

Chapter 1 : CDC - Indoor Environmental Quality - NIOSH Workplace Safety and Health Topic

The Indoor Environment Group have backgrounds in engineering, sciences, economics, statistics and public health. Our work aim to improve understanding on pollutants that impact the built environment, and energy-efficient strategies to better indoor air quality.

Additional Resources When constructing cost-effective buildings , it is easy to forget that the success or failure of a project may rest on its indoor environmental quality IEQ. Healthy , comfortable employees are often more satisfied and productive. Unfortunately, this simple truth is often lost, for it is easier to focus on the first-cost of a project than it is to determine the value of increased user productivity and health. Salary expenses are generally a high proportion of the operational expenses of a building. Even a small percentage gain in productivity, multiplied by the number of employees, can result in considerable savings. Facilities should be constructed with an appreciation of the importance of providing high-quality, interior environments for all users. Many of us have adapted to the indoor realm as our "natural" environment. IEQ encompasses indoor air quality IAQ , which focuses on airborne contaminants, as well as other health, safety, and comfort issues such as aesthetics, potable water surveillance, ergonomics, acoustics, lighting, and electromagnetic frequency levels. IEQ improvements to an existing building can occur at any point during the use of a building. The Thoreau Institute of Sustainability at the Presidio, in San Francisco, California has been a model of green building operations and community programming since it opened in Pursue energy efficient strategies to remove harmful odors and recover energy used in conditioning the interior environment; Create a high-performance luminous environment through the careful integration of natural and artificial light sources; and Provide high quality potable water. For example, the designer may select building products that do not produce noxious or irritating odors or contain volatile organic compounds VOC , and design exterior entrances with permanent entryway systems to catch and hold dirt particles. While HVAC systems may be designed to isolate certain operations e. Value Aesthetic Concerns Appreciate the importance of providing windows in all occupied spaces, for views and for natural ventilation. Ensure that windows have proper solar glare control, and encourage occupants to adjust to align with outdoor environmental conditions. Design spaces around basic human needs, proven preferences, and connections to the patterns of nature and the mind. Design circulation spaces with natural light and views that encourage interaction among building occupants. Where possible, use open stairways conveniently located which encourage people to use them instead of elevators both for health and energy savings. Require that individual buildings or facilities be consciously integrated into their natural and man-made context. Evaluate the use of access floors with displacement ventilation for flexibility , personal comfort control, and energy savings. Understand moisture dynamics as a key criterion in the selection of wall and roof assemblies. Evaluate the benefit of specifying high-performance windows to increase mean radiant temperature MRT. Consider external conditions impacting thermal comfort. Provide easily maintained window treatments that occupants can individually control for both thermal comfort and light exposures from the sun. Work closely with the Mechanical Engineering team to strike a balance between optimal fresh air and energy efficiency using either the ventilation rate procedure VRP or the indoor air quality procedure IAQP. Implement a construction management program that ensures key ventilation components are protected from contamination during construction. Ensure that construction filters placed in ductwork and mechanical equipment are routinely inspected and replaced as needed. Do not install carbon filters until all construction work, including dry wall and painting, has ceased. Commission HVAC systems to validate and document design performance intent. Review commissioning report to ensure that adequate ventilation rates have been achieved prior to initial occupancy. One Commissioning technique that can be employed over the life of the building is the use of a well maintained carbon dioxide monitoring system that will continually provide diagnostic feedback on the actual amount ventilation provided in the most densely occupied spaces. MERV is preferred for smoke removal, general surgery, hospitals, and other healthcare facilities. Consider a building design with a natural ventilation or hybrid component to both reduce energy consumption and to make some provisions for ventilation even if external power were not available a measure of resiliency. Use of natural

ventilation component is dependent on relative humidity being within an acceptable range. Investigate the use of separate outside air and conditioned air distribution systems. A good description of various types of heating and ventilation systems can be found at: Ensure fresh air intakes are located away from loading areas, exhaust fans, and other contamination points, preferably on roofs. If building is close to a large roadway source, consider the location of the fresh air intakes or possible breaks that may help reduce impact of the outdoor air on the indoor environment. Prevent vehicles from idling near the facility during normal operations. If there is a below grade parking garage, consider using monitored values of both carbon monoxide and carbon dioxide to control the fans to reduce exposures to not only the carbon monoxide but also the respiratory irritants of oxides of nitrogen and unburned hydrocarbons. Investigate the use of a permanent air quality monitoring system. ASHRAE acceptable level of carbon dioxide CO₂ for an indoor office environment at 20 cfm per person equates to no greater than ppm greater than outdoors. While outdoor CO₂ levels used to range from to ppm many years ago, increasing atmospheric CO₂ levels in the last few decades are now at least ppm. Even remote locations, such as on a mountain top in Hawaii, exhibit CO₂ levels above ppm. Carbon monoxide CO levels in office environments should be below 9 ppm. Coordinate ventilation and air filtration with chemical, biological, and radiological concerns and locate outside air intakes so they do not conflict with physical security requirements. During operation, either develop a plan for identifying needed filter media replacement or replace filter media on a regular schedule. Provide Energy Recovery Ventilation systems for needed ventilation air as a standard feature in new construction which is typically highly insulated and extremely airtight. The HVAC system must be able to control interior humidity throughout a wide range of outdoor conditions. The building envelope must be carefully designed to prevent intrusion of water and to dry if intrusion should occur. It must also incorporate barriers that control vapor and air infiltration. Carefully consider the envelope of the building to prevent moisture infiltration. Investigate and remediate immediately when there is a mold or moisture problem, either from high humidity, a leak, or flood. Ensure the number of spores in the indoor air is less than the outdoor air. It is recommended that there should be less than spores in a cubic meter of air. In areas where it is prevalent, include measures to test for radon and control and mitigate radon buildup. Limit the Spread of Pathogens Implement proper maintenance procedures to prevent nosocomial infections. Consider removing restroom doors to reduce the chance of acquiring infections. Avoid products containing formaldehyde i. Remove asbestos-containing material, or contain it in a manner that precludes the possibility of future exposure. Carefully follow lead-safe work practices during renovations by enforcing thorough clean-up. Create safe, convenient, and secure storage spaces for housekeeping chemicals. If an area in an occupied building is being renovated, then consider isolating and negatively pressurizing the construction area whenever work is being performed that would produce dust, fumes, or odors. If conditioned air is required due to high end finishing work, then air should be directly exhausted to the exterior environment and not returned to the fan. Ensure that office equipment emits minimal odors or pollutants and is contained in an unoccupied, enclosed space. Assure Acoustic Privacy and Comfort Minimize noise through the use of sound-absorbing materials, high sound transmission loss walls, floors, and ceilings, and equipment sound isolation. Minimize noise distractions by shared proximities grouping similar functions together and through controlled circulation patterns. Consider sound masking systems, where feasible. These systems introduce an unobtrusive background sound that reduces interference from distracting office noise. Note that some level of HVAC "noise" can serve as a background white noise source, eliminating the need for sound masking systems. Avoid the use of small diameter ducts with high velocity airflow. Control Disturbing Odors through Contaminant Isolation and Product Selection Directly exhaust copying and housekeeping areas, and provide added return air grills in these areas. This will help limit lower atmosphere ozone generation, commonly associated with duplicating and printing processes. Ozone acts as a power oxidant. It can attack surfaces of certain elastomers, plastics, paints, and pigments; and aid in sulfide and chloride corrosion of metals. Possible health hazards caused by ozone include eye and mucous membrane irritation as well as chronic respiratory disease. Minimize disturbing odors through contaminant isolation and careful selection of cleaning products. Ensure maintenance procedures are in place to remove all trash and recyclables from the building on a regular basis rather than storing them within the building for prolonged periods of time. Prohibit

smoking in all areas of the building. In special cases where smoking is permitted, e. Use and effectiveness of Air Cleaners. Create a High-Performance Luminous Environment Provide daylighting for ambient lighting wherever feasible. Supplement natural light with integrated, high-performance ballasts, lamps, fixtures, and controls. Replace magnetic fluorescent lamps with high-frequency electronic ballasts to reduce flickering. Reduce direct glare from both natural and man-made sources in the field of view—particularly in spaces with highly reflective surfaces, such as visual display terminals VDTs. Use ambient lighting systems that provide reduced levels of diffuse, general illumination, and supplement with task lighting. Most people do not need lighting in excess of lux. Avoid dark colors on walls. Locate windows to maximize benefits of natural light and minimize glare. Provide dimmable fixtures where possible, combined with task lighting for occupant control. Lighting levels are often designed for the most demanding user, and all other occupants are forced to adapt to light levels that are brighter than desired. Create a safer and more accommodating environments for the growing population of people with low vision defined as a chronic visual impairment that causes functional limitations or disability and other disease- or other age-related vision challenges. For newly installed or temporarily suspended domestic water systems, follow "start-up" procedures by flushing all downstream outlets. Control domestic water temperature to avoid temperature ranges where legionellae grow: Consider a closed loop system instead of an open system to reduce the potential of exposure at the cooling tower. Be Aware of Exposure to Electromagnetic Fields EMF Electromagnetic fields EMF are generated by forces associated with electric charges in motion, and by microwaves, radio waves, electrical currents, and transformers. EMF are thought to cause cancer, however there is currently insufficient evidence to prove this. There are no federal standards limiting occupational or residential exposure to EMF at this time, only various U. Nevertheless, facility designers and managers should consult the following resources to find out the latest scientific research and recommendations on dealing with EMF exposure:

Chapter 2 : Indoor and Outdoor Environment - Early Years Matters

Indoor environments It is estimated that we spend up to 80% of our time indoors, so the quality of the indoor environments in which we live and work is crucial to our health and wellbeing. We offer a range of testing and monitoring services covering many aspects of indoor environments, be they residential or commercial.

Our company vehicles are unmarked, which allows you to maintain a strong level of privacy for your home or business. For natural solutions to eliminate bacteria and sanitize athletic facilities, locker rooms, gyms and hospitals see our bacterial page. Mold removal does not have to be unsafe or costly. Mold and mold removal can be scary. Mold in a home or building adversely affects the indoor air quality. Even with all the pollutants released into the outdoors, indoor air can be much more dangerous to breathe. Mold and mildew in homes, schools and workplaces have a dramatic effect on our overall health—from allergic reactions to sometimes severe illnesses. Typical mold remediation methods tear out walls, ceilings, carpets and interior framework. Once this is done chemicals are applied. Chemicals, including bleach have been proven to be unsafe, ineffective long term, and bad for the environment. You deserve a healthy living environment. You deserve a better solution for mold removal and bacteria sanitization. At Indoor Environmental, our method uses an ultra green, organic enzyme that seeks out surface, air, hidden mold and mold spores, and bacteria. This recent biotech breakthrough utilizes food grade plant enzyme technology and is all natural, poses no health risk, and is environmentally friendly. Our enzyme product does not just kill mold, it removes it. Dead mold still carries allergenic properties which can have a negative impact on us. Our mold removal services eliminate most deconstruction and rebuilding, which saves time and reduces the cost of mold remediation. The only time we recommend the removal of building materials if they are physically or structurally unsound. Our non-invasive process allows you to keep furniture, carpeting and personal items. Without having to rebuild interiors you have more time and money to spend on your family and business. We had mold that had been caused by a bathroom fan being vented in the attic. We needed to treat the attic mold ASAP due to a pending real-estate transaction. Indoor Environmental quickly came and assessed the situation, treated the mold, and confirmed the mold was treated air test with very fast turn-around.

Chapter 3 : Indoor Air Quality (IAQ) | US EPA

Saturday 3rd November. The dual PDE3 and PDE4 inhibitor RPL causes additional bronchodilation when combined with commonly used short- o theinnatdunvilla.com

Areas of building performance impacted by both mechanical systems and the building enclosure include: These tools are valuable for evaluating a design and ensuring it will perform within an acceptable range before construction even begins. Many of the available computational tools have the capability to analyze building performance goals and output an optimal architectural geometry based on those goals; often through use of genetic algorithms. Alternately, an array of in-field testing equipment can be used to measure temperature, moisture, sound levels, air pollutants, or other criteria. For example, thermal infrared IR imaging devices can be used to measure temperatures of building components while the building is in use. These measurements can be used to evaluate how the mechanical system is operating and if there are areas of heat gain or heat loss through the enclosure. Passive design refers to the use of building geometry and construction to regulate heat and airflow in the interior without the use of active mechanical systems. Sustainable design refers to architecture designed with the goal of reducing resource use such as energy and water, minimizing the environmental impact of the building materials used, or generally reducing the environmental impact of the building. Even the interior designer will inevitably generate a few building science issues. IEQ is determined by many factors, including lighting, air quality, and damp conditions. Workers are often concerned that they have symptoms or health conditions from exposures to contaminants in the buildings where they work. One reason for this concern is that their symptoms often get better when they are not in the building. While research has shown that some respiratory symptoms and illnesses can be associated with damp buildings [3], it is still unclear what measurements of indoor contaminants show that workers are at risk for disease. In most instances where a worker and his or her physician suspect that the building environment is causing a specific health condition, the information available from medical tests and tests of the environment is not sufficient to establish which contaminants are responsible. Despite uncertainty about what to measure and how to interpret what is measured, research shows that building-related symptoms are associated with building characteristics, including dampness, cleanliness, and ventilation characteristics. Indoor environments are highly complex and building occupants may be exposed to a variety of contaminants in the form of gases and particles from office machines, cleaning products, construction activities, carpets and furnishings, perfumes, cigarette smoke, water-damaged building materials, microbial growth fungal, mold, and bacterial, insects, and outdoor pollutants. Other factors such as indoor temperatures, relative humidity, and ventilation levels can also affect how individuals respond to the indoor environment. Understanding the sources of indoor environmental contaminants and controlling them can often help prevent or resolve building-related worker symptoms. Practical guidance for improving and maintaining the indoor environment is available. Fields of specialization include architecture, HVAC design, thermal comfort, indoor air quality IAQ, lighting, acoustics, and control systems. HVAC systems[edit] The mechanical systems, usually a sub-set of the broader Building Services, used to control the temperature, humidity, pressure and other select aspects of the indoor environment are often described as the Heating, Ventilating, and Air-Conditioning HVAC systems. Building science includes the analysis of HVAC systems for both physical impacts heat distribution, air velocities, relative humidities, etc. This includes the wall, roof, windows, slabs on grade, and joints between all of these. The comfort, productivity, and even health of building occupants in areas near the building enclosure i. As part of its function, the enclosure must control not necessarily block or stop the flow of heat, air, vapor, solar radiation, insects, noise, etc. Daylight transmittance through glazed components of the facade can be analyzed to evaluate the reduced need for electric lighting. This field may also be referred to as sustainable design. A push towards zero-energy building also known as Net-Zero Energy Building has been present in the Building Science field. Certification[edit] There are no professional architecture or engineering certifications for building science. It is currently a specialization within these broad areas of practice. In the US contractors certified by the Building Performance Institute, an independent organization, advertise that they operate

businesses as Building Scientists. This is questionable due to their lack of scientific background and credentials. This is true in Canada for most of the Certified Energy Advisors. However, many of these trades and technologists require and receive some training in very specific areas of building science e. List of principal building science journals[edit] Building and Environment: This international journal publishes original research papers and review articles related to building science and human interaction with the built environment. This journal focuses on buildings, building stocks and their supporting systems. Unique to BRI is a holistic and transdisciplinary approach to buildings, which acknowledges the complexity of the built environment and other systems over their life. Published articles utilize conceptual and evidence-based approaches which reflect the complexity and linkages between culture, environment, economy, society, organizations, quality of life, health, well-being, design and engineering of the built environment. This international journal publishes original, high quality, peer-reviewed research papers and review articles dealing with modeling and simulation of buildings including their systems. The goal is to promote the field of building science and technology to such a level that modeling will eventually be used in every aspect of building construction as a routine instead of an exception. Of particular interest are papers that reflect recent developments and applications of modeling tools and their impact on advances of building science and technology. This international journal is devoted to investigations of energy use and efficiency in buildings.

Chapter 4 : Chemistry of Indoor Environments

Indoor arrangement of the physical environment is an art and a science. It is an art for you to make your program feel welcoming and like a home. It is a science as you use knowledge of developmentally appropriate practice to design your program's floor plan.

What should an environment for young children look like? Below is a brief description of the most important components needed to make an effective learning environment for young children. As you plan your environment, be sure to include the following: Places for developmentally appropriate physical activities. Environments should provide children with opportunities for a lot of developmentally appropriate physical activities. Young children are physical beings. They learn most effectively through total physical involvement and require a high level of physical activity, variety, and stimulus change Hale, Opportunities for concrete, hands-on activities. Young children need hands-on activitiesâ€”playing in water, building mud pies, making things out of wood, putting a doll to bed, etc. They also need lots of ways to practice and integrate new experiences into existing mental structuresâ€”dramatic play, drawing, taking photographs, using language, and making things with blocks. Children seek out a constant change of stimuliâ€”scenery, textures, colors, social groups, activities, environments, sounds, and smells. The more our children spend time in our programs, the more variation and stimulation they need. Color and decorations should be used to support the various functional areas in the classroom and center, provide needed stimulus change and variety, and develop different areas and moods in the room. Vibrant colors such as red, magenta, and yellow work well in the gross motor area ; soothing blues and green are good color choices for hands-on learning centers; and whites and very light colors are good for areas that need lots of concentration and light. Soft pastels and other gentle hues, on the other hand, work well in reading areas and other low intensity activities. Decorations should follow the same pattern, with an additional emphasis on changing them often, and providing order around topics, projects, and themes. The materials and equipment given to the children are just as important to learning as the physical space of the classroom. The following materials and equipment can be added to any early childhood environment. Children who spend most of their day in one environment need surfaces that respond to them, not hard surfaces that they must conform to. Flexible materials and equipment. Children can use sand, water, or play dough in a variety of ways, depending on their maturity, ability, past experience with the materials, interest, and involvement. A jigsaw puzzle, on the other hand, has only one correct solution. Programs should include lots of materials that have an abundance and variety of uses to give children a sense of creativity and control Wardle, Simple, complex and super complex units. According to Prescott , learning materials can be simple, complex, or super complex. Simple materials are those with essentially one function, complex those with two, and super complex, those with more than two. For example, a pile of sand is a simple unit. If one adds a plastic shovel to the sand it becomes a complex unit. Adding a bucket of water or collection of toy animals to the sand and shovel creates a super-complex unit. The more complex the materials, the more play and learning they provide Wardle, With a little creativity, small spaces can work out very well. For example, I once observed a very well planned and supportive early childhood environment designed under the bleachers of a high school! Lofts were built, there were cozy reading areas, and each Head Start child had a place of their own. When using community facilities, be sure that playgrounds and other equipment are safe and developmentally appropriate for the children in your care. Young children have unique personalities and needs that require us to respond to them as individuals, not as members of a group. The environment must be responsive to this need. Ease of cleaning, maintenance, supervision, cost, and adult aesthetics should not detract from providing spaces children feel are designed for them. Children need to have private areas , secluded corners, lofts, and odd-shaped enclosures. Are classrooms, bathrooms, kitchens, and eating areas close together so that children can develop self-help skills and important autonomous behaviors? Like children, teachers also need to have spaces that are functional. Teachers need to be able to arrange and rearrange their classrooms for various class activities and supervision purposes. Classrooms that include permanent, built-in features such as lofts, playhouses, tables, benches, alcoves, and cubbies can be

problematic. These types of fixed features make it difficult for teachers to create areas for gross motor activities, can cause injury in active children, or prevent inclusion of physical activities altogether. Classrooms built as a basic shell work best. Below are some of the critical environmental issues that must be carefully addressed as you plan the environment. Storage areas are a little like entrances and exits—they receive lots of traffic and are noisy and congested. For these reasons, storage areas can sometimes foster disruptive behavior and noise. Provide easy access to materials, allowing children to get what they need quietly and easily. The closer materials are to where they will be used, the better. Storage must also be designed so that materials for independent child use are separate from those teachers control. Activity areas need to be located next to supplies and be easy to clean up. The classic example is the art area. While providing easy access to paint, easels, paper, and brushes, the art area needs to be close to a water source and on a surface that can withstand a mess. Similarly, the reading area must be close to book shelves, magazine racks, and comfortable places to sit. Managing noise is important in a classroom. Placing carpet on the floor absorbs noise as does absorbent tile on the ceiling. The reading center should be next to a quiet area like the art area. Blocks are loud, and should be located next to other loud areas such as the woodworking bench. Noisy activities can also be placed in transition areas or moved outside in good weather. Dividers are any physical objects that serve to delineate areas within a classroom, create interest areas, control traffic, and distribute children throughout the classroom. Almost anything can be used as a divider, so long as it is safe: Safety is obviously a critical issue. Some dividers are easy to push over. The larger and heavier they are at the bottom, the safer. A divider can also be secured by fastening it to the floor or a wall. Several equipment companies have introduced dividers that attach directly to storage units and furniture. Ideally, dividers should be multi-functional for use as storage units, play furniture, and display boards. Keep in mind that solid dividers or walls of more than inches high disrupt the circulation of air in the classroom and limit supervision of children. Less solid dividers, like fabric, avoid this problem. One teacher creatively used colorful fabric streamers attached to the ceiling as effective dividers. Further, the environment is designed to enable staff to facilitate the optimum learning for their children. Finally, the environment makes parents and guardians feel welcome, involved, and empowered.

Chapter 5 : Department of Health | Environmental Health | Environmental and Indoor Health

ELI's Indoor Environments & Green Buildings Program provides information to support the development and implementation of sound policies to address key health and environmental issues in design, construction, operation, and maintenance of schools, homes, and other buildings.

Chapter 6 : Indoor Environments & Green Buildings | Environmental Law Institute

In typical indoor environments, radon progeny are commonly attached to submicron particles and the fraction of larger particles, say in the micrometer-size range, can safely be neglected for the computation of dose-exposure conversion factors.

Chapter 7 : Welcome to Indoor Environmental Weymouth, MA

The indoor environments of personal cars and school buses are also important to children's exposure, as a child can spend up to an average of 84 minutes per day in a vehicle, depending on his or her age.

Chapter 8 : Building science - Wikipedia

Indoor environments are highly complex and building occupants may be exposed to a variety of contaminants (in the form of gases and particles) from office machines, cleaning products, construction activities, carpets and furnishings, perfumes, cigarette smoke, water-damaged building materials, microbial growth (fungal, mold, and bacterial).

Chapter 9 : Child Care Providers - Child Care Aware

The quality of our indoor environments affects well-being and productivity, and risks for diverse diseases are increased by indoor air pollutants, surface contamination with toxins and microbes, and contact among people at home, at work, in transportation, and in many other public and private places.