heat focal points have been designated within among staff.
- Heat preparedness has been integrated into School Disaster Management Plans.

Actions Being Taken by Other Stakeholders

Teachers:

- Hydration and rest breaks have been integrated into daily routines.
- Teachers have been monitoring students for early signs of heat stress.

Students

- Students have launched peer-to-peer heat awareness campaigns.
- Buddy check systems for signs of heat stress are being practiced.

Parents

- Parents have been providing extra water and light meals.
- Parents have been adjusting their children's clothing for comfort in hot weather.

Municipal Officials

- Shaded bus stops have been installed on school routes.
- School alert systems have been synchronized with municipal warnings.

Health Officials

- Schools have been integrated into heat-related illness surveillance systems.

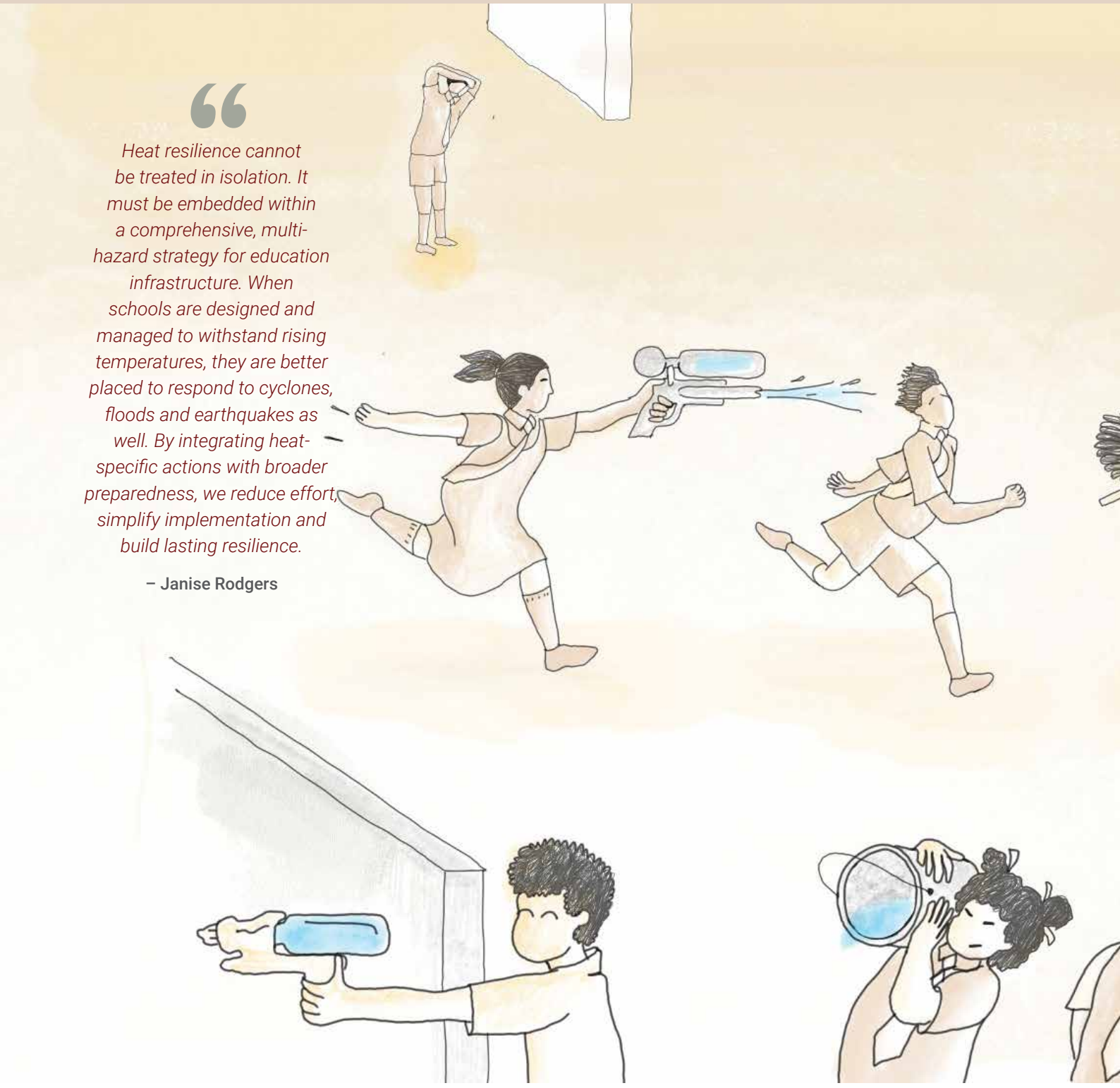
Finance Authorities

- Budgets have been allocated for retrofits, maintenance, and shade creation.

The landscape of heat prevention actions being taken in school settings across the world is inspirational in terms of innovative thinking. It is, however, worrying because the actions listed above are being taken in very few locations. Most of the school-going population exposed to extreme heat is still outside the safety nets they need, and the intensity and spread of the problem is growing as climate change impacts more children, and with greater severity.

Splash Week: When a Heatwave Became a Lesson in Joy – Puerto Rico

At Berkeley Academy in Puerto Rico, teachers found a playful way to keep learning going through sweltering heat. Each summer, the school declares “Splash Week,” turning the playground into a safe water-play zone with sprinklers, balloons and water guns. The event cools classrooms and minds alike, lifting morale during peak heat and reminding students that adaptation can be creative as well as practical. While not every region can spare water, the school’s spirit captures the essence of child-centred heat resilience.



> *Heat resilience cannot be treated in isolation. It must be embedded within a comprehensive, multi-hazard strategy for education infrastructure. When schools are designed and managed to withstand rising temperatures, they are better placed to respond to cyclones, floods and earthquakes as well. By integrating heat-specific actions with broader preparedness, we reduce effort, simplify implementation and build lasting resilience.*
>
> **– Janise Rodgers**

Seven Steps to Making Schools Heat Smart

Ensuring heat resilience in schools is easy, and inexpensive, if done in a collaborative and organized manner. The most important elements of this approach are role clarity and coordination. Existing governance systems in schools and cities are often adequate, provided all the pieces come together for effective preparedness and response. Heat resilience in schools can be achieved in seven clear steps as illustrated below. Though these are broadly sequential, many of these actions can be initiated in parallel. Schools, cities, and relevant authorities can decide where they wish to invest more, depending on the context and local needs. As you will see, these steps cannot be taken by any single agency and will require a range of actors to come together and work collectively. They say it takes a village to raise a child. It will also take the entire village to keep the child safe!

Collective Action for Cooler, Safer Schools

Keeping schools cool and safe is achievable when efforts are coordinated and everyone knows their role. Building heat resilience does not always require large investments or complex new systems. It begins with awareness, collaboration, and simple, well-organized action. When teachers, students, parents, local officials, and community partners all contribute, schools can quickly transform into safe, cool, and productive learning spaces even in extreme heat.

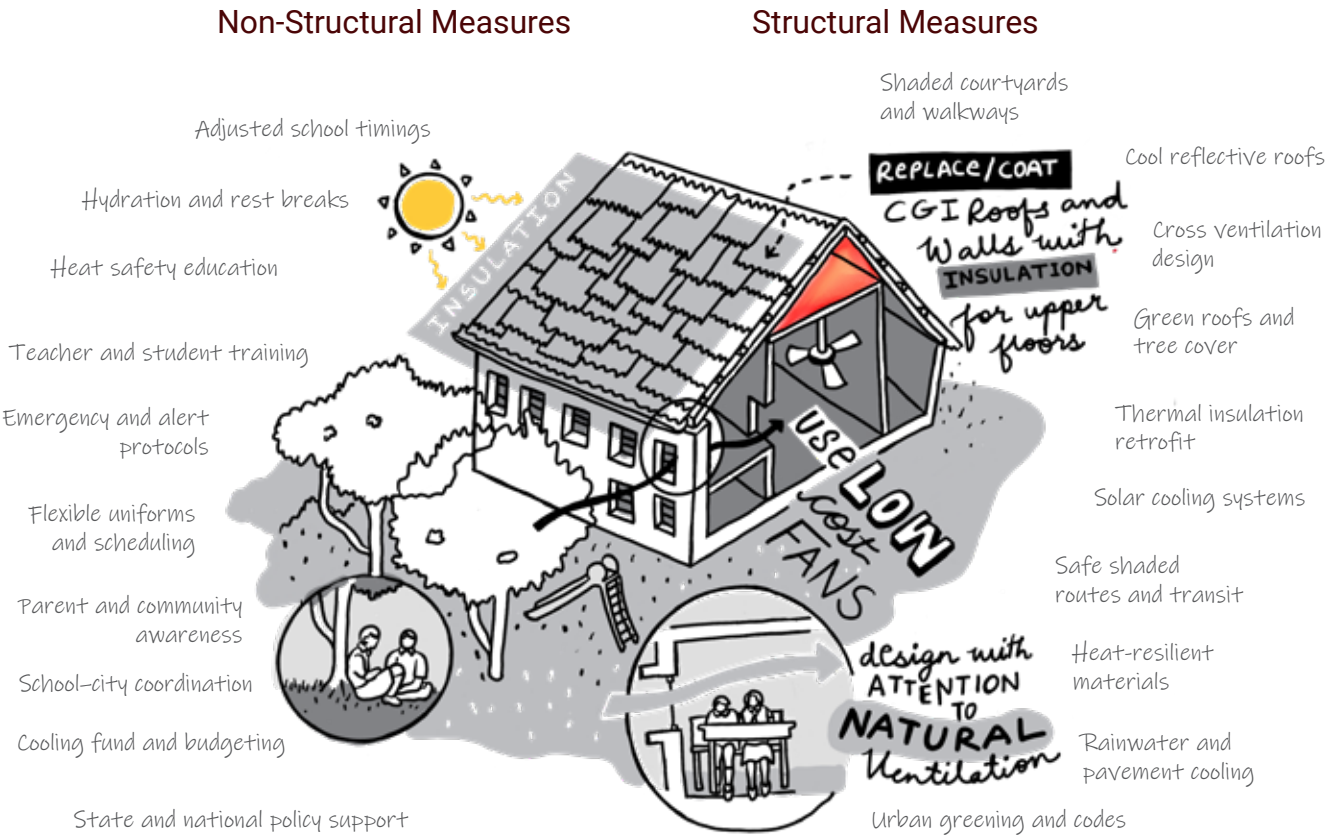
This guidance sets out seven practical steps to make schools heat smart. These steps have emerged from real experiences of school administrators and communities who have faced heat risks and found effective solutions. The process starts at the school level and builds upward, helping link actions in classrooms and playgrounds with those of local governments, health services, and disaster management systems.

The seven steps together form a complete approach: establishing clear governance, using science and forecasts, educating and empowering students, addressing underlying risks such as water and nutrition, implementing cooling actions, investing in resilience, and preparing for future heat events. Each of these areas can be taken up individually or in parallel, depending on local priorities, resources, and readiness. What matters most is shared purpose and coordination.

These steps are also connected to the broader idea that resilience comes through a mix of structural and non-structural measures. Structural actions include improvements in design and infrastructure that keep classrooms cooler. Non-structural actions include behavioural, organizational, and educational measures that help people adapt and stay safe. Together, they form the foundation for sustainable heat-smart schools.

As the following pages show, it takes a community to raise a resilient school, and a resilient school to protect the community's children.

The steps to make schools heat smart range from simple, low-cost measures that can be implemented immediately at the local level to more complex actions requiring coordination across city, state, and national systems for wider impact. The following overview helps administrators and other stakeholders see this spectrum of actions, organized into two easy-to-understand categories: structural and non-structural interventions.



> *If a city works for children, it works for everyone.*
>
> **– Enrique Peñalosa, former Mayor of Bogotá, Colombia**

01

Set Up Governance: Who Will Do What

Governance is the backbone of effective heat resilience. Schools cannot manage heat in isolation. They rely on external systems such as meteorological agencies, health services, and municipal infrastructure. Clear roles and responsibilities prevent delays and ensure timely action. Governance should be inclusive, bringing in parents, teachers, students, local officials, and health workers.

Action at the Level of School Administrators

There are different levels of administration that have a role in making schools heat resilient. These include education ministries and disaster management authorities at the national level, provincial or state government departments, district administration, and local governments including municipal authorities. The Community of Practice, however, has considered the experience of the school administrators as a starting point, and builds up going from action to strategy, and further to policy.

Since a lot of work has already happened globally on school safety, the best place to start is the integration of heatwaves as a part of the school disaster management efforts. Within this, the following specific actions by school administrators will establish a sound heat governance system closest to the children:

- School Disaster Management Committees, with teachers, parents, students, and local officials take ownership of action specific to extreme heat. Where such committees do not exist, they need to be formed with urgency.
- Ensure that Standard Operating Procedures (SOPs) on extreme heat preparedness and response are made part of existing School Disaster Management Plans. In case such plans do not exist, they should be put in place, with heat as an important integral part.
- Develop terms of reference and a calendar for meetings of the School Disaster Management Committee, including pre-summer checks.
- Create a School Level Heat Action Plan linked to heat thresholds.
- Equip school-based actors, including administration staff, teachers and students, to respond to early warnings and advisories issued by meteorological departments and disaster management agencies.
- Include diverse voices, especially girls, children with disabilities, and non-teaching staff.
- Reach out to neighbourhood and city-level disaster management committees to integrate the school heat action plan with those of the neighbourhood and city.

Addressing heat, with a large share of invisible dimensions and invisible impacts, will take several stakeholders to come together and act in a coordinated manner. Teachers, students, parents, municipal officials, health officials, finance authorities, disaster management authorities, engineering and public works departments, architects and planners, policymakers, and influencers in various ministries, and think tanks, NGOs, resident welfare associations, local clubs and interest groups, and the media, all have a role.

Establish inclusive governance structures at school and municipal levels to coordinate heat resilience.

Know your heat thresholds!

Heat thresholds are those cut-off temperatures at which significant adverse impact is anticipated on children, for which action can be taken just by tracking temperatures and without waiting for emergencies to unfold. Thresholds are dependent on variation from the 'normal', and hence are location specific. Find out the thresholds of your area based on information from the meteorological and health departments. Do not forget to ask about indexed heat – the combined impact of temperature and humidity.

We can connect health and learning outcomes. This will allow schools to track how heat-related health issues affect student performance and support better decisions on scheduling, infrastructure, and wellbeing initiatives.

— Bono Sen

When the City Learned to Cool Schools, Not Just Hospitals and Transport Systems – India

When Ahmedabad reframed heat as a civic emergency, schools joined hospitals and transport systems in the city's first Heat Action Plan. Clear temperature thresholds triggered actions such as moving assemblies, adding water points and identifying classrooms for cool-roof pilots. The plan's success showed that low-cost, school-based measures can sit comfortably within wider municipal heat strategies, and a holistic governance approach can yield better dividends than isolated small and beautiful pilot projects. (Natural Resources Defense Council, 2016)

02

Use the Science - Forecasts, Data, and Impact Awareness

Science and data are critical to anticipate and manage risk. Schools equipped with forecasts can adjust timings, suspend outdoor activities, and prepare hydration and first aid. Data also helps justify budget requests for retrofits. Heat indices, which combine temperature and humidity, provide a better measure of danger than temperature alone.

Initiate Action at the School Level, then Move Up

Forecasts and data are usually seen as a top down, resource intensive and high-tech area of work within the disaster management sector. Flipping this upside down, however, will pay rich dividends in terms of impact on the ground as well as an upcoming generation with climate risk sensitivity imbibed in their fundamental thinking. This is also important for many heat impacted communities because hyper local weather data and forecasts are often not available due to gaps in the locations of sensors, including weather stations. Here are some actions that can be initiated by school administrators, with a ripple effect across school communities and higher level administration systems:

- Adopt heat index based thresholds for school-level action (yellow, orange, red alerts).
- Subscribe to meteorological alerts; ensure SMS or app-based communication and dissemination to staff and parents.
- Conduct heat audits to map hotspots in classrooms, corridors, playgrounds and immediate surrounds of the schools.
- Record symptoms and absenteeism during heat events to build evidence for interventions.
- Use simple tools (apps, notice boards) to share heat alerts and guidance.
- Spotlight your actions, inform parents, city authorities and education departments. Use your demonstration to encourage other schools to act, and more children to be protected.

Base school decisions on reliable forecasts, data, and diagnostics for timely action.

Under the Zürich Climate Resilience Programme, Practical Action and local partners in Nepal are establishing heat stations in schools across the foothill districts. Students and teachers are learning to record and interpret temperature data, share insights with their peers, and apply this knowledge to classroom planning and safety measures.

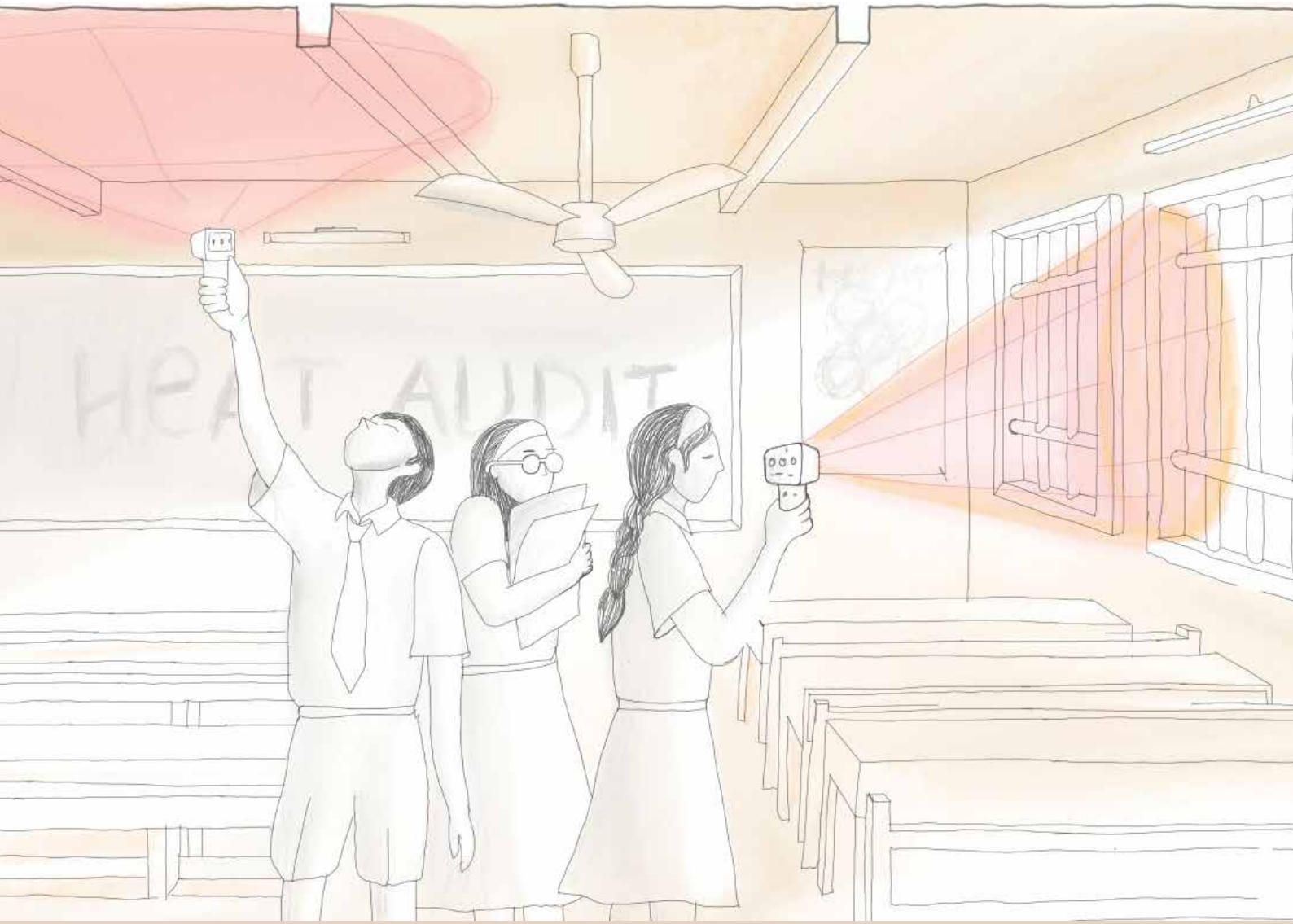
— Suman Chapagain

Emerging evidence suggests a link between rising temperatures and an increase in interpersonal violence. While further research is needed to confirm these trends, it is becoming clear that domestic violence and aggression in schools may intensify with heat stress. These issues must be recognized as part of the broader mental health and wellbeing agenda as we advance the approach to Heat Smart Schools.

> *We need a clear classification scale for heat-related illnesses, ranging from mild symptoms to life-threatening conditions, along with defined protocols for treatment.*
>
> **— Alvaro Valera Sosa**

The heat index: There is more to it than just temperature!

The heat index combines air temperature and humidity to show how hot it feels to the human body. When humidity is high, sweat cannot evaporate and cool us effectively. This "felt temperature," also called the wet-bulb temperature, helps predict heat stress risk. For example, 35°C may not seem extreme, but with 90% humidity, it can feel like over 50°C, putting children and adults at serious risk.



The Classroom Thermometer and Hygrometer as an Early Warning – Philippines

When extreme heat hit the region in March 2025, Department of Education advisories empowered school heads to act. This included mandating classroom thermometers hygrometers to measure indexed heat, to enable action on live readings. When combined with department rules that permit temporary class suspension or shifts to alternative delivery, visible classroom readings turned abstract worry into concrete triggers: teachers shortened outdoor sessions, started hydration breaks and shifted strenuous work out of peak heat hours. The practice shows how simple monitoring, backed by clear ministry guidance, can make local teams act before heat becomes an emergency. (Department of Education – Naga City, 2025)

03

Implement Adaptation Actions for Cool Schools and Neighbourhoods

Schools can take immediate, low-cost steps to cool classrooms and grounds. Passive cooling measures such as cross-ventilation through gable or ceiling vents, shaded courtyards, and reflective or cool roofs are effective. Nature-based solutions like planting trees and creating shaded outdoor learning spaces also provide long-term co-benefits. Retrofitting is critical, since most schools that will serve children in 2050 already exist.

We cannot air-condition our way out of extreme heat, but practical steps can make schools cooler and safer!

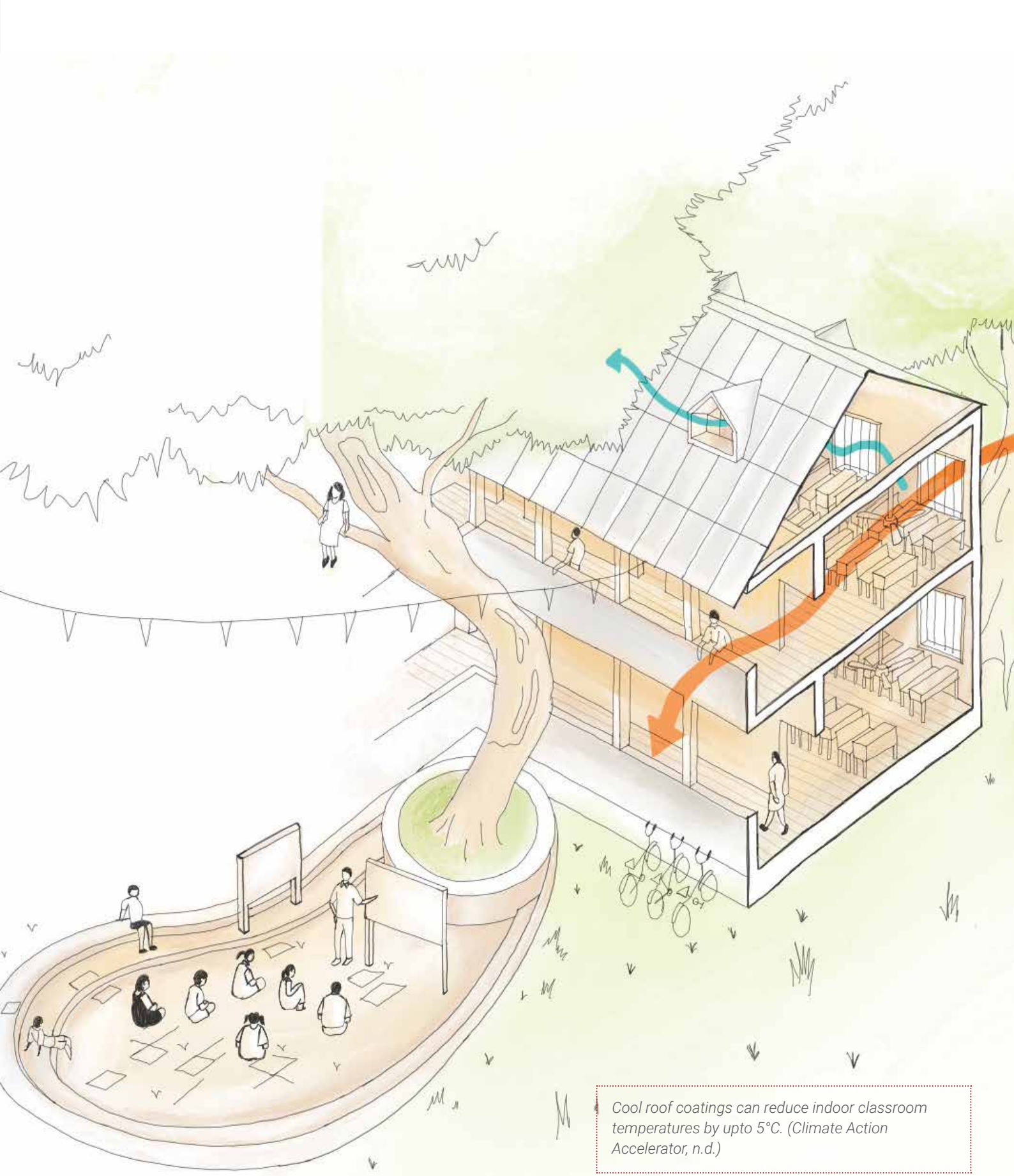
In a world that is heating up beyond human endurance limits very fast, softer solutions to help adapt are the best way forward. Such actions include structural and non-structural adaptation measures, some of which are listed here:

- Design schools using sustainable, local materials and traditional cool building techniques.
- Prioritize passive cooling – reflective and insulated roofs, cross-ventilation, shaded courtyards.
- Retrofit high-risk classrooms with insulation and radiation barriers.
- Install energy efficient fans and cooling devices, or solar-powered ventilation and heat pumps, where passive methods are insufficient.
- Increase greenery with native shade trees and vertical gardens.
- Designate accessible classrooms or halls as cooling centres for community use during severe heat.
- Replace paved surfaces in schoolyards with nature-based cool pavements. Provide shaded spaces for school guards and helpers, and waiting children and parents.

Retrofit and redesign schools using passive cooling, efficient technologies, and nature-based solutions.

> *Many schools in South and Southeast Asia have CGI roofs and tin walls that intensify heat inside classrooms. Recent testing in Indonesia shows that simple measures such as reflective roof paint and roof insulation can significantly lower indoor temperatures and improve learning conditions.*
>
> **— Liva Shrestha**

> *The American Society of Heating, Refrigerating and Air-Conditioning Engineers' ANSI/ASHRAE Standard 55 ('Thermal Environmental Conditions for Human Occupancy') and the India Model for Adaptive Comfort (IMAC) study both focus on adult occupants and general indoor comfort. They do not account for the unique physiological and activity profiles of children. We therefore need inclusive, child-specific thermal comfort definitions for school environments.*
>
> **— Ramiz Khan**



Cool roof coatings can reduce indoor classroom temperatures by upto 5°C. (Climate Action Accelerator, n.d.)

Embed Heat Resilience Directly in School Building Codes – Nepal

Nepal's Education Infrastructure Guidelines integrate heat-resilient design directly into school building codes, making ventilation, shading, insulation and orientation all mandatory checks. District engineers applying these standards report cooler indoor conditions even without mechanical cooling. The approach shows how embedding resilience in standard design guidance prevents costly retrofits later. (World Bank, n.d.)

04

Educate and Empower Children as Agents of Change

Children are powerful multipliers of knowledge. Embedding heat awareness into school routines builds long-term resilience. Through classroom lessons, games, and peer-to-peer learning, students can recognize symptoms of heat stress, advocate for hydration, and influence practices at home. Heat literacy should be inclusive, with tactile and visual materials for children with disabilities.

Schools Can do What they are Best at: Teach!

There are various opportunities that can be used by schools to bring knowledge about heat resilience into the learning package that they offer to children. These include curricula, where stories and examples of heat resilience can be included in multiple subjects; extracurricular activities including environmental and social initiatives; self-regulation of heat action plans by children and such interventions. Some of the specific actions schools can take up include:

Integrate heat literacy into science, social studies, and health curricula. Even languages and mathematics can use heat examples and teach in an engaging way and without increasing the academic burden.

- Train teachers and children to identify heat stress symptoms and act quickly.
- Establish 'water bell' systems to prompt regular hydration breaks.
- Encourage student peer educators to lead awareness sessions in assemblies.
- Use creative tools such as games and storytelling to reinforce learning.
- Create space for community members to take shelter from heat in schools, with appropriate measures in place to ensure security of children. Promote intergenerational learning mechanisms and spaces for elders to share traditional wisdom on heat.

Build heat literacy into curriculum and empower children as monitors, advocates, and change agents.

Building heat resilience in schools requires an intersectional lens that recognizes how gender, age, and health intersect with local environments. Research by The George Institute for Global Health on pregnancy outcomes under extreme heat shows how rising temperatures can intensify risks even for those already supported by health systems. Primary health centres and hospitals must therefore be part of a connected neighbourhood model for resilience, linking education and health to protect children, teachers, and families as one community.

– Chris Mary Kurian

Only 20 percent of teachers feel confident explaining how to take action on climate change.(UNESCO, n.d.).

Students with autism can be especially affected by the bright sunlight that often accompanies extreme heat. Many girls avoid rehydrating because school toilets are unsafe or unhygienic. Such realities highlight the need to integrate behavioural and social nuances into operating protocols for heat resilience in schools. While doing so, even children with special needs can be treated as leaders and change agents.

— Rhea Shah

Students and Youth Connect Local Action to Global Voice – East Africa

In East Africa, students whose classes were disrupted by extreme heat joined school greening and tree-planting drives to make learning spaces cooler. Programmes such as Regreening Africa documented pupils creating shaded gardens and climate clubs that shared lessons on coping with heat. Some of these young advocates also took their stories to COP 29, speaking about how heat affects education and urging action for climate-resilient schools. Their participation shows how local school efforts and youth voice together help shape safer learning environments. (Plan International Kenya, 2023; Reuters, 2024)

05

Address Underlying Risks Such as Water, Nutrition, Health and External Environments

Extreme heat compounds underlying risks such as dehydration, malnutrition, and health conditions. Schools without reliable water, safe food storage, or health linkages face heightened vulnerability. Children exposed to such problems at home will continue to face heightened risk despite schools becoming safer. Heat-related illnesses often go undiagnosed or misreported, further obscuring the scale of the problem. Children with chronic conditions like asthma, malnutrition or co-morbidities are especially at risk.

Nip Vulnerability in the Bud, and Make Children Stronger

There is much that schools and school communities can do to create conditions in the lives of children that will make them more resilient overall, and increase their capacity to deal with heat in the schools. Some of the steps to be taken within schools and around them are:

- Install and maintain safe drinking water stations ensure refills and cleanliness.
- Ensure maintenance of clean and safe toilets.
- Adapt school meals to heat conditions - safe storage, foods that cool the body, hydration-friendly menus.
- Set up systems for teachers and schools to know underlying health issues for children who may need special attention.
- Set up health surveillance systems linking schools with local health facilities.
- Ensure inclusivity: plan for children with disabilities, asthma, or other vulnerabilities.
- Create an inclusive, shaded and cooled space for heat-related health emergencies.
- Adapt uniforms to be light, breathable and cool.
- Conduct assessments of routes to and from and home, to identify and address heat exposure during walks or vehicle rides.
- Run programmes to engage with parents, and for children to take heat hazard hunts and solutions to their homes and neighbourhoods.

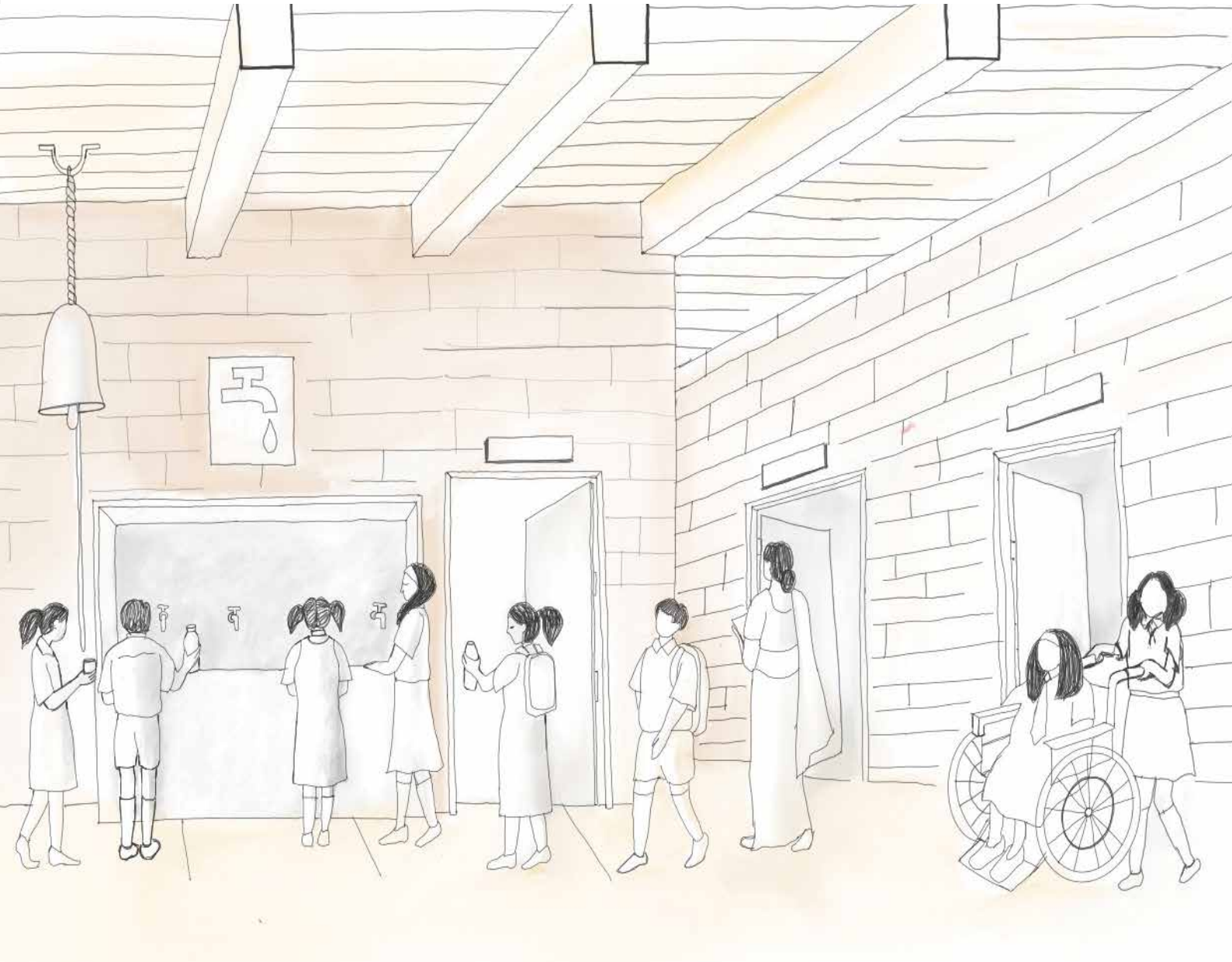
Move from thermal comfort to thermal safety by ensuring children's basic needs are safeguarded during extreme heat.

> *Heat resilience should extend to student transport. School buses and vans must be equipped with drinking water, first-aid kits, and fire extinguishers, parked in shaded areas, and operated within safe capacity limits. These measures should be integrated into school transport regulations to protect children from heat stress during their commute.*
>
> — **Ambika Dabral**

> *Scenario development, supported by modelling, can help anticipate and understand future heat and climate risks. The GeoHazards International's Next Generation Scenarios Guidance offers useful direction for this process.*
>
> — **Janise Rodgers**

Local Climatic Zones provide a strong foundation for heat action planning and can also guide resilience efforts in schools. They enable tailored solutions and help optimize resources by precisely addressing the cooling needs both indoors and outdoors for each school.

– Rajashree Kotharkar



Water Bells and Hydration Breaks – India

When summer heat began causing fatigue and dehydration among students in southern India, several states introduced a simple and practical idea called the "Water Bell." Schools ring the bell three times a day at 10:35 a.m., noon and 2 p.m. to remind students to pause, drink water and refill bottles. Teachers join in, turning hydration into a shared daily ritual. The initiative spread quickly across schools, showing how small, structured habits can strengthen children's health and heat resilience. (Swamy, 2019)

06

Invest in Risk Reduction - From Paper to Practice

Financing is a major barrier to scaling heat-smart schools. While many interventions are low-cost, schools often lack dedicated budgets. A mix of school improvement grants, municipal allocations, corporate social responsibility resources, and climate adaptation funds need to be mobilized. Pooling procurement and using standard specifications will reduce costs and improve quality.

Find the Money Pot, Unlock It, and Then Use It Well

There are funds available with many domestic and international sources, and the interventions we have discussed do not require astronomical amounts. There is a need to identify these resources, and to ensure that the usual barriers between commitments and deployment are resolved. The following initial steps can be considered:

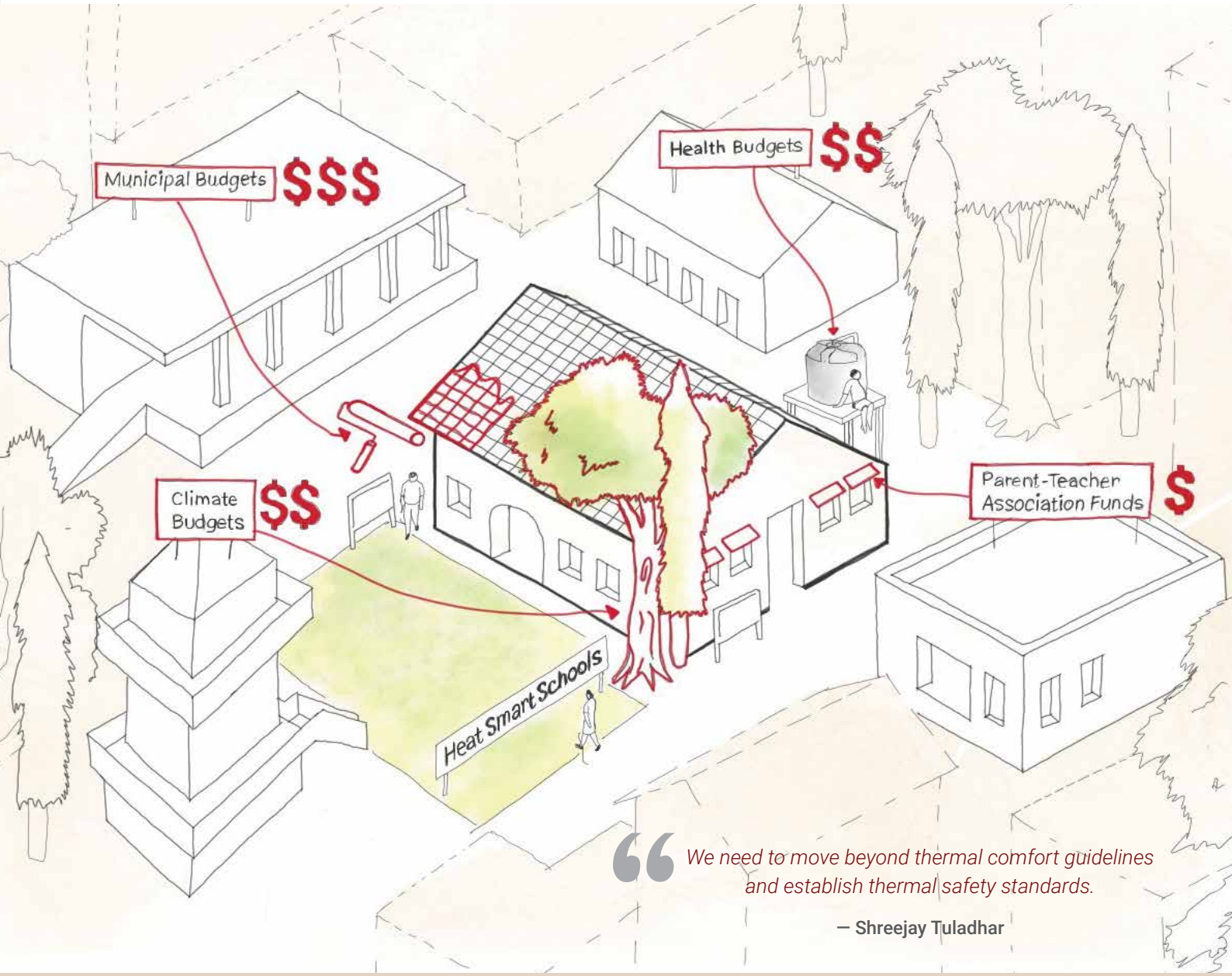
- Integrate heat resilient features into school construction and maintenance budgets.
- Ensure that besides budgets, these are incorporated in public procurement processes, including tender templates.
- Tap into multiple funding streams - education, health, municipal, public works, corporate social responsibility, philanthropy, and enterprise. Educate funding decision makers and donors.
- Prioritize low-cost, high-impact actions such as hydration stations, shading, cool roofs.
- Use pooled procurement and bundling of projects to reduce costs and improve standards.
- Track and report benefits such as improved attendance and reduced illness, to sustain financing through proven returns on investment.
- Support heat resilience innovation through outcome based specifications and procurement.
- Standardize heat resilience metrics - maximum indoor temperatures and humidity, required air changes, thermal mass, building r-values (a measure of resistance to heat flow).
- Consider future temperature and humidity for setting benchmarks for actions and required investments. Build schools for the hotter future we know is coming, and not for today.
- Integrate corrective asset performance review and feedback loops into code design and budgeting.
- Create place-specific standards, aligned to local schedule of construction rates, that integrate local climate and vernacular building method.
- Include improved access to appropriate building materials and skilled workmanship for new construction as well as retrofitting of schools.

Mobilize and sustain financing for heat-smart schools by tapping education, public works, health, and climate budgets.

> *A well-designed resilience programme can pay for itself in the first year. By bundling solutions for heat, energy efficiency, and seismic protection, we can reduce risks in new and existing schools. Public procurement can be the lever to achieve this at scale.*
>
> **– Abhas Jha**

GIFT City applied the Risk Informed School Evaluation tool to strengthen resilience in the school within its jurisdiction. The initiative aligns with India's Samagra Shiksha Abhiyan, a national programme that integrates school education from pre-primary to senior secondary levels with an emphasis on quality, equity, and safety. By building capacity within the school, the approach ensures that resilience efforts are locally led and sustainable.

– Vipul Nakum



We need to move beyond thermal comfort guidelines and establish thermal safety standards.

— Shreejay Tuladhar

Greener Grounds for Cooler Learning - Nairobi, Kenya

Nairobi's public space inventory by UN-Habitat and the county government identified schoolyards as key community assets within the city's network of green and open spaces. The project supported local authorities to restore and maintain these shared grounds, improve tree cover and create safe, inclusive play areas that double as neighbourhood cooling zones. In several locations, school compounds became demonstration sites for urban greening and environmental education, showing how integrating schools into citywide green-space planning can cool neighbourhoods while strengthening community ties. (UN Habitat, 2020)

07

Prepare for the Future with Surveillance, Response, and Recovery Planning

Heat is not a one-time shock. It is a recurring and intensifying challenge. Schools must embed preparedness into everyday operations. Comprehensive Heat Action Plans (HAPs) at the school level should define triggers, roles, and standard operating procedures (SOPs). Regular drills familiarize students and staff with response protocols. After-action reviews ensure lessons learned feed back into practice. Schools should also plan for recovery, including catch-up classes, psychosocial support, and infrastructure retrofits and repairs.

Hoping for the Best, Ready for the Worst!

Being prepared for disasters has been a subject requiring great sensitivity when done with school children. The sensitivity of young minds, and the need to balance fears and hopes drive this agenda in a way that is sound yet more full of fun and hope than fear. Schools can initiate this with actions such as those listed below.

- Develop a written heat resilience protocol with clear roles and triggers.
- Conduct regular drills inclusive of all students, including those with disabilities.
- Coordinate with health services for ambulance support, first-aid and pre-positioned Oral Rehydration Salts (ORS) and cooling packs.
- Document and review incidents; integrate lessons into updated standard operating procedures.
- Plan for recovery: catch-up classes, psychosocial support, and maintenance before the next summer season.
- Train students in first aid responses for heat-related illnesses.
- Consider mental health as a critical element, bringing in counsellors where feasible, and imbibing approved psychosocial support approaches where this may be the best way.

Institutionalize preparedness and continuous improvement to keep schools safe under recurring and intensifying heatwaves.

AI for Resilience

Emerging technologies such as Artificial Intelligence are offering new ways to carry out risk assessments and resilience planning at high resolutions and speed like never before. Open source tools such as the Sunny Lives model by SEEDS and Microsoft can determine hyper local heat hotspots, including those related to indoor heat. See UNDRR Masterclasses on Leveraging AI for Disaster Risk Reduction (UNDRR, n.d.)

Only 21% of countries conduct climate risk assessments for schools, and just 20% provide robust guidance for school adaptation to climate risks. (UNESCO, 2025).

Drills Before the Heat – Cebu City, Philippines

As heat pushed daytime temperatures into dangerous ranges, Cebu City authorities and the Department of Education moved quickly. The mayor ordered modified class hours and some local schools suspended face-to-face learning to protect students. The Department of Education issued memoranda giving school heads discretion to reschedule classes and shift to alternative delivery when the heat index spikes, while local reports show schools practising hydration and schedule adjustments. The city's pragmatic response shows how local government and the Department of Education guidance combine to protect learners. (Philippine News Agency, 2024)

Everyone Has Something to Do

A whole-of-society effort to keep learning safe and cool.

Inside the School

Teachers

- Nominate heat monitors; shift strenuous lessons.
- Track temperature, symptoms, and attendance.
- Teach heat literacy and safety routines.
- Ensure hydration breaks and shaded teaching.
- Rotate classrooms, propose small cooling projects.
- Maintain kits; practice emergency drills.

Students

- Lead peer campaigns and heat action teams.
- Map hot/cool spots; join citizen science.
- Share safety practices at home; form climate clubs.
- Follow hydration routines; care for peers.
- Join tree planting and awareness drives.
- Participate actively in drills and alerts.

Parents

- Join School Heat Action Committees; volunteer skills.
- Follow alerts; adjust routines for safety.
- Share traditional cooling knowledge.
- Provide water, safe food, light clothing.
- Support greening at home and school.
- Mobilize Parent Teacher Association funds; cooperate on flexible timings.

Community and Local Networks

NGOs, RWAs and Community Groups

- Co-create heat maps and vulnerability assessments.
- Mobilize volunteers for shading, hydration, greening.
- Run awareness sessions and safety drives.
- Support frugal cooling using local materials.
- Build “Neighbourhood Cool Networks” linking schools, clinics, shelters.
- Connect schools to philanthropy and corporate social responsibility funding, and civic support.

Media and Communication Platforms

- Raise awareness on children’s heat risks.
- Feature school and community innovations.
- Amplify advisories and early warnings.
- Produce child-friendly safety content.
- Report preparedness progress and gaps.
- Encourage public dialogue and accountability.

Private Sector and Corporate Social Responsibility

- Support retrofits and greening.
- Provide cooling tech, sensors, smart irrigation.
- Co-create micro-enterprise models for cooling.
- Sponsor training, innovation challenges, and awareness campaigns.
- Adopt schools for long-term partnerships.
- Offer pro bono expertise and impact tracking.

City and Local Governance

Engineering and Public Works

- Embed thermal safety in codes and tenders.
- Develop retrofit and passive cooling guidelines.
- Improve shading, ventilation, paving design.
- Ensure clean water, efficient cooling, solar power.
- Audit seasonal infrastructure; train contractors.

Municipal Officials

- Align school actions with ward heat plans.
- Issue alerts, install gauges, ensure shade and water.
- Integrate greening into ward climate plans.
- Provide saplings, tankers, sanitation checks.
- Link school drills to citywide advisories.

Health Officials

- Train health workers on heat illness and first aid.
- Share surveillance data and thresholds.
- Provide information, education and awareness materials and child guidance.
- Ensure ambulance links and cooling shelters.
- Support hydration and nutrition awareness.

Disaster Management Authorities

- Include schools in Heat Action Plans and audits.
- Mandate heat protocols in school disaster management plans.
- Share advisory templates for alerts and parents.
- Equip schools as community cooling shelters.
- Train staff; run annual drills and supply checks.

> *It takes a village to raise a child. It will take the same village to keep every child safe.*
>
> — **Anshu Sharma**

Finance Authorities

- Integrate heat resilience in tenders and budgets.
- Provide micro-grants for shade and hydration.
- Fund training, awareness, and safety materials.
- Support safe water, storage, and retrofits.
- Develop multi-year adaptation funding plans.

Design, Policy and Knowledge Leadership

Architects, Planners, and Designers

- Embed passive cooling and comfort in design.
- Use local, climate-fit materials.
- Design shaded corridors, open classrooms, buffers.
- Conduct thermal audits; propose low-cost retrofits.
- Co-design with school communities.
- Document cooling outcomes to inform policy.

Policy Makers and Think Tanks

- Mainstream heat resilience in education and disaster management policy.
- Enable flexible timings and learning continuity.
- Align budgets across sectors and inclusion goals.
- Promote sustainable cooling incentives and codes.
- Institutionalize heat resilience benchmarks nationally.

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Annexures

A Quick Start Heat Smart School Checklist

- [ ] **Governance:** Heat protocols included under School Disaster Management Committees and Plans; Standard Operating Protocol approved; pre-summer checks scheduled.
- [ ] **Thresholds:** Heat Index triggers defined; action matrix displayed in staff rooms.
- [ ] **Infrastructure:** Cool roofs, shaded courtyards, and cross-ventilation improvements completed.
- [ ] **Water & Health:** Hydration stations functional; first aid training conducted; ORS available.
- [ ] **Operations:** Timetable adjustment policy adopted; water bell reminders in place.
- [ ] **Education:** Heat literacy integrated into curriculum and extracurricular activities; student clubs established.
- [ ] **Data:** Classroom heat audits conducted; absenteeism monitored.
- [ ] **Finance:** Budget allocated for retrofits; maintenance contracts updated.
- [ ] **Drills and Recovery:** Drills conducted at defined intervals; after-action reviews documented.
- [ ] **Community Links:** School designated as cooling centre; coordination with the city's Heat action Plan.

Sample Heat Audit Form (Hazard Hunt)

- [ ] **Classroom location**; orientation; roof type; shading availability.
- [ ] **Indoor conditions:** Temperature, humidity, heat index (for different times within school hours), number of occupants.
- [ ] **Ventilation:** Number of windows and ventilators; are they operational or not.
- [ ] **Outdoor hotspots:** Playground surfaces, shaded areas, waiting zones.
- [ ] **School building materials and designs:** bricks, clay, insulation, openings, etc.
- [ ] **Hydration points:** Functionality, cleanliness, refill schedules.
- [ ] **Health incidents:** Symptoms observed; first aid administered; referrals.
- [ ] **Recommendations:** Priority level, cost estimate, responsible person.

Heat Alert Communication Templates

These are indicative templates that can be used by schools, and by the authorities to institutionalize in schools under their jurisdictions. They are only meant as broad guides, and can be adapted to local contexts, additional information that can be added, and language translations as needed.

Template SMS to Parents (Yellow Alert):

Dear Parent,
Tomorrow's forecast indicates moderate heat (Yellow Alert). Please send extra water. Caps and light clothing allowed. Outdoor activities will be limited.
– Principal

Template SMS to Parents (Orange Alert):

Dear Parent,
Tomorrow's forecast indicates severe heat (Orange Alert). School will operate 7:30am–12:30pm. Hydration breaks every hour. Please avoid sending perishable food.
– Principal

Template SMS to Parents (Red Alert):

Dear Parent,
Tomorrow's forecast indicates extreme heat (Red Alert). In-person classes suspended. Remote assignments will be shared. Stay safe.
– Principal

PA Announcement (Water Bell):

Attention: This is your water bell. Please hydrate and check on your classmates.

Glossary

1. **Disaster Resilient Infrastructure (DRI) :** Infrastructure systems and networks, the components, and assets thereof, and the services they provide, that can resist and absorb disaster impacts, maintain adequate levels of service continuity during crises, and swiftly recover in such a manner that future risks are reduced or prevented, including extreme heat. Disaster Resilient Infrastructure (DRI) in education in infrastructure focuses on ensuring that school systems can continue functioning during and after extreme heat events, safeguarding health and safety of students while ensuring education continuity.

2. **Structural Adaptations:** These are physical modifications to school buildings and infrastructure that help reduce heat exposure and maintain comfort during extreme heat. Examples include cool roofs, shaded outdoor areas, reflective paints, cross-ventilation, and the use of heat-resistant materials. Structural adaptations are often long-term investments that improve resilience and energy efficiency.

3. **Non-Structural Adaptations:** These refer to behavioural, procedural, and policy measures that enhance a school community's capacity to cope with heat. Examples include adjusting school timings, promoting hydration, heat awareness training, developing emergency protocols, and integrating heat safety into curriculum and routines. Non-structural adaptations are flexible and often easier to implement quickly.

4. **Extreme Heat:** Periods of excessively high temperatures, typically above the historical average for a specific region, which pose risks to human health, infrastructure, and the environment. In urban school systems, extreme heat increases student vulnerability and school and learning disruptions.

5. **Heat Index (HI):** A measure combining air temperature and humidity to indicate perceived heat. (Show the heat index chart)

6. **Urban Heat Island Effect:** The phenomenon where urban areas, with their high concentrations of buildings, concrete, and asphalt, absorb and retain heat, leading to higher temperatures compared to surrounding rural areas. This effect is often amplified in schools with metal roofs and concrete yards.

7. **Heat Stress:** The physiological burden caused by exposure to high temperatures, which can result in heat exhaustion, heatstroke, and other heat-related illnesses.

8. **Heat Shock:** Heat shock occurs when the body is exposed to a sudden and extreme increase in temperature, causing rapid physiological stress. This can disrupt cellular processes and may result in symptoms like dizziness, confusion, rapid heartbeat, nausea, and muscle cramps. Prolonged or severe heat shock can lead to more critical conditions such as heat exhaustion or heat stroke, which require immediate medical attention.

9. **Heat-related Illnesses:** Heat-related illnesses are health conditions caused or exacerbated by prolonged exposure to high temperatures. They range from mild to severe and can escalate quickly if untreated. Common heat-related diseases include:

- **Heat Cramps:** Painful muscle spasms, often due to dehydration and salt depletion after intense sweating.

- **Heat Exhaustion:** Symptoms include heavy sweating, weakness, dizziness, nausea, headache, and fainting. It requires rest and cooling to prevent progression.

- **Heat Stroke:** A severe, life-threatening condition marked by a body temperature above 104°F(40°C), confusion, rapid heartbeat, and potential organ damage. Immediate medical attention is essential.

- Heat Syncope: Fainting or dizziness due to prolonged standing or sudden changes in position in high temperatures.

- Heat Rash: Skin irritation caused by excessive sweating, common in humid conditions. Vulnerable population groups like children, and those traveling, living or playing in hot environments are particularly at risk of heat-related diseases. Preventive measures like hydration, shade, cooling systems, and protective clothing are essential in mitigating these health risks.

10. **Passive Cooling:** Design strategies such as ventilation, shading, and reflective roofs that reduce heat without energy use.

11. **Nature-Based Solutions (NbS):** Actions based on the protection, conservation, restoration, sustainable use and management of natural or modified terrestrial, freshwater, coastal and marine ecosystems. These actions address social, economic, governance and environmental challenges effectively and adaptively, while simultaneously, ecosystem services, disaster risk reduction, resilience and biodiversity benefits and supporting human well-being.

12. **Heat Action Plan (HAP):** A coordinated plan with thresholds, roles, and actions to reduce heat risk.

13. **ORS:** Oral Rehydration Solution used to prevent and treat dehydration.

14. **After-Action Review:** A structured review after an event or drill to capture lessons learned.

15. **Thermal comfort:** As per ASHRAE Standard 55 thermal comfort is that condition of mind which expresses satisfaction with the thermal environment. Thermal comfort is influenced by environmental factors like air temperature, radiant temperature (warmth from walls, roofs, windows), air movement and humidity, as well as personal factors like clothing and metabolic rate.

16. **Thermal Safety:** Thermal safety refers to the condition in which people are protected from harmful or dangerous effects of heat or cold exposure in their environment.

17. **Building envelope R-values:** The R-value of a building envelope (walls, roof, floors, windows) is a measure of its resistance to heat flow. The higher the R-value, the greater the material's insulating power, meaning it slows down the transfer of heat between indoors and outdoors.

18. **Vertical gardens:** A vertical garden (also called a green wall or living wall) is a system where plants are grown vertically on a structure such as a wall, facade, or freestanding frame, rather than horizontally on the ground.

19. **Heat drills:** Practice exercises conducted in schools or workplaces to prepare students and staff to respond effectively during extreme heat events

20. **Cool roofs:** are any roofing system designed to reflect more sunlight and absorb less heat than a standard roof. This is usually achieved by using materials or coatings that have high solar reflectance (ability to reflect sunlight) and high thermal emittance (ability to release absorbed heat).

21. **Cool Pavements:** These are paving materials designed to absorb less and reflect more solar radiation than conventional pavements. They are a type of adaptation action that can be used in schoolyards and other outdoor areas to reduce the urban heat island effect and lower ambient temperatures.

22. **Heat Literacy:** The knowledge and skills needed to understand the risks of extreme heat and the actions required to stay safe. This includes recognizing the symptoms of heat stress, understanding the importance of hydration, and implementing preventive measures at school and at home.

23. **School Administrators:** are the professionals responsible for the management, leadership and operations of a school. They ensure that the school meets educational standards while providing a safe and supportive environment for students and staff. They include school leaders (principals, vice-principals), as well as education department heads responsible for the running of the school.

Recommended Readings

These are some key documents that provide useful information for working on heat resilience in schools. The links provided here were accessible in October 2025.

Urban Extreme Heat Risk Management - Resource Package

https://www.undrr.org/publication/urban-heat-risk-management-resource-package

Comprehensive School Safety Framework

https://inee.org/sites/default/files/resources/The-Comprehensive-School-Safety-Framework-2022-2030-for-Child-Rights-and-Resilience-in-the-Education-Sector.pdf

UN Secretary General's Call to Action on Extreme Heat

https://www.un.org/sites/un2.un.org/files/unsg_call_to_action_on_extreme_heat_for_release.pdf

Schools as Cleaner Air and Cooling Center: Tips for Facilities Managers

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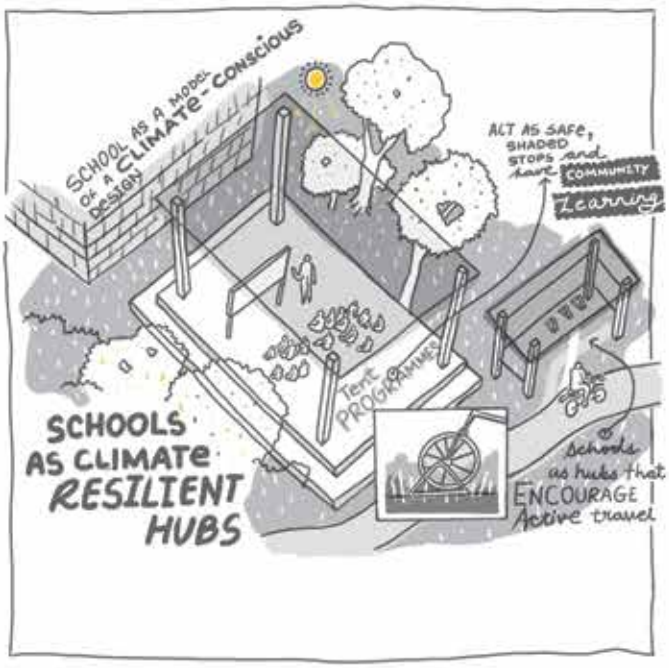

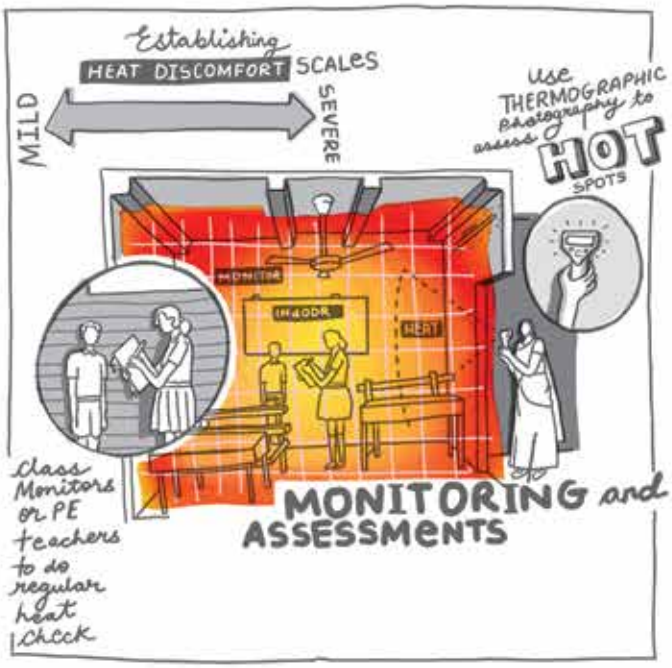

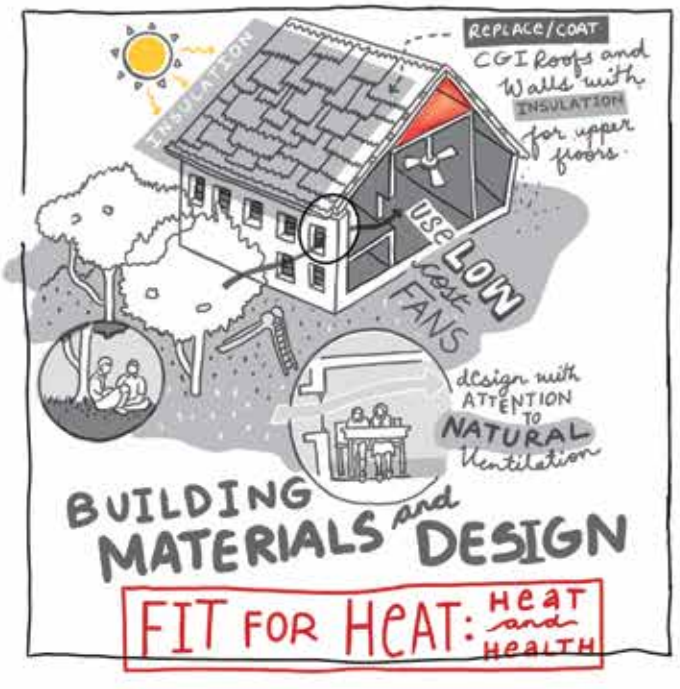

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