Improving Environmental Health in Schools White Paper

A Vision
for Advancing Equitable Environmental Health Standards in Learning Environments
– An Environmental Justice Initiative

Objective: To improve systems-level environmental health, safety, and justice in schools through the revival and expansion of School Integrated Pest Management.

Introduction

In August 2021, schools began a third academic year affected by the COVID-19 pandemic. Amidst the ongoing Delta variant wave, the current school year will be the most important one in recent history. In the wake of an entire academic year of disruption, an extensive cadre of education stakeholders desperately need an Integrated Environmental Management approach to provide healthy, sustainable, and inclusive learning environments.

The authors of this white paper are environmental health academics who recognize the importance of in-school education. However, we also understand that infectious disease transmission in schools is an existential challenge affecting the health of local communities and, ultimately, society at large. We have extensive experience implementing environmental improvements both before and during the current pandemic. We wish to persuade the United States Environmental Protection Agency (EPA), as the lead agency for protecting human health and the environment, that now is the time to revive and expand their School Integrated Pest Management (SIPM) initiative to improve environmental health in schools and document the tangible benefits that follow.

The term "One Health" has been attributed to a management approach that considers human health as a function of animal health and the prevailing environmental conditions (see https://www.cdc.gov/onehealth/basics/index.html). Therefore, One Health support systems are collaborative, multisectoral, and transdisciplinary. Furthermore, a One Health approach is highly scalable and can be applied to any human niche. Here we apply the concept to pre-Kindergarten through twelfth-grade schools and focus on improving environmental health standards.

Environmental health has long been a fundamental component of comprehensive public health systems. Standards are usually policy-led and aimed at reducing the risk of harmful environmental exposures. Past experiences have shown that SIPM protects especially vulnerable individuals such as asthmatic elementary school students and invariably results in healthier school communities with optimal learning and working environments for all school inhabitants.

Evidence regarding the risks to children exposed to pesticides has grown since the 1990s (Landrigan, 2001; Landrigan et al., 2004; Landrigan et al., 2003), and in 2012 the American Academy of Pediatrics issued a statement on pesticide exposure in children (Roberts and Karr, 2012). The report included the findings that *"Children encounter pesticides daily and have unique susceptibilities to their potential toxicity. Acute poisoning risks are clear, and an understanding of chronic health implications from acute and chronic exposure is emerging. Epidemiologic evidence demonstrates associations between early-life exposure to pesticides and*

pediatric cancers, decreased cognitive function, and behavioral problems." As more evidence regarding the risks to children emerged, the EPA supported technical assistance and education programs to protect children.

One such program focused on facilitating IPM implementation in the school environment was supported by the Pesticide Environmental Stewardship Program (PESP) beginning in the late 1990s. The initiative gained momentum during the Obama Administration but stalled during the Trump administration.

The authors contend that reviving and expanding IPM in schools throughout the U.S. will reduce pest and pesticide health risks, improve pandemic response, dovetail with Global Climate Change efforts, and mitigate challenges immigrant children face. Further, escalating efforts to establish school IPM supports One Health efforts and will alleviate the unequal distribution of environmental risk to disenfranchised populations. Finally, setting equitable environmental standards in all education systems is a fundamental environmental justice imperative.

The 2021 State of Our Schools report (Filardo, 2021) begins by recognizing the enormous significance schools play in society, summing up the importance as follows:

"Three aspects of public education and school facilities are in sharp focus from the pandemic:

- *Education is a social enterprise that depends on buildings and grounds where staff, students, and the community come together.*
- *The economy depends on universal elementary and secondary public education for workforce participation and productivity.*
- *Longstanding deficiencies in public school facilities pose health risks for students, staff, and families, particularly in low wealth communities."*

Challenge & Opportunity One – Integrated Pest Management Builds Resilience

In pre-pandemic times parents and guardians sent their children off to school for an average of 180 days annually (U.S. Department of Education 2007-2008), generally confident that their loved ones will be in a safe learning environment. This academic year, the ongoing threat of SARS-CoV-2 has left many wondering how to balance the risk of sending children into a congregate setting with the lifelong ramifications of lost learning and related short and long-term financial losses. While the quality of the school environment has always influenced the health and wellbeing of those inhabiting the facilities, the consequences of poor conditions today will have far more significant health impacts.

As we address school facility issues nationally, now is the time to capitalize on risk reduction efforts holistically and not forget the relatively easy improvements that integrated pest management programs bring. School children should not continue to face health risks associated with pests or inappropriate pesticide use. The latter is inclusive of EPA-registered disinfectants.

In 2012 the American Academy of Pediatrics (AAP) issued a policy statement addressing Pesticide Exposure in Children (Roberts and Karr, 2012). While it is well established that children are more vulnerable to the effects of toxicants (National Research Council, 1993) and

both children and school employees experience illness due to pesticide exposure in schools (Alcorn et al., 2005), the AAP statement highlights current risks to children, offers solutions, and demands action. The authors cite epidemiologic evidence associating early life exposure to pesticides with pediatric cancers, decreased cognitive function, and behavioral problems. AAP recommends steps to reduce the risks from pesticides by advocating policies that promote Integrated Pest Management (IPM), comprehensive pesticide labeling, and marketing practices that incorporate child health considerations.

Many well-managed school districts practicing IPM recognize considerable benefits. Gouge et al. (2006) documented that schools implementing high-level IPM averaged a 71% reduction in pesticide applications and a 78% reduction in pest complaints. School districts practicing IPM have lower chances of pest-related exposure, and one inner-city school district in Arizona reported a 75% reduction in roving bed bug reports.

School districts practicing IPM have demonstrated a higher level of emergency preparedness for newly emerging vector-borne disease and infectious pathogens. In 2003 Arizona school staff involved in IPM programs proactively managed mosquitoes as the West Nile virus moved west across the country. Districts with IPM programs were actively monitoring grounds for mosquito development sites and were some of the first to submit mosquito samples positive for West Nile virus in the state. District response was well planned and included education efforts for local communities. Similarly, during the 2009-2010 novel Influenza A (H1N1) virus pandemic, districts with IPM programs were far more likely to reach out to subject matter experts to seek guidance regarding appropriate disinfectant use in schools. Finally, reducing risks associated with pests and pesticides, including disinfectants, reduces district liability and litigation risk.

Many school IPM efforts are led by the district facility, custodial, maintenance, and food-service managers. Sanitation and site maintenance are critical preventative components in IPM programs. However, most school districts contract with external companies for pest management services, and information flow between key school staff and pest management technicians is highly variable. Additionally, survey work conducted in North Carolina by Nalyanya et al. (2005) found that pest management companies may report IPM practices in schools but still apply pesticides on a predetermined schedule, often contrary to the principles of IPM. They conclude that the pest management professionals surveyed did not practice rigorous IPM. Successful partnerships usually involve school staff with pest management responsibilities or service providers who collaborate well with school staff.

As with the broader field of environmental health, IPM is science-based. It is a decision-making strategy that aims at establishing the safest, most effective pest management practices, which consider the ecology of pests in the target environment and the vulnerability of associated populations. But outmoded calendar-based pesticide application practices still exist in far too many schools today. When infestations occur, the emphasis is on repeated pesticide applications, while IPM efforts center on monitoring and identifying pests and correcting pest-conducive conditions. When problems are confirmed, action is taken to address the fundamental reasons why pests are present.

Existing state regulations concerning pest management in schools are often pesticide-centric, devoid of sanitary rules and requirements for IPM training. More than 35 states have approved specific laws pertaining to pesticide use in schools and 38 states in childcare facilities (Hurley et al., 2014). These restrictions include, but are not limited to, restricted spray zones, reentry requirements beyond label, and definitions of the types of products to be used in and around schools. However, they are insufficient and do not generally result in school IPM without other factors. While the pest management industry continues to make advances and improve standards, it is unlikely that school districts can rely entirely on contractors to establish rigorous IPM programs if they are not required to do so by law or customer demand and subject to oversight and enforcement. Companies that do execute IPM contracts often find them challenging since most preventive actions have to be undertaken by school staff who may not have the time, knowledge, or resources to undertake the work. For example, sustaining high standards of sanitation, ongoing preventative maintenance, and reliable reporting of pests and conducive conditions are all responsibilities of the school staff. Additionally, administrators managing single or few schools and those without staff with pesticide applicator licenses and training must hire contracted service providers. While this is not inherently a problem, seeking the lowest-bid contractor often is. Moreover, remote rural districts often find they have minimal choices.

Kowalewski et al. (2016) evaluated the needs-based training provided by the Extension-lead school IPM team in Oregon. The program reaches an average of 85 percent of state school districts annually. The authors conclude that: *"As more states develop pesticide management and IPM programs specific to schools, the need for specialized training will increase."* Further, the authors encourage Extension scientists to establish an engaging and needs-based IPM training curriculum for school staff deployed on school grounds. The Oregon team used focus groups and survey findings to evaluate training. The results highlighted the importance of person-to-person and hands-on training within the school employee audience.

Environmental Health Practitioners (EHPs) represent some of the very few regulators mandated to inspect schools and can be instrumental in guiding schools towards better IPM practices as part of their regular education and enforcement activities. By linking IPM to the best management practices critical to environmental health, EHPs can expand the thinking of school staff to understand how to support and demand better pest management. However, for EHPs to provide the technical guidance schools need, the workforce must have a high level of technical competency or strong functional collaborations with in-state experts who can provide that knowledge.

Breathing Easy - Merging IPM, IAQ, and CO_2 Management

Before March 2020, 56.6 million students, 3.7 million teachers, and 1.8 million non-instructional school staff attended elementary and secondary schools, 88.6 percent in public and 11.4 percent in private facilities (Hanson, 2021). School buildings are densely populated buildings often surrounded by beautiful grounds and landscapes. Inner-city school campuses provide green spaces disrupting heat island effects, and school buildings are heavily utilized assets. Schools serve as meeting places for local groups, voting locations, emergency shelters, and community resource centers during crises. School campuses even rate well as carbon sequestration zones

since campus trees and minimal input grounds capture carbon (Bremer et al., 2020). Increases in soil carbon occurs when soil disturbance is minimal, grounds are actively growing plants year-round, and through the application of organic matter compost. Campus soils, turf, trees, and shrubbery all capture and store carbon dioxide from the atmosphere. Using IPM principles with carbon sequestration in mind, managing campus grounds could place education facilities as significant carbon storage zones.

However, building architects, landscape designers, school grounds staff, and landscaping service contractors need IPM technical support and training. Often when districts plan the installation of landscape plants on new campus grounds, increase, or replace plants on existing school grounds, there are unintended consequences due to a lack of IPM knowledge. For example, IPM experts discourage plantings against buildings for multiple reasons. For instance, placing dense ground cover, flowering, or fruiting plants in locations away from buildings helps to keep commensal rodents, sugar-loving ant species, and honey bees a significant distance from doorways.

During the 2017-18 academic year, 131,930 K-12 schools in the U.S. (NCES, data accessed 09/06/21) operated more than 13.7 billion square feet of building area (CBECS, data accessed 09/06/21) on an estimated 2 million acres of land (Filardo, 2016). The square footage of district buildings is equivalent to 81 percent of all U.S. commercial office space. Except for U.S. highways, K–12 public schools are the nation's largest public building sector (CBECS, data accessed 09/06/21).

Beyond doubt, school buildings are precious to all community members, not only parents and guardians of school-age children. Despite this, 53 percent of public school districts report the need to update or replace critical building systems, including HVAC systems (ASCE, 2021). Around 31 percent of public schools use portable buildings due to student enrollment exceeding capacity limits, and approximately 9 percent of portable classrooms are in poor condition (ASCE, 2021). None of this is surprising considering that state capital funding fell 31 percent between 2008 and 2017. Estimates indicate a $38 billion annual funding gap for public school facilities (ASCE, 2021).

Over the last 19 months, we have borne witness to how an integrated approach using physical, chemical, and engineering mitigation measures, together with pharmaceutical treatments and preventatives (vaccines), has influenced levels of human illness during a global pandemic. **But in too many instances, the varied school responses to SARS-CoV-2 mitigation have left some school students and staff (including teachers) with an increased risk of illness and injury.**

This white paper makes a case for investments in school environmental health through improvements in integrated pest management (IPM), indoor air quality (IAQ), cleaning, disinfection, and other infection prevention methods. Together with drinking water quality, fire prevention, and food safety, these components are referred to as an Integrated Environmental Management approach. Building on past successes and failures, the authors recommend a participatory extension-to-action approach that has a proven record in low-income, minority, tribal, and overburdened communities, as well as financially affluent neighborhoods.

Mobilize Forces – Fueling Existing Change Agents

Presently, there is a change agent core actively engaged in multiple components of school environmental health. The authors of this document serve as a steering committee to a school IPM Community of Practice (CoP) with 115 participants from around the country. Membership of the CoP is open to all stakeholders with interest in school health and safety specific to IPM. Most members collaborate closely with IAQ, drinking water quality, pesticide safety, food safety, and public health scientists in their respective regions. The authors of this document are long-term school IPM, IAQ, and pesticide safety academics and nationally recognized in their respective fields of science. While most of the change agents involved in constructing this document are academic scientists, some are also policy specialists, and all are environmental advisors for school systems. All are invested in implementing Toxics Use Reduction (TUR)/Pollution Prevention (P2), IPM, IAQ, green cleaning, and pesticide safety in schools.

The authors of this white paper find that both policy and school-based demonstration are required to alter practices long-term significantly. Taking a community-oriented approach establishes sustainable programs that support specific school needs and reflect local values. School districts are essentially community-based organizations managed by local and regional decision-makers. But ultimately, they are accountable to state education and environmental agencies, tribal governments, the state legislature, the U.S. Department of Education, and finally, the Department of Interior. **All these entities are profoundly challenging to reach irrespective of community needs and science-based solutions offered.**

While over half of U.S. states have a school IPM rule or law, relatively few states have school IPM mandates tied to training and enforcement regarding pests (or disease) and conducive conditions. Fewer still have demonstration and implementation programs, and very few can deliberately target resources and training efforts in underserved communities. However, a few states have superlative model programs with statewide cover, including Oregon, Maine, California, and Texas. Authors of the paper Stock et al. (2019) stated: *"Since 2011, Oregon State University has conducted integrated pest management (IPM) training specific to public schools. School personnel receive onsite training on key IPM practices as well as associated materials. To determine which practices and materials school employees are using as a result of the program, we administered a survey to 2016 training attendees. We found that all returning attendees had been implementing practices and using materials as a result of the training. The most common practice was sealing holes to keep pests out. Additionally, the majority of respondents reported a reduction in pesticide use. Our approach may serve as a reference for Extension specialists in developing school IPM programs in other states."* Oregon has both an IPM in school law and rigorous training and support program.

While progressive district administrators everywhere are likely to seek expert assistance, many are unaware that all states have an objective, cost-free, science-based support system available in the form of university Cooperative Extension scientists. Nevertheless, most state Extension programs currently do not have dedicated scientists focused on school environmental health initiatives, despite the Extension system providing an ideal platform for programs.

Extending Extension - Environmental Justice

Although the rate of population growth in the U.S. has slowed, the largest metropolitan cities in the U.S. continue to grow, stretching inner-city education capacities far beyond the intended limits. According to the 2020 Census, the proportions of the U.S. population identifying as Hispanic or Latinx, Asian, Black, and those reporting multiracial ancestry are increasing. Diversity increasingly describes the overall U.S. demography, especially within population centers (Jensen et al., 2021). In April 2021, the United Nations High Commissioner for Refugees released data showing that the number of people displaced by climate change-related disasters has risen to 21.5 million since 2010 (UNHCR, 2021). Along with demographic shifts, climate change and human migrations will change how students experience education. Schools in New Jersey, Florida, Puerto Rico, and elsewhere have faced daunting relocation and rebuilding challenges following hurricanes and floods in recent years. Inner-city school administrators in Sun Belt states face extreme heat challenges to a greater extent, while rural schools face increasing wildfire impacts. Sound building infrastructure and good environmental conditions are becoming increasingly important for good academic performance, student health, and long-term wellbeing. But we have a history of failing to manage schools according to their long-term needs and were clearly inadequately prepared for the reality of today.

Currently, financial support for school infrastructure improvement is available through the American Rescue Plan. Yet many school administrators and purchasing staff rely on commercial vendor marketing and salespeople to inform them of the best options and ultimately guide their decisions on air cleaners, cleaning supplies, and disinfection products. Unfortunately, some vendors use marketing materials absent scientific data to make sales. Without unbiased, science-based guidance and standards, school staff are left in a *caveat emptor* - buyer beware position, vulnerable to best marketer deals. **Thus, school staff and local decision-makers need in-state, science-based guidance that applies to their local situation.** The existing change agent core and a broad array of environmental health professionals are the risk-reduction workforce available to school administrators. **Backing from regional EPA and HQ staff could amplify and extend our reach as influencers of district decision-makers.**

Challenge & Opportunity Two – Environmental Programs, Evaluation, and Compliance

Poor environmental quality is linked to decreased learning (Neal, 2008). For example, researchers from North Carolina State University reported in 2009 that addressing cockroaches using IPM reduced asthma allergens to insignificant levels in schools (Nalyanya et al., 2009). Generally, IPM practices have successfully reduced pest-related issues in schools, and the outcomes are well documented (Green and Gouge, 2015; Lame, 2005; Gouge et al., 2006). The foundation of any IPM program is education, training, trusted, and consistent communication. However, in general, school staff, especially teachers, have extremely limited time for environmental health-related professional development or extending such knowledge to students, parents, and guardians.

Further, in 2020, teachers and administrators had to rapidly modify teaching methods for distance and hybrid learning. Pest problems and IAQ issues have been exacerbated by lengthy

closures and the changes in the way school buildings are used. For example, food consumption now occurs in almost all available areas of the school campus to maximize social distancing. Education, communication, and recapitulation of simple concepts provided to school staff by in-state environmental experts can create sustainable information exchange while allowing school staff to focus most of their efforts on curriculum teaching and support. But those initial contacts and communication conduits must be established before this can occur, and there is currently no overarching entity that provides holistic environmental standards for schools.

Various state-government agencies are charged with establishing minimum school facility guidelines, assessing school buildings against these guidelines, and providing monies to bring the buildings into compliance. Unfortunately, many are failing to conduct onsite assessments. For example, between 2017 and 2019, the State of Arizona School Facilities Board inspectors conducted a single inspection of a single school. In addition, during 2020, onsite inspections were "paused" due to COVID-19 (AZSFB, 2021). Legally, deficiency inspections and preventive maintenance inspections are required under state law every five years. Nevertheless, these activities are only helpful if resulting deficiencies are subsequently corrected.

School administrators understand that schools should comply with federal, tribal, or state Occupational Safety and Health Administration regulations. But administrators may not be aware of the full scope of requirements, and some critical components are entirely lacking. For example, in many locations, specific ventilation rate standards are deficient or nonexistent. The Centers for Disease Control and Prevention (CDC), U.S. Department of Education, and American Society of Heating Refrigerating and Air-Conditioning Engineers (ASHRAE) reference building codes in COVID-19 mitigation guidance. This may be in expectation that states, tribes, or school districts will adopt best practices or develop minimum legal standards. No doubt, progressive school districts will strive to adopt recommendations, but many school districts will not. The following statement is from the CDC page https://www.cdc.gov/coronavirus/2019-ncov/community/schools-childcare/ventilation.html.

*"**Ensure Heating, Ventilation, and Air Conditioning (HVAC) settings are maximizing ventilation.***
Make sure your ventilation systems are serviced and meeting code requirements. They should provide acceptable indoor air quality, as defined by ASHRAE Standard 62.1external icon, for the current occupancy level for each space. Home-based childcare programs should meet requirements established by their state and local regulatory authorities."

There are no overarching code-mandated air exchange rates for PreK-12 schools. But there may be building code minimum ventilation (outdoor air) rates and minimum exhaust rates in local jurisdictions. Most contemporary codes use ASHRAE Standard 62.0 or 62.1. For example, ASHRAE standard 62.1 specifies a ventilation rate of 15 cubic feet per minute per person (cfm/p) for ages 5-8 in classrooms and 13 cfm/p for ages nine and higher. However, even this guidance fails to account for contaminants with no regulated limits, such as formaldehyde off-gassing from new carpet.

Adding to the environmental management challenge is that many, if not most, school districts do not have the institutional infrastructure, dedicated staff, funding, and training to identify and address environmental health and safety issues, even when they are aware of existing standards. Compounding the problem further is that funding for preventative maintenance is typically in direct competition with funding for academic needs. Compliance assistance, if available, is often after a notice of noncompliance has been issued and is agency-based and not part of a comprehensive set of guidance across all regulatory requirements. In June 2020, the Government Accountability Office (GAO) determined that most states do not conduct statewide environmental health and safety (EHS) assessments to determine school facility needs. Instead, the task is left to school district officials (GAO, 2020), who rarely have a comprehensive list of school EHS regulations or the infrastructure to address them.

Challenge & Opportunity Three – Environmental Health Specialists & School-Based Training

Environmental Health Professionals inspect schools to identify environmental health and safety conditions and sanitation practices that threaten students and staff (including teachers) wellbeing. They are usually an integral part of multiple state, tribal, or county health departments.

Some EHPs focus on proper storage and handling of hazardous chemicals, usually regulated through state environmental departments. State agricultural departments usually regulate pest management practices, pesticide use, and storage. Playground safety, infectious disease prevention, food handling in kitchens and cafeterias, IAQ, drinking water, legacy chemicals (e.g., asbestos, PCS, lead-based paint), general fire prevention, and electrical safety are also regulated. Schools may be evaluated by local boards of education, the state department of education, health and general services, or any number of other entities**. In summary, school environmental safety standards and legal compliance are enforced infrequently through various local, state, tribal, and federal agencies with few cooperative connections, with some critical standards missing.**

In most states, there is no overarching entity that provides harmonized environmental standards for schools and a minimal change agent workforce providing school staff agency over their work environments. School staff (including teachers) need ready access to technical support and school-based demonstration and integration of environmental monitoring and mitigation practices. **Since March 2020, it has become increasingly clear that conditions inside school buildings will directly affect the wellbeing of students, teachers, staff, and the extensive populations within school communities for the foreseeable future.**

It is important to note that EHPs have outstanding professional organizations that provide significant online professional development opportunities. For example, the National Environmental Health Association and the National Education Association have extensive online professional development but minimal school-based technical field training.

Transprogrammatic school managers, service contractors, and the plethora of compliance evaluators all need school-based inspection and evaluation training on IPM, IAQ, chemical safety, green cleaning, and pesticide safety, including SARS-CoV-2 disinfection and related infection prevention. Historically, IPM, IAQ, Food Safety, Asbestos Management, Drinking

Water, and Chemical Safety have been cornerstones of school environmental health efforts. However, even though individual components are closely aligned and benefit all school stakeholders, environmental health training requirements for teaching and non-teaching school staff are highly variable and, in underserved communities, simply less accessible. Moreover, hands-on practicum training programs previously supported by EPA, USDA, and CDC have diminished or eliminated over the past decade due to reduced budgets.

Challenge & Opportunity Four – EPA Registered Disinfectants are Pesticides, but Rarely Treated as Such

Pests in schools include rodent, insect, arachnid, weed, and **microbial pathogens,** including SARS-CoV-2. EPA List-N disinfectants are not Restricted Use Pesticides, and therefore there are no Federally mandated training requirements for use. Additionally, there are significant differences between school district, state, tribe, and territory policies regarding pesticide use. Because custodial staff use disinfectants so frequently, they are usually exempted from pesticide use notification and posting requirements that apply to other pesticides in some states. All too often, cleaning, and disinfectant products are assumed to be of little concern with regard to staff or building user safety. **School staff desperately need guidance, technical assistance, and professional development opportunities covering safe and effective disinfectant use tailored to their local needs.** Many of us reviewing SARS-CoV-2 disinfectant use lists note significant dependence on active ingredients that trigger asthma and numerous products not on the EPA List N.

Establishing minimum standards for pesticide safety training of individuals applying pesticides in schools has excellent potential to reduce risks to children. Untrained applicators are the least likely to be informed of basic safety practices, legal requirements, and other rules to protect children and staff (Hurley et al., 2014).

Pest Management Professionals (PMPs) are essential environmental specialists in their field, although not often recognized as such. Some school service providers inspect schools for pests and pest-conducive conditions monthly, and there is a clear opportunity for a *pareto* improvement in the services they provide. *Pareto* improvements generate benefits that come at no cost to any party involved. Some pest management businesses can augment service contacts with additional environmental inspection and mitigation components. Over the past 19 months, we have seen an increase in the number and types of companies providing disinfection services. While some have done an admirable and welcome job, others have sold school districts unproven equipment and unnecessary services. School administrators are responsible for the operational oversight of schools. Still, experience shows that those securing external pest management service contracts assume there is little need to oversee the results or the methods used. In addition, administrators with many demands on their time believe environmental health and pesticide safety standards are being met. **Thus, there is an existing need for PMP training and school service oversight. This will be especially important if disinfection services continue to expand.**

Back to school has meant increased chemical exposure for many young students. In addition, there are credible concerns regarding the misuse and overuse of disinfectants and disinfection tools in home and school facilities because of SARS-CoV-2 infection prevention efforts. Surface and hand cleaning are essential components of infection prevention best practices. But poison control reports from multiple countries have documented dangerous exposures to hand sanitizers, disinfectants, bleach, chlorine gas, and chloramine gas. For example, Canadian data between March to June 2020 was reported by Yasseen et al. (2020), and U.S. data from January to March 2020 was published by Chang et al. (2020). The reports document increased school exposures as well as in-home exposures (Kuehn, 2020).

Custodians work directly with cleaning and disinfectant products in schools. These frontline workers are quite literally the guardians of student, teacher, and staff health and safety. Unfortunately, their now routine exposure to disinfectant products (often with minimal training and insufficient personal protective equipment) has increased worker risk of acute and chronic adverse health effects. This exposure has worsened by introducing disinfectant applicators such as electrostatic sprayers, mister/foggers, pesticide sprayers, etc. EPA has only approved a few products for use in electrostatic equipment, and some of the approved products require the use of respirators. Unfortunately, most K-12 schools do not have the necessary respirator program to ensure adequate respiratory protection. In addition, some applicators are using products unapproved for use in the application equipment, posing efficacy as well as health and safety issues. Unfortunately, we are also aware that school staff applicators began using electrostatic sprayers without the required training and licensing required in several states. Overall, cleaning as an occupation is in the top 20 jobs with the highest rates of occupational injuries and illnesses in the U.S., in part due to chemical exposures (Lee et al., 2014).

Significant knowledge gaps regarding public disinfectant use have emerged (Gharpure et al., 2020), including:

- How to effectively and safely use and store disinfectant products and application equipment. Approximately 1/3 of survey respondents in 2020 engaged in non-recommended high-risk practices with the intent of preventing SARS-CoV-2 transmission.
- How to select the safest products effective against the virus. This involves understanding which active ingredients and additives can cause occupational illnesses and pose health risks to building occupants. For example, asthma triggers for sensitive individuals (Folletti et al., 2017).
- How important ventilation is during and after disinfectant use.
- Understanding the various type of wipes designed for very different purposes on the market. For example, disinfectant wipes and hand sanitizing wipes are not interchangeable.
- When antimicrobial products expire and require disposal as hazardous waste.
- How to safely dispose of disinfectant concentrates in compliance with state regulations.
- Appropriate use of personal protective equipment (PPE).
- Appropriate and safe use of fogger, mister, vaporizer, and electrostatic disinfectant application systems.

There is a wealth of evidence documenting unintended negative health impacts due to cleaning and disinfectant exposure that predates the COVID-19 pandemic. For example, several studies provide evidence of adverse respiratory impacts. Bleach exposures, for example, have been related to increased frequency of respiratory inflammation and recurrent bronchitis (Zock et al., 2007).

Harley et al. (2021) measured statistically significant decreases in air concentrations of 17 chemicals when participants switched from prior use cleaning products to green cleaning products. Decreases in geometric mean concentrations of 1,4-dioxane (−46:4%), chloroform (−86:7%), benzene (−24:8%), naphthalene (−40:3%), toluene (−24:2%), and hexane (−35:5%) were documented. Additionally, almost all participants (98%) said the replacement products worked as well as the original products, and 90% said that they would consider buying green cleaning products in the future.

The increased application of disinfectants within buildings and subsequent increases in reported exposure and injury has further elevated the urgent need for expert, unbiased guidance and in-state training.

Given the increase in cleaning and disinfection of indoor spaces, IAQ monitoring, and ventilation improvements are imperative. Improving IAQ in schools has been termed the no-regret investment as the airborne transmission of SARS-CoV-2 is reduced by improving ventilation. Not only are ventilation improvements a cost-effective public health measure, but there are also numerous data sets documenting improved learning outcomes (Fisk, 2017) and good health (Seppänen et al., 1999) correlate with improved IAQ.

Challenge & Opportunity Five – Revival and Expansion of Existing School IPM Programs

Many national school IPM CoP members collaborated to produce an online resource site for school staff called *iSchool Pest Manager* http://ischoolpestmanager.org/docToolbox.html?t=Checklist. Additionally, both in-person and asynchronous, online school IPM training modules were created called *Stop School Pests*. The materials were later rebranded and marketed as *The Pest Defense for Healthy Schools* https://pestdefenseforhealthyschools.org/. But in the absence of ongoing marketing, promotion through trusted information channels, and evaluation of impacts, the resources remain underutilized. Further, the change agents involved in the CoP also created a National Pest Management Strategic Plan for School IPM (https://ipminstitute.org/wp-content/uploads/2016/05/School-IPM-2020-Pest-Management-Strategic-Plan-V3.0.pdf) and deployed statewide school IPM evaluations to identify emerging needs and areas of deficiency. In short, carefully targeted funding of active programs would lead to a rapid revival and national expansion of school IPM efforts. This would improve in-school practicum training and unbiased information flow to school staff on pertinent environmental health topics.

Challenge & Opportunity Six – Pandemic Response & Social Justice

In May 2021, the CDC acknowledged that SARS-CoV-2 is primarily transmitted as an airborne virus, making IAQ an uncontested critical priority for schools. March 2020, there

were 56.6 million K-12 students in our nation's 130,000 schools, including 6 million students in special education. In addition, there were more than 10 million children in childcare and early education facilities. Multiple studies spanning three decades have documented low-income students disproportionately attend the most hazardous schools (U.S. Commission on Civil Rights, 2018). Common issues include overcrowded buildings with substandard ventilation, poor sanitation, unacceptable indoor air conditions, and chronic pest problems.

Substandard environmental conditions in schools have long been an environmental justice issue and are now at the forefront of education concerns. On March 23, 2021, 185 Bureau of Indian Education schools in Arizona had been closed for an entire year. Just as Indian Land schools reopened for the fall 2021 semester, escalating COVID-19 cases again triggered Public Health Emergency orders. On August 12, 2021, the Navajo Department of Health - Navajo Office of Environmental Health & Protection issued Public Health Emergency Order No. 2021-019, reemphasizing "Safer at Home" and a Public Health Emergency Order Declaring "Orange Status" for Schools encouraging hybrid learning and virtual learning for those age 12 years and younger.

The overall learning loss of keeping schools closed is staggering. According to a U.S. Census Bureau survey dated August 2020 (McElrath, 2020), nearly 93% of households with school-age children reported that "distance learning" was being used as an education delivery mode. Household Pulse Surveys showed that high-income households with children used online resources at higher rates than those in lower-income households. Households with an annual income of less than $50,000 and households with income $50,000-$99,999 were significantly more likely to use paper materials sent home for distance learning than households with income of $100,000 or more. However, this still fails to adequately convey the stark patterns of digital inequality attributed to socioeconomic differences. For example, Tuba City Unified School District #15 is located on the Navajo Nation in northern Arizona. 96% of the 15,786-district population are American Indian, 29.7% of families live below the poverty level, and 40.4% depend upon Food Stamps/SNAP benefits. **Only 28.2% of families have broadband internet at home.**

In August 2020, the overall cost of school closures was estimated as a $700 billion loss to the U.S. economy. But lost parental earnings and school upgrade costs associated with reopening schools are not the most significant losses. Moreover, despite some investments, there remains a significant achievement gap between white and black and Hispanic students, and school closures are likely to widen existing disparities (Hanushek et al., 2020).

The 2020 GAO report documented about 54% of public school districts need to update or replace multiple building systems. An estimated 41% of districts need to update or replace heating, ventilation, and air conditioning (HVAC) systems in half of their schools (about 36,000 schools nationwide) (GAO, 2020). Many schools built in the 1800s and early 1900s have no mechanical heating, ventilating, and air conditioning systems.

The Minimum Efficiency Reporting Value (MERV) is a measurement scale established by ASHRAE to report the efficacy of air filters. MERV ratings range from 1 to 20, with 1 being the

lowest level of filtration and 20 being the highest. In general, a MERV rating of 13 or higher eliminates mold spores, smoke, bacteria, **virus carriers**, and most environmental allergens. Guidance from the CDC, The World Health Organization (WHO), ASHRAE, and other professional organizations includes evaluating building air handling units (AHU) to ensure proper operations, increasing air changes per hour in all classrooms, utilizing high-efficiency particulate air (HEPA) filtered air scrubbers in areas with lower air changes per hour, improving ventilation and air filtration levels to MERV 13 in all primary air handlers (where the equipment can handle it), quarterly AHU servicing, rebalancing, and monitoring carbon dioxide (CO_2) in classrooms (ASHRAE, January 6, 2021).

Desktop CO_2 monitors measure the level of exhaled air in a room and are being deployed as proxy indicators for aerosol carriers of SARS-CoV-2. Multiple states, including California and Nevada, now mandate classroom monitoring of CO_2, with threshold triggers for increasing ventilation (outdoor air intake). For example, the State of California Division of the State Architect 5.506.3.1 states *"If in-classroom CO_2 concentration exceeds 1,100 ppm more than once in a week, the classroom ventilation rates will be adjusted to ensure peak CO_2 concentrations remain below the maximum allowable setpoint"*. While no set CO_2 level can determine a zero SARS-CoV-2 transmission risk, applicable relative risk models are emerging (Ahmed, 2017). Researchers are clear that the relative infection risk in each environment scales with excess CO_2 and keeping levels as low as possible allows optimization of the protection provided by ventilation (Peng & Jimenez, 2021). Aside from infection prevention efforts, many IAQ studies use CO_2 as an air quality indicator and ventilation adequacy. For example, research measuring declines in students' cognitive performance showed a 13% decrease when the CO_2 concentration increased from 600 to 1000 ppm, and by 24% at 1800 ppm (Fisk, 2017; Ahmed et al., 2017; Seppänen et al., 1999). Similarly, continuous monitoring using 0.3µm (PM 0.3) particle detectors are being promoted for use as filtration indicators used to trigger supplemental HEPA filtration in classrooms (Pantelic, 2021). These systems require technical expertise to select, install, operate, and maintain. Thus, school districts need school-site participatory experience and access to independent technical experts. For those new to the participatory experience concept, this is a two-way pedagogical strategy that results in collaborative efforts involving scientific experts and community members working together to strengthen autonomous learning. The approach also facilitates cooperation and capacity building.

The American Rescue Plan (ARP) has provided $122 billion in funding to the Elementary and Secondary Schools Emergency Relief (ESSER) Fund. The funds can be used to improve school ventilation and upgrade air filtration by replacing or fixing HVAC systems and placing HEPA air filtration units in classrooms and commonly occupied spaces. In addition, the U.S. Department of Education has released new guidance encouraging the use of ARP-ESSER funds to improve ventilation systems and make other indoor air quality improvements in schools to prevent the spread of COVID-19 and tackle longstanding school ventilation improvement needs (https://www.ed.gov/coronavirus/improving-ventilation?utm_content=&utm_medium=email&utm_name=&utm_source=govdelivery&utm_term=). Within the ARP Congress has allotted $100 million to the EPA specifically to focus on environmental justice; $50 million of those resources are geared toward the EPA partnering with

states, cities, and communities to deploy those resources and focus on environmental-justice-related projects. The other $50 million focuses on boosting the air quality monitoring in these communities that have been disproportionately impacted for decades.

However, school facility managers need help determining proven technologies from the many unproven technologies such as ozone generators, ionization, plasma, and many others. Schools also need guidance regarding budgeting and appropriate maintenance of the systems if new technologies are installed.

Summary

Currently, unhealthy environments exist in schools across the country. Root causes vary between districts but include a lack of awareness of the multitude of environmental health and safety issues, a lack of understanding of local, state, and federal environmental health regulations designed to reduce risks, a failure to include environmental health concepts in capital planning and operating budgets, a lack of appreciation and funding for dedicated and environmental health trained staff, and the lack of a central convener within state governance. Establishing an Integrated Environmental Management approach for schools, including the revival and expansion of SIPM, will require a coordinated capacity-building effort. Access to resources to address longstanding deficiencies will be critical. However, schools will also need ongoing technical support and training for staff and teachers, enabling them to assume greater responsibility for continuous environmental management of their schools. Ideally, a holistic approach will include all environmental health components, including IAQ, IPM, green cleaning, pesticide and chemical safety, food safety, fire prevention, building legacy pollutant management, and drinking water quality. Thus, creating a comprehensive management system with continuous monitoring and maintenance.

There is an immediate need for improved communication and cooperation between school stakeholders, including regulators and enforcement. There needs to be a coherent support system with contemporary best management practices aligned with compliance requirements and cross-disciplinary training. Additionally, sharing real-time environmental data and reporting across multiple divisions would support proactive interventions preventing school closures or limited operations. Finally, integrating environmental-health needs into the budget, capital planning, and operational processes is paramount. Overall efficiency improvements would result if school districts could report progress and challenges to a singular state-level coordinating entity.

As the 2021-2022 academic school year begins, COVID-19 infections are rising in children and unvaccinated adults. Additionally, a severe Influenza season is anticipated due to higher levels of susceptibility than usual. There is an urgent need to convey clear guidelines regarding infection prevention strategies in childcare facilities and schools for the 20 percent of the U.S. population using schools every day (including parents and guardians, students, faculty, and staff). Similarly, tertiary education institutions face the same challenge and often provide significant employment for state residents. For example, in 2021, the University of Arizona employs more people than any other Arizona-based employer. **Environmental health standards in learning environments directly influence the health and wellbeing of stakeholders (Grineski &**

Collins, 2018). Amidst a pandemic, environmental standards in learning environments will affect the entire community's health, financial stability, and social integrity.

The Energy Independence and Security Act of 2007 (https://www.epa.gov/schools/endnotes-state-school-environmental-health-guidelines#note2) amended the Toxic Substances Control Act, 15 U.S.C. 2601 et seq., by adding a requirement for the U.S. EPA, in consultation with relevant federal agencies, to develop voluntary guidelines to assist states in establishing and implementing environmental health programs for K-12 schools. Supporting IPM, chemical safety, and IAQ programs in schools presents many challenges, unique situations and exposure vulnerabilities to address. Schools typically have around four times as many occupants as an office building of the same area. Additionally, schools house the most vulnerable members of society and most of our future citizenry. **Therefore, an Integrated Environmental Management approach will be critical to the safe and sustainable provision of in-person school.** Beyond this, education institutions themselves, inclusive of tertiary education, must serve a more central role in promoting transformative change to understand and apply the principles of One Health and strive to achieve optimal human health, recognizing the interconnection between people, animals, plants, and our shared environment. Further, it is incumbent upon education systems of all kinds to both model and teach sustainable and regenerative environmental management with climate change mitigation at the heart of the matter. The survival of our species may well depend upon their success.

Proposed EPA and Extension Initiatives

Land-grant universities, with Cooperative Extension county-based staff and associated experiment stations, have played an effective and vital role in bringing science to the people as we face the challenges of an ever-changing world. Extension scientists and related change agents are the existing workforce who facilitate the transformation of science facts into scientific solutions. Kopp (2020) states: *"Today, the urgent challenges of the Anthropocene demand a more robust relationship between scientific research and on-the-ground action, strong networks sharing local lessons globally, and channels for injecting global, long-term perspectives into the noise of short-termism. The land-grant experience provides lessons for "Anthropocene universities" seeking to tackle these challenges, including the importance of (1) establishing or expanding university-based boundary organizations akin to cooperative extension, (2) incentivizing the integration of engagement into the university's research, teaching, and service missions, (3) centering values of democracy, justice, equity, and inclusion in engagement, and (4) cooperating across institutions and sectors."*

We implore the EPA to build on or establish partnerships with state and tribal change agents who operate independently of industry and provide in-school environmental health program assistance. Scientists from IPM, IAQ, and other environmental health fields can provide assessments and school-site participatory demonstrations, allowing school staff to trial new technology and approaches. They can facilitate school staff with environmental data capture, making the invisible investments in IAQ quantifiable and VISIBLE in relative risk-reduction terms. Finally, they can provide science-based guidance and oversight on IAQ, green cleaning, and pest management services in schools.

Progressive industry groups can build in more aggressive risk-reduction services to bolster their business, and legal enforcement staff will also benefit from increased data and information gathering in school districts within their jurisdiction.

Facilitating harm reduction efforts requires the connection and cooperation of school staff, contractors, compliance evaluators, and in-state Extension scientists. There exists an overarching goal to attenuate risk. This can be achieved through proactive maintenance of facilities, monitoring useful environmental metrics, understanding relative risk evaluation, and adopting best practices to optimize environmental conditions.

Most of the listed authors already provide training and technical support regarding insect, arachnid, weed, rodent, and pathogen mitigation for school staff, environmental health professionals, and the pest management industry. **But in-state needs are consistently overwhelming. In-field activities are generally grant-funded, resulting in intermittent short-term efforts, and state representatives are acutely aware of underserved communities.**

Funding for change agents could include university Extension scientists and county Extension educators in addition to state, tribal, county, and non-governmental EHPs. Existing funding mechanisms include State and Tribal Assistance Grants (Infrastructure Assistance funds) and Pesticide Environmental Stewardship Program funds. Although many EHPs are trained to conduct compliance inspections in schools, relatively few can keep entirely updated on the full array of environmental best practices. In addition, alliances connecting departments of health, education, and university Extension scientists are needed to align goals between agencies in accordance with local needs. For example, IAQ management to maximize infection prevention would be very different from IAQ settings to mitigate indoor wildfire air pollution effects.

Experience has shown that using an IPM approach results in the elimination of ineffective and unnecessary pesticide use. Similarly, taking an IAQ, low-impact cleaning, and pesticide safety best practices approach to infection prevention will result in the elimination of ineffective and unnecessary disinfectant and inappropriate equipment use (and purchase). In all cases, when chemicals or other mitigation tools are used, selections are proven, science-based, in regulatory compliance, and effective.

We have an opportunity to embed IPM, green cleaning, pesticide safety, and most importantly, IAQ programs in schools as enduring, well-funded programs with accessible technical and training support. Integrated Environmental Management should be as much a part of the education experience as school lunch and school bussing. But historically, state education departments have been challenging to engage. **We propose that environmental standards should be as much the responsibility of these departments as setting curricula, enrollment, and graduation requirements.**

Similarly, the Federal role in education is to promote student achievement and preparation for global competitiveness by fostering educational excellence and ensuring equal access. To address the most fundamental needs towards this goal, the U.S. Department of Education must coordinate with the EPA and other lead agencies to highlight the importance of improving

environmental conditions nationally by disseminating the latest discoveries on best practices supportive of teaching and learning. In the near term, supporting efforts to keep schools open is the most immediate education access challenge.

We have an opportunity to break down silos between and within agencies to make enduring improvements to school environmental health. It is in the best interest of communities nationwide to improve environmental standards in schools, and Integrated Environmental Management will help narrow education disparities.

Education is primarily a state, tribal and local responsibility in the U.S. It is states, tribes, and communities, which establish schools and colleges and develop curricula. **If future generations of American citizens are to be globally competitive and prepared for the rapidly changing world of tomorrow, education systems will have to both model and teach sustainable and regenerative environmental management.**

***"Today, through this report [2021 State of Our Schools], we are issuing a national call to action because, quite simply, the state of our schools is a national emergency, one that compromises the precious opportunity of all our children and the very future of American prosperity."* – Filardo 2021.**

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