

Microscale Urban Adaptations to Mitigate Heat & Air Pollution Exposures and Improve Children's Health: An Overview

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INTRODUCTION

WHY?

- Children living in urban areas are at heightened vulnerability to the effects of extreme heat and air pollution.¹
- Exposure to these and related ambient stressors (e.g., radiation, pollution) is associated with a myriad of direct, indirect, and interactive adverse health outcomes, including hyperthermia,² thermal burns,³ sunburns,⁴ asthma,⁵ and an increased risk of skin cancer later in life.⁶
- Little is known regarding how existing urban infrastructure and lack of vegetation within outdoor recreational playspaces affect overall child well-being, activity, and learning. Because of this, minimal evidence exists to inform the effective *mitigation of exposures* to enhance health and support climate adaptation.

WHAT?

- A large-scale playspace re-naturalization will be occurring in the spring of 2020 at Paideia Academies, a Title I Charter School in South Phoenix. The end-product will be a "Natural Play and Learning Environment" with numerous co-benefits to improve ambient air health, provide experiential learning, and increase food access.
- Pre- and post intervention monitoring of environmental and health variables will quantify exposure mitigation, changes in activity, and learning outcomes.

WHO?

- Paideia Academies is a Title 1 Charter School in South Phoenix serving pre-K to eighth grade scholars.
- 840 scholars, of which 84% are on the free/reduced lunch program. Most of these students are Hispanic/Latino (67%) and Black/African American (20%).

SENSING



Fig 1: Clarity Air Quality Monitor: PM₁, PM_{2.5}, PM₁₀, NO₂ Six locations (4x playspaces, 2x parking lot).



Fig 4: A) Davis roof weather station for local data & education, synced to Weather Underground; B) Realtime UV Index information.

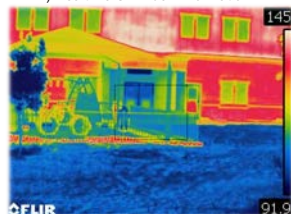


Fig 6: Thermal IR Image, playspace 2.

Fig 2: In-situ monitoring

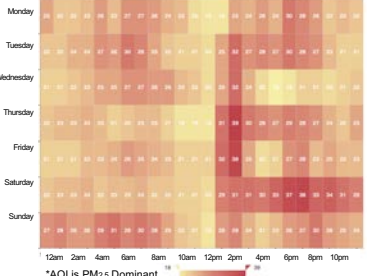


Fig 3 (below): Arable microclimate sensors; temperature, short- and long-wave radiation, NDVI, and relative humidity.



All platforms have integrated analytics, with data sent to the cloud for retrieval anytime, anywhere.

Fig 5: Air Quality Index*: Parking Lot Sept-Nov 2019



Heart rate monitors & UV dosimeters to assess the influence of microclimate conditions, design, & UV light on activity

Natural Play & Learning Environment Plan

Future Plans



Designs: Informed by child, teacher, parent, and administrator input in addition to ambient data. Children also completed photo stories and artistic renderings for playspace input.

Physical Activity: Assessed using the *System for Observing Play and Leisure Activity (SOPLAY)*,⁷ focused on activity type & intensity, space use (e.g., shade), pro/anti-social behavior.

Considerations:

- The right plants in the right place
 - Improving Air Quality
 - Aeroallergens
 - Shade
 - Weather
 - Native
 - Edibles
 - Watering cost
 - Cost
- 1 Decrease exposures to extreme heat, radiation, air pollution, and noise.
 - 2 Increase safe physical activity throughout the year.
 - 3 Enhance child well-being through sustainability education, nature-based play, and healthy food.
- 3 Decrease the incidence of hyperthermia, asthma attacks, and sunburns.

Health Data: Working with school nurse & teachers to track the continuum of impacts (below) due to heat and pollution, including missed classes, nausea, & behavior.



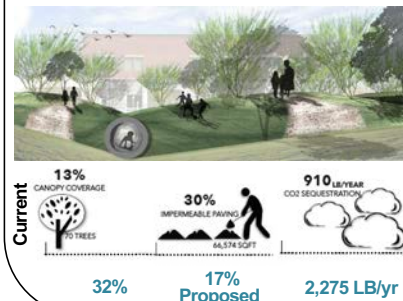
Right: Scholars seek the only shade in the playspace on a hot day. Activity data show that females are less active than males.



Case Study: EPA Rain Works Challenge – Design Studio

READY! SET! ACTIVATE! Using Green Infrastructure to Promote Health Equity in South Phoenix

A research-based schoolyard redesign proposal with the vision to use green infrastructure to create resilient natural learning and play landscapes that promote health equity by improving the quality and access of green space for the student community. Led by Chingwen Cheng.



ACKNOWLEDGEMENTS & FUNDING



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