Project BackpAQ

This proposal is for development of middle and high school curriculum that promotes learning about and experience with the monitoring of air quality (AQ) in disadvantaged communities, and drives engagement among underrepresented youth in STEM activities.

Key to the program is deployment of a suite of community-based mobile air quality monitors that leverage new low-cost sensors. These handheld units can be readily assembled by advanced middle-school and high school students and other STEM-oriented youth who are motivated by interest in obtaining, understanding and sharing hyper-local air quality data.

Introduction

There remains a critical need for more ground-truth generated hyper-local AQ data to support investigation of suspected criteria pollutants which can be contributors to asthma and other respiratory and lung diseases in the community.

According to U.S. Environmental Protection Agency data, children under 18 and adults over 65 are most vulnerable to poor air quality, suffering from illnesses including asthma, cardiovascular disease, and diabetes. New studies show elderly women breathing unsafe levels of fine-particle pollution are twice as likely to develop dementia and Alzheimer's disease.

Citizens, particularly in urban communities, are also telling us that they'd like to know more about the air they are breathing where they actually spend the majority of their time, in places such as homes, schools, churches, shopping, restaurants, and other locations not directly served by conventional stationary AQ monitors.
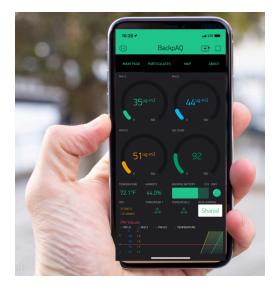
Towards an Air Quality Curriculum

A comprehensive curriculum around air quality and the identification, monitoring, analysis and reporting of criteria pollutants will be developed and piloted among middle-school and high school students, principally in disadvantaged communities where the need is most acute. SSV will partner with select middle and high schools, and provide training and support for partner instructors and coaches. Particular

focus will be on driving engagement of students with a hands-on approach to monitoring and subsequent data analysis and sharing of findings with their community, schools, and local officials.

Hands On Experience

A key part of the curriculum is hands-on, build-it-ourselves experience with a new generation of inexpensive mobile monitors. These monitors utilize new, low-cost sensors to collect real-time air quality data such as PM2.5, and employ GPS

to geo-locate these on-the-move monitors. The data is also sent up to the cloud where it can be efficiently managed, analyzed, shared and further leveraged. Software including data visualization and GoogleMaps location will also be provided and can be customized and extended by students.

The student-built monitors, encased in a lightweight polycarbonate box, weigh less than a pound, and are powered by rechargeable LiPo batteries to give over 12 hours of daily use. They feature carabineers and nylon straps for easy fastening to a backpack or bicycle frame, or can be left plugged-in in a secure location.

What they'll measure

 As designed, the monitors will measure and display criteria pollutants PM1, PM2.5, and PM10 concentrations in ug/m3, as well as display the US EPA Air Quality Index (AQI). Temperature and relative humidity are also measured and recorded.

Monitoring of additional pollutants, such as CO, O3, NO2 and SO2 are possible future enhancements.

Student Engagement

Each BackpAQ pairs with its own Apple or Android smartphone app to provide a rich interactive user experience and allow customization and personalization of monitored data and how it's displayed. BackpAQ units automatically log data to the cloud where it can be visualized using a GoogleMaps user experience (below, left) and powerful Thingspeak and Mathworks analytics (below, right).

To spark initial engagement, students will assemble their own monitors from kits containing all of the electronic components. It's estimated that kits will cost about $80.

Taking Action

Students building and carrying their devices through their daily lives will deepen their engagement with and understanding of air pollution and the importance of hyper-local monitoring.

The data SSV and our student partners collect will help inform how to best engage underrepresented students in STEM activities - such as these - and interest them in potential STEM careers.

Students will also receive training in and hands-on experience with advanced data science tools. It is hoped that this initial cohort will become ambassadors to their peers across the region, attracting more student, school and city participation. The lessons we'll learn from this project will help others develop similar approaches tailed to their own communities.