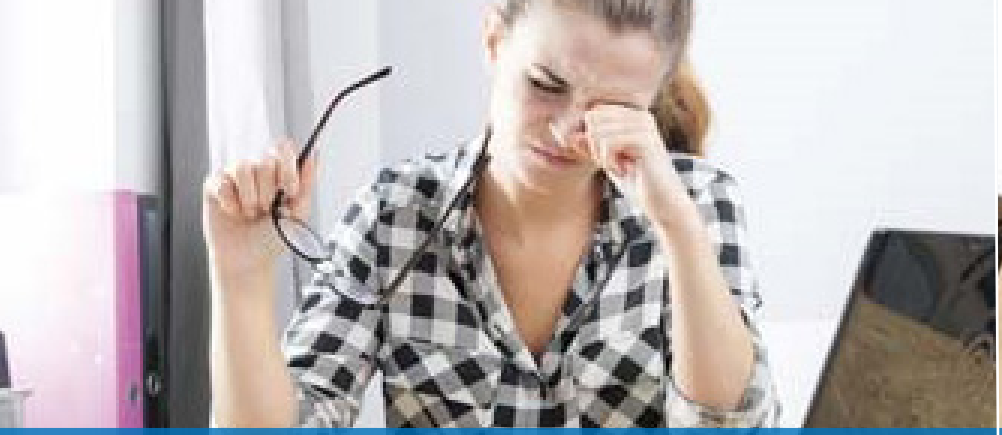
Humidity for Schools

An indepth look at the role humidity control plays in creating a healthy and safe school environment.

Humidity for a better life

condair



A 2009 study by Markovic found that our eyes become more susceptible to infection at low humidity levels, due to the increased evaporation rate of the tear layer that would normally remove any pollutants.

In 2010, a study by Rainer found that skin dryness increases significantly between relative humidity of 35% to 15%.

Introduction

On average, elementary students (K-12) spend 180 days in school a year. So, during the 9 months of the school year, children spend almost 20% of their time in a classroom. We worry about the health and comfort of our families at home, however what about their second home at school?

Most children will not understand the importance of indoor air quality, and they shouldn't have to! It is up to engineers, architects, contractors and building operators to make sure we create healthy environments in which students can grow and learn.

Humidity for Health

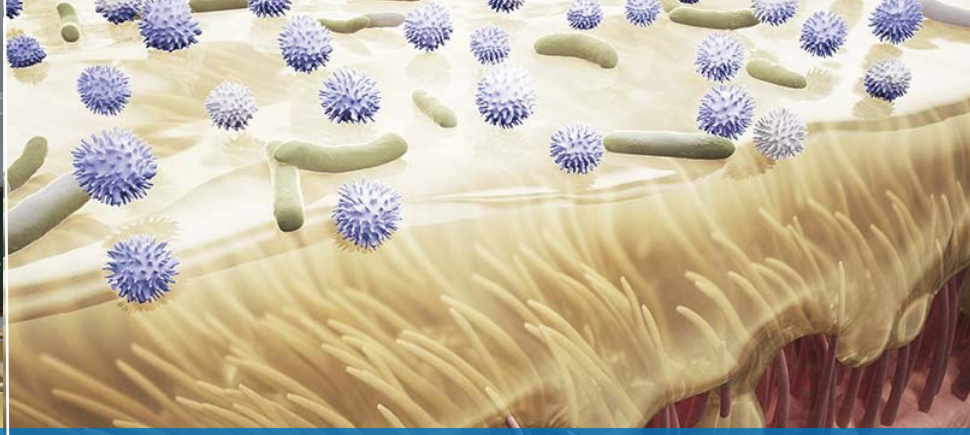
Water makes up about 60% of the human body. Maintaining this level of moisture is crucial to our health and wellbeing as nearly every major system in our body relies on water to function properly. As we go about our day, moisture is lost to the environment through breathing, perspiration, urination, and evaporation. While it's important to drink enough water, the moisture content of the air around us plays a more significant role in our body's hydration than first meets the eye.

When humidity levels are low, the air must compensate by pulling moisture from any source it can find. We typically notice this as chapped lips, dry eyes, and itchy skin, but there's more going on beneath the surface. Studies have proven that humidity levels below 40% RH lead to a reduction in the mucus layers that protect us from infection and also impair our body's ability to regenerate damaged tissue (Kudo 2019).

Mucus membranes lining the nose and respiratory tract prevent viruses and bacteria from entering the body, while also sufficiently humidifying the air you breathe before it reaches the lungs. When humidity levels drop in the fall and winter months many people experience a dry, itchy throat and even nosebleeds. This is the result of too much moisture being drawn from these mucus membranes. They become less capable of trapping and filtering out illness-causing bacteria and viruses as moisture decreases. Eventually, cracking will occur, providing these microbes a direct path to the bloodstream.

According to a study by Rainer in 2010, 45% RH is optimal for mucus membrane functionality. This is just one of the major reasons why the flu is so prevalent during the fall and winter months.

Low air humidity below 40% RH acts as a conduit for viruses and airborne bacteria to disperse and travel around indoor environments.



Drying of the mucous membranes in our nose and bronchi inhibits our natural defence mechanism against airborne pollutants. This leaves us vulnerable to infections from airborne germs, such as the flu and common cold.

Humidity for Schools

Proper humidification and indoor humidity levels (40-60% RH) in schools have proven beneficial in studies for several reasons. These benefits include:

- Reducing airborne bacteria, viruses and fungi emission rates
- Weighing down biological aerosols, so that they can be disinfected and wiped off surfaces
- Improved learning performance (reduced discomfort, fatigue, distraction, etc.)

Let's start with the air quality in a school environment. Two studies in particular, Qian 2012 and Hodopsky 2014, indicate that an occupied indoor space, such as a classroom, tends to show a greater concentration of bacteria, fungi and particulate matter when compared to an unoccupied space. Much of the occupancy associated emissions come from resuspension, from exhalation, and movements as well as direct shedding from the occupants.

While the Qian and Hodopsky studies look at the air quality in classrooms, a separate study in 2014 by Meadow looks at surfaces in these spaces as well. The focus of this study was the effect that occupants have on the built environment. Bacteria samples throughout a university classroom were taken from four different surface types: desks, chair seats, floors, and walls. Results showed that human-associated microbes were found on indoor surfaces proving that transmission from humans to the built environment is possible and that human transmission is the main driver for spread between other surfaces. Transfer can be through contact as well as through settled airborne particles.

It is clear that where there are people, there is the risk of organisms spreading within the environment, even after an infected person has left the classroom. This increases the risk of sickness and student absenteeism.

Humidification can not only help to reduce the infectivity of the bacteria and viruses in the air, but also help to reduce the number of aerosolized particles, weighing them down to surfaces where they can be cleaned.

Indoor humidity levels of 40-60% RH in schools has proven beneficial for the health and wellness of teachers and students.

The COVID-19 crisis shows us just how vital it is that we place management of the built environment at the very centre of disease control. Many scientific studies have demonstrated that the ideal indoor humidity level of between 40-60%RH will reduce the spread of respiratory infections.

Sickness will of course directly affect student performance, by reduced physical and cognitive function, but also by the sheer absence from the classroom with taken sick days.

However, a key study was done whose results directly demonstrate the influence of humidity on learning performance. In this study, the effects of air temperature and relative humidity on the learning performance of students were observed through experiments and questionnaires.

Undergraduate students were subjected to eight different indoor air temperatures and relative humidity levels. Several parameters were then measured and analyzed, including degree of discomfort, fatigue, distraction, and learning efficiency.

The results were clear: undergraduates performed better at 40% relative humidity and 24 °C (Liu 2021).

What is even more interesting from the perspective of humidification, is that learning performance variations were consistent with environmental comfort, but relative humidity impacted learning performances more than indoor air temperature.

Low humidity environments decrease the overall learning performance. Rooms maintained at 40% relative humidity lowered the degree of fatigue by 23.3%, increased reading speed by 12.2%, and minimized the degree of distraction by 61.1%, as compared to a room at 20% relative humidity (Liu 2021).

Proper humidification design should be emphasized when designing and managing learning spaces. Not only can it help to reduce the spread of viruses and bacteria between students but can help improve learning performance.

Cost of Absenteeism

Student health often leads to classroom absenteeism, but is there a cost directly associated with this?

Associated costs of absenteeism from the workplace are easy to quantify due to paid sick leave, however few are aware that the cost of student absenteeism can also be clearly quantified as well.

Absenteeism in schools is becoming a larger problem, as much of the school funding is tied to student attendance. The average student in the United States (K-12) misses 4.5 days per school year (Azor-Martinez, 2014). About 189 million school days

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are missed because of colds each year. This causes parents to miss more than 126 million workdays to take care of their children at home and bring them to doctor visits (Allen 2012). Including the number of workdays missed due to adults being sick, more than $22.5 billion is lost to cold-related work absenteeism each year.

This number does not account for the untold dollars lost to reduced productivity in factories, offices, colleges, universities, laboratories, and other institutions.

Although there are many factors that contribute to school absenteeism, many studies and data lead school board professionals to believe that student illness is the lead cause of lost days in the classroom, and that the most commonly transmitted infections in schools are respiratory (colds and flu) (Azor-Martinez, 2014).

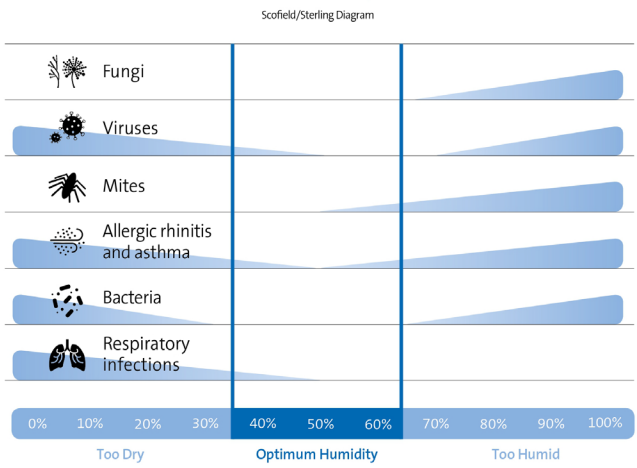
Overall, the cost of absenteeism in the US is not negligible. Over $40 billion is spent in the US each year fighting the common cold. This includes the cost of:

- Visits to the doctor
- Over the counter and prescription medications
- Missed days at school and work

This number does not include the dollars related to other health issues and costs related to low indoor humidity levels such as skin irritations, eye and contact lens problems, flu, pneumonia, and more.

Sterling Chart

The Sterling Chart illustrates how relative humidity affects health and well being and shows that the optimal air humidity level for humans is between 40 to 60% RH. This optimal humidity zone minimizes risks to human health from biological contaminants and pathogens.



Student health often leads to classroom absenteeism and there is a cost directly associated with this.

Scientific Evidence

Below are examples of a few studies showing the link between IAQ, influenza and student absenteeism. A well humidified space can help reduce the spread of respiratory illness, and ultimately reduce absenteeism in classrooms.

Study: The effect of indoor relative humidity on absenteeism & colds in schools

Author: G Green

Citation: ASHRAE Transactions vol. 80, Jan 1975

Method: Student absenteeism and indoor relative humidity were monitored in several public schools across the Saskatoon and Halifax areas of Canada during the wintertime to determine whether there was any correlation between air humidity and sickness. Both humidified and non-humidified schools were analyzed. The study was carried out several different times.

Summary Result: Absenteeism was found to be significantly lower in schools with higher average relative humidity levels. Green discovered a linear correlation between indoor relative humidity levels and student absenteeism, finding that increasing average relative humidity from 22 to 35% resulted in a 20% reduction in absenteeism.

Study: Illness among school children during influenza season

Authors: Kathleen M. Neuzil, MD, MPH; Cynthia Hohlbein, RN; Yuwei Zhu, MD, MS

Citation: Arch Pediatr Adolesc Med. Oct 2002; 156:986-911

Method: Study participants were 313 children in 216 families at a K-8 elementary school in Seattle, WA conducted during a 1-year period. Baseline surveys obtained information on household size, prevalence of childhood asthma, and receipt of influenza vaccine. When a child was absent from school during the winter season, from December 4, 2000, through April 13, 2001, surveys were sent to the child's parent or guardian to determine the reason for the absence, to characterize the types and severity of illnesses that occurred during the winter season, and to determine the effect of the illness on medication usage, physician visits, parental industrial absenteeism, and secondary illnesses within the family.

Summary Result: Total illness episodes, school absenteeism, parental industrial absenteeism, and secondary illness among family members were significantly higher during influenza season compared with the non-influenza winter season. For every 100 children followed up for this influenza season, which included 37 school days, an excess 28 illness episodes and 63 missed school days occurred. Similarly, for every 100 children followed up, influenza accounted for an estimated 20 days of work missed by the parents and 22 secondary illness episodes among family members.

Study: Humidification to reduce respiratory illnesses in nursery school children

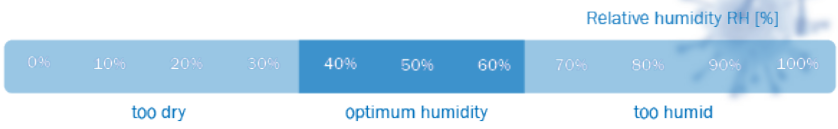
Author: C S Sale

Citation: South Med Journal. 1972 Jul;65(7):882-5. doi: 10.1097/00007611-197207000-00024.

Method: Assessed the effects of humidification on 515 nursery children (2½ to 6 years old) in three private kindergarten buildings. Absenteeism related to colds was analyzed when the buildings were humidifier versus not. Building 1 was humidified to an average relative humidity of 50%, with the humidity of buildings 2 and 3 being 10 to 15% lower. Students were split into four groups: humidification in school and at home (group 1), only in school (group 2), only at home (group 3) and no humidification at all (group 4).

Summary Result: Absentee days were reduced by almost 50% through humidification at school. A further decrease in absenteeism was achieved by additional humidification at home, while the absentee rates returned to pre-study rates when humidification ceased.

Group	Location	# of children	Absentee rate during intervention	Absentee rate after intervention
Group 1	Humidification school and home	39 children (7.5%)	**1.3%**	**5%**
Group 2	Only school	101 children (19.5%)	**3.9%**	**6.5%**
Group 3	Only home	95 children (18.5%)	**5.1%**	
Group 4	No humidification	280 children (54.5%)	**7.1%**	
TOTAL		515 children (100)%)		



Conclusion

From September until June, students spend up to 20% of their time in the classroom. High occupancy rates combined with low humidity levels creates the “perfect storm” for viral transmission, resulting in more than 189 million school days missed per year. The effects of low humidity levels in the classroom are most noticeable in the form of student absenteeism, however, several studies have shown that learning performance is also significantly impacted due to higher fatigue and difficulties focusing.

Maintaining proper humidification in the classroom will reduce the spread of viruses and bacteria between students and help to improve student performance, making indoor humidity levels of 40-60% RH fundamental in keeping our schools productive, comfortable, and healthy.

References

These are just a few projects where Condair provided humidification solutions for education facilities.

- California State University
- University of Iowa
- Syracuse University
- Harvard University
- Vimy Ridge Academy
- Yale University
- McGill University
- Fashion Institute of Technology

About Condair

Condair Group, founded in 1948 and based in Switzerland, is the global leader in humidification, dehumidification and evaporative cooling. Supported by science, we engineer individual, holistic solutions that customers can trust through the entire lifecycle. With optimal humidity, we increase productivity and create healthier built environments.

Condair Group has production sites in Europe, North America and China, its own sales and service organizations in 22 countries, and representatives in 50 locations worldwide. You can rely on our comprehensive portfolio of innovative technologies for air humidification, dehumidification and evaporative cooling for the entire lifecycle of each product.

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