

# School Facilities and Student Achievement



Photo by Lincoln Barbour

## *A Message From Our Board*

The research is conclusive: school facilities have a measurable impact on the achievement of our children. From kindergarten through high school, **the environment in which our students learn affects their performance and, ultimately, their future.** While factors such as teachers and parental involvement have an indisputable impact on student achievement, well-designed school facilities — the places where our children spend the majority of their waking hours — can significantly bolster whatever human inputs our students receive. On the other hand, poorly-designed or -maintained buildings threaten to undermine every other effort we may put into our educational system.

*Well-constructed and -maintained facilities are critical to the well-being and success of the children, faculty, and staff that comprise our K-12 system.*

— Jay Coalson,  
Co-Chair



Jay Coalson  
Co-Chair

This brief outlines the academic literature and draws real-life case studies from throughout Oregon, focusing on three areas that research shows have considerable impact on student performance:

- **Lighting:** *The quality and quantity of light that our students receive impacts the health, behavior, and achievement of our students.*
- **Air Quality:** *Airborne pollution and thermal discomfort have well-documented negative effects on attendance and concentration.*
- **Noise:** *A quiet learning environment benefits both students and teachers, positively impacting the retention of information.*



Chris Dudley  
Co-Chair



Justin Hurley  
Co-Chair

Our research demonstrates that **investing in our school facilities is the same as investing in our students.** We all want what's best for the children of this state, and we all know the harsh consequences that come when the ill-prepared students of today struggle to join the workforce of tomorrow. We hope that you will use this brief as a tool that will allow us to make the best possible decisions for the welfare, achievement, and future of Oregon students.

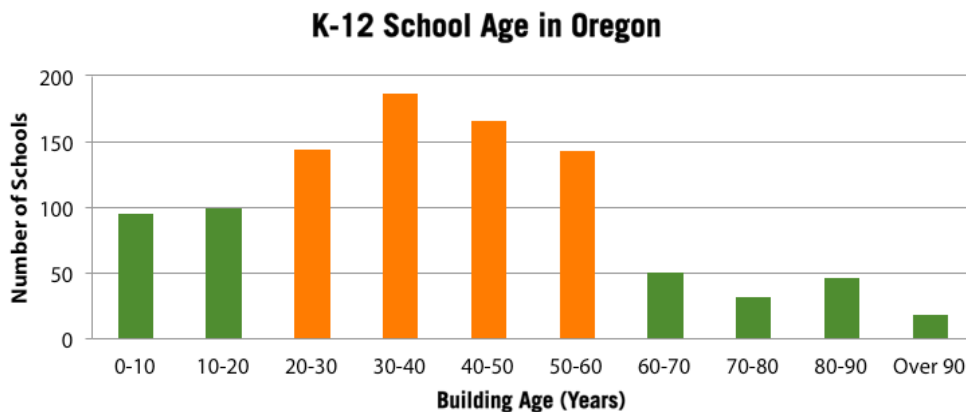


## Introduction

This brief will discuss three areas — **lighting**, **air quality**, and **noise** — that have considerable impacts on student performance. We present what school officials here in Oregon have to say about the importance of facilities in classroom performance, and provide an introduction to the substantial literature that links the quality of school buildings (and their components) to student health and achievement. To learn more, please visit the Center for Innovative School Facilities website at [CISForegon.org](http://CISForegon.org).

## Lighting

Studies consistently show that lighting impacts the health, behavior, and achievement of students in an indoor environment<sup>1-3</sup>. However,



Source: *The Center for Innovative School Facilities, 2011*

exposed to different lighting conditions found a 21% increase in performance from students exposed to the most daylight compared to those exposed to the least<sup>5</sup>. The study was replicated in three difference school districts (while controlling for elements such as demographics and teacher experience) and verified by a re-analysis of the data two years later<sup>5,6</sup>. A separate, long-term study found an average differential of 14% in the test performance of students in daylit versus non-daylit school facilities<sup>7</sup>.

the amount of natural light (also known as “daylighting”) used to illuminate classrooms has declined steadily since the 1950s<sup>4</sup>. Since the vast majority of the state’s schools were constructed between 20 and 60 years ago (see graph), the absence of natural light — and the all-too-common usage of antiquated fluorescent lamps — is a serious issue for Oregon K-12 facilities.

Research that analyzed standardized math and reading scores among students





## Case Study: Lighting at Two Oregon Schools

Improved lighting has had a significant effect on a number of school facilities in Oregon. *“It’s been huge for us here,”* says Steve Emmert of Sherwood’s Laurel Ridge Middle School while describing the difference between the lighting in the old facility versus the new. “The building is full of windows, so there’s a tremendous amount of natural lighting. And I will tell you that ***every single person who comes into this building remarks about how calm it is.*** A lot of that has to do with the fact that no matter where they are in the building, they feel connected to the outside — it’s very, very calming. I’ll also say that our behaviour data looks really good. The middle schoolers will tell you that the windows provide a lot of accountability: they know that, no matter where they go in the building, people can see what they’re doing.”

*“It has made my job so much easier. I love the fact that I can walk through the halls and look into all of the classrooms without necessarily going in. I love it.”*

— Steve Emmert, Principal  
Laurel Ridge Middle School

Jeff DeFranco of the Springfield School District agrees. “We did some window retrofits at two of our middle schools (some new windows, double-paned, low glare). One of the big changes wasn’t just the windows, but also their coverings: they used to have big, giant drapes that were either open or closed. Now they’ve got pull-down roller shades on each window. And ***we’ve heard from teachers that it helps them because they can do partial dimming. They can bring the shades all the way down when they want to use their projectors, or up when they want good visibility, or partway down if the kids are distracted. They appreciate having greater control of their classroom’s daylight and the resulting environment .***”

### What Makes a Well-Lit Classroom?

Over the years, researchers have pinpointed a number of lighting elements that constitute a well-lit classroom. A consciously-designed lighting system should consider the following factors:

- **Natural light**

As explained previously, classrooms that maximize student access to daylight experience increased performance, attendance, health, and even physical development<sup>8,9</sup>.

- **Lighting fixtures**

While natural light is usually the best option for students, well-chosen lamps can reduce the negative effects of artificial lighting. The most appropriate technology depends on the type of space and the activities that take place within it<sup>1</sup>.

- **Minimal glare**

Students benefit from clear, glare-free views within the classroom, particularly for those subjects — such as math — where visual demonstrations are key to student understanding<sup>11</sup>.

- **Control of light sources**

Being able to shade students from direct sunlight and control distractions with adjustable window coverings helps avoid the negative influence that each have on performance<sup>11</sup>.

<sup>1</sup>Consult James Benya’s Lighting for Schools<sup>10</sup> for more information.

## Air Quality

Children are uniquely susceptible to indoor air quality: their bodies require more oxygen than those of adults, and they inhale a proportionally greater volume of air<sup>12</sup>. It's hardly a surprise, then, that dust, mold, bacteria, allergens, carbon dioxide levels, and airborne chemicals can cause major harm to young respiratory systems<sup>4,13,1</sup>. Serious illnesses, including asthma, have been strongly linked with indoor pollution and poor ventilation<sup>2</sup>. The American Lung Association reports that, in 2008, a staggering 14.4 million school days were lost in the United States from absences caused by asthma — asthma aggravated by the airborne pollutants so common in facilities with outdated or ill-maintained heating, ventilation, and air conditioning (HVAC) systems<sup>3</sup>. Oregon suffers from an 8.4% prevalence rate of asthma among children below 18 years — nearly 73,000 students overall — which has had a measurable effect on absenteeism rates statewide<sup>14</sup>.

*The fact that fresh outdoor air is transported through dirt is asking for problems<sup>15</sup>.*

Antiquated and poorly-maintained HVAC systems pollute the air that passes through school buildings and decreases the efficiency of the system as a whole. Layers of dust that accumulate in vents are known to cultivate and disperse harmful microorganisms that can trigger health problems in facility occupants<sup>15</sup>.

***“We did a survey of teaching staff, and the number one facility issue was thermal comfort — inconsistent heating and cooling — and it’s disruptiveness to the classroom environment and kids’ ability to stay connected to the task at hand.”***

— Jeff DeFranco,  
Springfield Public Schools



### Case Study: Air Quality at Laurel Ridge Middle School

Air quality and antiquated HVAC systems are a problem in Oregon school buildings, one that the Sherwood District tackled head-on when it built its new Laurel Ridge Middle School. “There was a lot of special consideration given to the HVAC,” recalls Steve Emmert, Principal of Laurel Ridge. In the new facility, air quality monitors evaluate the status of fresh air in classrooms and motion detectors ensure that energy (and money) doesn’t go to waste heating empty rooms. Emmert describes the results as “wonderful.” Compared to the old, “stuffy” system, the improved air quality had noticeable impacts on both student attention and the health of the building’s occupants. ***“The air quality within our building is pretty phenomenal,”*** he relates. ***“We just haven’t had a lot of illness, and we live in one of the highest allergy capitals of the world.”***

## Air Quality (cont.)

Poorly-functioning or blocked systems also struggle to maintain temperature and humidity levels conducive to learning, subjecting students to atmospheres too hot, too cold, too damp, or too dry for optimal performance<sup>16,17</sup>. Achievement scores consistently bear this out, with student performance in environments with good temperature control generally exceeding those from children who learn in poorly-regulated classrooms<sup>18</sup>. Jeff DeFranco of Springfield sums up the problem:

***“In some of our old schools, we had 1950s-era, steam-producing boilers and deteriorating piping. You’d have one classroom where the kids are baking, and literally across the hall the kids have their jackets on because they’re so cold.”***



### Case Study: Noise Reduction in Springfield, Oregon



*“We have an elementary school called Douglas Gardens Elementary School, built in 1964. It has classroom pods, with classrooms around the outside and a break-out space in the middle. When they built it, they used temporary walls — walls that slide — to separate the break-out space from the classrooms. The noise factor was very problematic: there were a lot of complaints from the teaching staff, the kids were distracted, and whatever was happening in that center area would disrupt what was happening the classroom. So the center break-out space stopped getting used.*

*We ended up going in there and replacing the temporary walls with real walls to provide good sound separation. The teaching staff likes using that breakout space now, because whatever’s happening in the space doesn’t disrupt what’s happening in the classroom. We can have teachers working with smaller groups of students, with more opportunities for hands-on projects or small-group acceleration or remediation activities with kids. They’re definitely getting more use out of that central area compared to how it was previously, and the facility now operates in greater support of the educational program.”*

— Jeff DeFranco, Director of Communications and Facilities, Springfield Public Schools

## Noise Pollution

It will surprise no one to learn that being unable to hear a teacher undermines student ability to absorb the material being taught<sup>19,20</sup>. While this of itself is reason to take noise pollution seriously, the harmful effects of poor acoustics and background noise go far beyond simple hearing difficulties: long-term memory, reading ability, teacher effectiveness, and even a student’s attitude suffer when a student learns in a noisy facility<sup>21-25</sup>. Children subjected to loud classrooms score significantly worse in standardized tests measuring reading and math abilities<sup>16,24,26</sup>, and coping mechanisms for dealing with chronic noise (i.e., tuning out all auditory input, no matter the source) may further impair a student’s ability to receive instruction<sup>1</sup>.

***“It only takes a small change in speech-to-noise ratio for a child to go from understanding almost everything to understanding very little.”***

— Lawrence Feth, Professor of Speech and Hearing Science, Ohio State University

## Noise Pollution (cont.)

As with poor air quality, children are more susceptible to the negative effects of noise pollution than adults<sup>19,24</sup>. Evidence suggests, however, that noise exposure impacts teachers as well as students: fatigue, irritation, and lost teaching time (from noisy interruptions) are common complaints from teachers in loud classrooms<sup>1,21</sup>. Despite this reality, few classrooms meet the acoustic criteria outlined by the American Speech-Language-Hearing Association (ASLHA)<sup>28</sup>. Areas of particular concern in school design, location, and maintenance include:

- **Noise from facility equipment.**

HVAC, electrical, and plumbing systems all contribute to ambient noise within an academic setting. Care should be taken during purchasing and design decisions to account for how building equipment — and even instructional appliances — will add to classroom noise levels.

- **The acoustic properties of learning spaces.**

Sound reverberates on hard surfaces, so proper absorptive treatments for walls, floors, and ceilings are crucial to effective communication between teachers and students within the classroom.

- **Baseline indoor and outdoor noise levels.**

Noise from adjacent classrooms or nearby facilities (such as highways, airports, or construction sites) can drastically impact the acoustic profile of a school building. Awareness during the siting, design, and construction of a school building can limit these disruptions and decrease ambient noise levels for students<sup>29</sup>.



### Concluding Thoughts

In this brief we've outlined a few of the many reasons why school buildings are a crucial factor in student achievement in Oregon. Facilities are very much the rising tide that lifts all boats — well-designed learning environments have demonstrable impacts on student health, student achievement, and even teacher performance. Please join the Center for Innovative School Facilities in ensuring that the children of Oregon receive the best possible educational experience we can provide. Surely they deserve nothing less.

*Students and staff in more comfortable learning environments — whether that's a result of daylighting or thermal comfort or cleaner air — tend to perform better, because they have their basic needs met and at that point they're able to focus on more complex tasks.*

— Jeff DeFranco,  
Springfield Public Schools

*The facility makes a difference. The kids take a great deal of pride in being here. They've taken a pride not only in the facility, but there's more pride in their academic performance.*

— Steve Emmert,  
Laurel Ridge Middle School

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**The Center for Innovative School Facilities** is a non-profit group of school administrators, facility managers, construction and design specialists and community advocates who volunteer their time and energy to create better schools for the children and communities of Oregon.