Excerpts from the *Reference Guide for Indoor Air Quality in Schools*

https://www.epa.gov/iaq-schools/reference-guide-indoor-air-quality-schools

With an emphasis on Particulate Matter (PM) based on the monitors purchased by WeatherBlur (Sper Scientific Particle Meter PM 2.5 & 10). These monitors measure air pollution particles of <2.5 microns ($PM_{2.5}$, known as fine particulates) and <10 microns (PM_{10}, known as course particulates)

Appendix E - Typical Indoor Air Pollutants

Presented is information about several indoor air pollutants common to schools, in a format that allows for easy comparison. A separate Adobe Acrobat version is also available: Appendix E.

The pollutants presented include:

- Biological contaminants
    - Mold
    - Dust mites
    - Pet dander
    - Pollen, etc.
- Carbon dioxide (CO_2)
- Carbon monoxide (CO)
- Dust
- Environmental tobacco smoke (ETS) or secondhand smoke
- **Fine particulate matter ($PM_{2.5}$)**
- Lead (Pb)
- and Nitrogen oxides (NO, NO_2).

Each pollutant is described or analyzed across five categories: Description, Sources, Standards and guidelines for indoor air quality, Health effects, and Control measures

Fine Particulate Matter ($PM_{2.5}$)

Description: Fine Particulate Matter ($PM_{2.5}$), or soot, is a component of diesel exhaust, and is less than 2.5 microns in diameter, in comparison, the average human hair is about 100 microns thick. It may consist as a tiny solid or liquid droplet containing a variety of compounds.

Sources: The main source of $PM_{2.5}$ is diesel engines in trucks, buses and non road vehicles, e.g.,

- Marine
- Construction
- Agricultural
- and locomotive

These types of diesel engines emit large quantities of harmful pollutants annually.
Standards and Guidelines for Indoor Air Quality: There are currently no Federal government standards for $PM_{2.5}$ in school indoor air environments. EPA's National Ambient Air Quality Standards list 12 $\mu g/m^3$ as the annual limit and 35 $\mu g/m^3$ as the 24-hour limit for $PM_{2.5}$ in outdoor air.

Health Effects: Particulate matter is associated with a variety of serious health effects, including lung disease, asthma and other respiratory problems. In general, children are especially sensitive to air pollution because they breathe 50 percent more air per pound of body weight than adults. Fine particulate matter or $PM_{2.5}$, poses the greatest health risk, because it can pass through the nose and throat and become lodged in the lungs. The particles can aggravate existing respiratory conditions, such as asthma and bronchitis, and they have been directly associated with increased hospital admissions and emergency room visits for heart and lung disease, decreased lung function and premature death. Short-term exposure may cause:

- Shortness of breath
- Eye and lung irritation
- Nausea
- Light-headedness
- and possible allergy aggravations.

Control Measures: Effective technologies to reduce $PM_{2.5}$ include particulate filters and catalysts that can be installed on buses. An easy, no-cost, and effective way to control fine particulate matter is to minimize idling by buses, trucks and other vehicles.

More information on Indoor Particulate Matter from EPA:

https://www.epa.gov/indoor-air-quality-iaq/indoor-particulate-matter

Particulate matter (also referred to as PM or particle pollution) is a complex mixture of solid and/or liquid particles suspended in air. These particles can vary in size, shape and composition. EPA is especially concerned about particles that are 10 micrometers in diameter or smaller because these particles are inhalable. Once inhaled, particles can affect the heart and lungs and in some cases cause serious health effects. The human health effects of outdoor PM are well-established and are used to set health-based standards for outdoor air (National Ambient Air Quality Standards, NAAQS). PM is also found in all indoor environments. Indoor PM levels have the potential to exceed outdoor PM levels and the NAAQS. However, less is known about the specific impacts of indoor PM on health.

Health Effects of Inhalable Particles

Exposure to inhalable particles can affect both your lungs and your heart. Many studies directly link the size of particles to their potential for causing health problems. Small particles (less than 10 micrometers in diameter) can get deep into your lungs, and some may even get into your bloodstream. People with heart or lung diseases such as coronary artery disease, congestive heart failure, and asthma or chronic obstructive pulmonary disease (COPD), children and older adults may be at greater risk from PM exposure. Scientific studies have linked PM exposure to a variety of health impacts, including:

- Eye, nose and throat irritation;
- Aggravation of coronary and respiratory disease symptoms; and
- Premature death in people with heart or lung disease.

Indoor PM Sources

PM found indoors will include particles of outdoor origin that migrate indoors and particles that originate from indoor sources. Indoor PM can be generated through cooking, combustion activities (including burning of candles, use of fireplaces, use of unvented space heaters or kerosene heaters, cigarette smoking) and some hobbies. Indoor PM can also be of biological origin.

Levels of PM Indoors

Indoor PM levels are dependent on several factors including outdoor levels, infiltration, types of ventilation and filtration systems used, indoor sources, and personal activities of occupants. In homes without smoking or other strong particle sources, indoor PM would be expected to be the same as, or lower than, outdoor levels.

Outdoor Air Pollution

Exposure to outdoor air pollution, such as diesel exhaust, ozone and particulate matter, can trigger an asthma episode or exacerbate asthma symptoms. There are simple actions that schools can take to minimize student and staff exposure to outdoor air pollutants.

- Diesel Exhaust
- Ozone, and Particulate Matter

Diesel Exhaust

Exposure to diesel exhaust from school buses and other diesel vehicles can exacerbate asthma symptoms. Diesel engines emit soot, also known as particulate matter (PM), as well as ozone-forming nitrogen oxides and other toxic air pollutants. PM and ozone (a primary

ingredient of smog) are thought to trigger asthma symptoms and lung inflammation, resulting in:

- reduced lung function
- greater use of asthma medication
- increased school absences
- and more frequent visits to the emergency room and hospital

Diesel PM is also associated with more severe allergies and respiratory disease. In recent studies, outdoor ozone, or smog, has been associated with more frequent diagnoses of new asthma cases in children.

Schools can take simple steps to reduce exposure to diesel exhaust pollutants:

- Do not allow school buses or other vehicles such as delivery trucks to idle on school grounds and discourage carousing.
- Encourage your school bus fleet manager to implement district-wide anti-idling policies and practices.
- Work with your school bus fleet manager to replace the oldest buses and to reduce emissions from newer buses by retrofitting them with emission control technology and/or by switching to cleaner fuels.
- For more information, visit National Clean Diesel Campaign or call (734) 214-4780.

Ozone and Particulate Matter

The Air Quality Index (AQI) is a tool to provide the public with clear and timely information on local air quality and whether air pollution levels pose a health concern. The AQI is reported and forecasted every day in many areas throughout the United States on local weather reports and through national media. Asthma episodes are most likely to occur the day after outdoor pollution levels are high.

Schools can take simple steps to ensure the health and comfort of students when the AQI reports unhealthy levels:

- Limit physical exertion outdoors.
- Consider changing the time of day of strenuous outdoor activity to avoid the period when air pollution levels are high or consider postponing sports activities to another time.

Air Quality Index (AQI) Basics: https://www.airnow.gov/aqi/aqi-basics/

What is the U.S. Air Quality Index (AQI)?

The U.S. AQI is EPA's index for reporting air quality.

How does the AQI work?

Think of the AQI as a yardstick that runs from 0 to 500. The higher the AQI value, the greater the level of air pollution and the greater the health concern. For example, an AQI value of 50 or below represents good air quality, while an AQI value over 300 represents hazardous air quality.

For each pollutant an AQI value of 100 generally corresponds to an ambient air concentration that equals the level of the short-term national ambient air quality standard for protection of public health. AQI values at or below 100 are generally thought of as satisfactory. When AQI values are above 100, air quality is unhealthy: at first for certain sensitive groups of people, then for everyone as AQI values get higher.

The AQI is divided into six categories. Each category corresponds to a different level of health concern. Each category also has a specific color. The color makes it easy for people to quickly determine whether air quality is reaching unhealthy levels in their communities.

Five major pollutants

EPA establishes an AQI for five major air pollutants regulated by the Clean Air Act. Each of these pollutants has a national air quality standard set by EPA to protect public health:

- ground-level ozone
- **particle pollution (also known as particulate matter, including PM2.5 and PM10)**
- carbon monoxide
- sulfur dioxide
- nitrogen dioxide

Click here for using the Air Quality Index: https://www.airnow.gov/aqi/aqi-basics/using-air-quality-index

The National Ambient Air Quality Standards for Particulate Matter

SUMMARY

• On December 7, 2020, the U.S. Environmental Protection Agency (EPA) announced a final action to retain the nation's current air quality standards for particulate matter, or "PM."

• Particle pollution includes fine particles ($PM_{2.5}$), which are 2.5 micrometers in diameter and smaller, and coarse particles, which have diameters between 2.5 and 10 micrometers. Fine particles can be emitted directly from a variety of sources, including vehicles, smokestacks and fires. They also form when gases emitted by power plants, industrial processes, and gasoline and diesel engines react in the atmosphere. Coarse particles include road dust that is kicked up by traffic, some agricultural operations, construction and demolition operations, industrial processes and biomass burning.

THE STANDARDS

• The Clean Air Act requires EPA to set two types of National Ambient Air Quality Standards for particle pollution: primary standards, to protect public health, and secondary standards, to protect public welfare. The law requires that primary standards be "requisite to protect public health with an adequate margin of safety," including the health of sensitive groups of people. For PM, scientific evidence suggests that people with heart or lung disease, children and older adults, and nonwhite populations are at particular risk.

• Secondary standards must be "requisite to protect the public welfare" from both known and anticipated adverse effects. Particle pollution causes haze in cities and some of the country's most treasured national parks. In addition, particles such as nitrates and sulfates contribute to acid rain formation which erodes buildings, historical monuments, and paint on cars. Particle pollution also can affect the climate by absorbing or reflecting sunlight, contributing to cloud formation and influencing rainfall patterns.

Primary (Health) Standards for Fine Particles ($PM_{2.5}$):

- EPA established both an annual and a 24-hour standard for fine particles (PM2.5) in prior reviews. These standards work together to protect the public from harmful health effects from both long- and short-term fine particle exposures.
    - ***Annual standard***: The annual fine particle standard is designed to protect against health effects associated with both long- and short- term exposure to $PM_{2.5}$. **EPA is retaining the current annual standard with its level of 12.0 micrograms per cubic meter ($\mu g/m^3$)**. An area meets this standard if the three-year average of its annual average $PM_{2.5}$ concentration is less than or equal to the level of the standard. The annual standard has been in place since 2012.
    - ***24-hour standard***: The 24-hour primary standard is designed to provide supplemental health protection against short-term fine particle exposures, particularly in areas with high peak $PM_{2.5}$ concentrations. **EPA is retaining the existing 24-hour standard, with its level of 35 $\mu g/m^3$**. An area meets the 24-hour standard if the 98th percentile of 24-hour $PM_{2.5}$ concentrations in one year, averaged over three years, is less than or equal to 35 $\mu g/m^3$. The current 24-hour standard was issued in 2006.

Primary (Health) Standard for Coarse Particles (PM_{10})

• **EPA is retaining the existing 24-hour primary standard for coarse particles (PM_{10}), with its level of 150 $\mu g/m^3$**. An area meets the 24-hour PM_{10} standard if it does not exceed the 150 µg/m3 level more than once per year on average over a three-year period. The existing PM_{10} particle standard has been in place since 1987.

Secondary (Welfare) Standards for Particle Pollution:

• EPA's current secondary standards for particle pollution are identical to the primary standards for $PM_{2.5}$ and PM_{10}, except for the secondary annual $PM_{2.5}$ standard which has a level of 15.0 µg/m3 .