



# THE SCIENCE BEHIND HEALTHY HOMES

25 FACTORS THAT IMPACT YOUR HOME

**Delos**<sup>™</sup>

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# EXECUTIVE SUMMARY

When we consider ways to live healthier lives, we tend to think first of behavioral factors such as physical activity, eating well, adequate sleep, and not smoking. However, a variety of social determinants also factor in to influence our health and well-being. These include education, access to healthcare, social and economic opportunities, access to resources and support systems, and the quality of the places, spaces, and conditions in which we live.

One of the most important social determinants is housing. Our homes are foundational to our well-being, providing shelter, comfort, security and peace of mind. However, even when we have access to stable housing, various conditions within and around our homes can continue to affect our health. For example, sustainable and natural elements built into the home can promote our well-being, while unhealthy materials such as lead and VOCs can pose risks to our health. We can help influence the severity of many of these effects by modifying our built environments—for example, by introducing indoor plants or installing an exhaust fan in the kitchen.

We spend around 90% of our time indoors, with two-thirds of this time spent at home; maintaining a healthy home environment is thus particularly important.

**Healthy People 2020**, the U.S. government's health prevention agenda, identifies creating environments that promote good health for all as a national objective. In alignment with these goals, Delos—the global wellness pioneer—is excited to share **The Science Behind Healthy Homes: 25 Factors that Impact your Home**. Informed by leading research on health and the built environment, this white paper outlines factors across the home that can impact our health and well-being, and proposes strategies to transform our homes into healthier places to be.

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## Air Pollution Isn't Just an Outdoor Problem

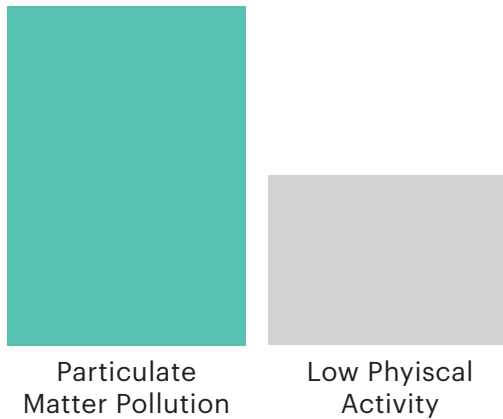
When we think about air pollution, we usually imagine the outdoor environment. However, research suggests that the concentration of toxins, allergens and other pollutants can be up to five times higher indoors than it is outside. And when we consider one of the most dangerous air pollutants—very small particulate matter (PM<sub>2.5</sub>)—almost 75% of our exposure occurs in our homes.

## Clean Air Is Essential to Our Health

Air pollutants can contribute to a range of short-term symptoms such as eye, nose and throat irritation and headaches, as well as long-term adverse health outcomes such as diabetes, cardiovascular disease, lung cancer, and respiratory issues. They can even play a role in premature mortality; air pollution is considered one of the greatest killers of our generation.

# Particulate matter pollution is harmful to our health

## HEALTHY LIFE YEARS LOST\* DUE TO:



\*in the US

## TOP CONTRIBUTORS TO HEALTH LOSS

- #02 Smoking
- #10 Particulate Matter
- #21 Secondhand Smoke

## EXPOSURE TO AIR POLLUTION

Small increases are associated with decreases in lung function equivalent to:

**65%** of what you would see in a former smoker

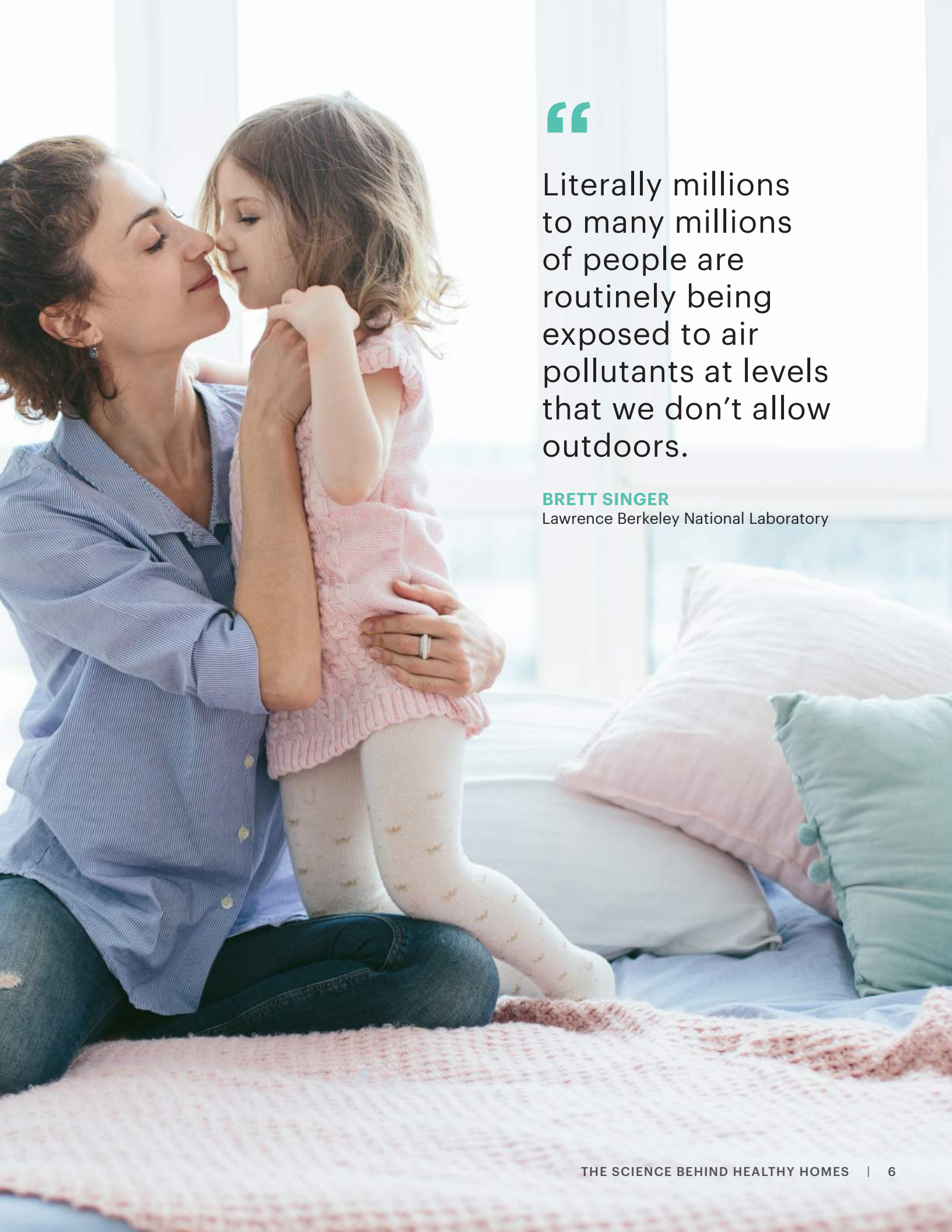
**04x** that which you would get from secondhand smoke exposure at home

## IN 2015,

air pollution was responsible for:

- 19% of all cardiovascular deaths
- 24% of all deaths caused by ischemic heart disease
- 21% of all stroke deaths
- 23% of all lung cancer deaths globally





“

Literally millions to many millions of people are routinely being exposed to air pollutants at levels that we don't allow outdoors.

**BRETT SINGER**

Lawrence Berkeley National Laboratory



## HEALTH FACTORS

- 1 Infiltration of Ambient Air Pollution:** Indoor air quality is significantly influenced by outdoor air quality, due to the infiltration of air from outdoors. Over a third of Americans live in counties where air quality is sub-optimal and exceeds the maximum thresholds for key pollutants set by the Environmental Protection Agency (EPA), such as ozone and particulate matter.
- 2 Cooking Emissions:** Cooking, especially using gas stoves, can generate harmful pollutants—such as carbon monoxide (CO), nitrogen dioxide (NO<sub>2</sub>), and particulate matter—that can linger at high concentrations, particularly without effective ventilation.
- 3 Allergens & Asthma Triggers:** Substances like pollen, pet dander, saliva, and pest waste can cause allergic reactions in many people. Common symptoms of allergic reactions are similar to those of a cold, such as a runny nose and congestion, sneezing, and watery eyes. Allergens can also trigger asthma symptoms for some people with asthma.
- 4 Mold:** Dampness and mold affect almost half of U.S. homes, with causes including everything from rain, snow, leaking plumbing systems and flooding, to indoor activities such as cooking or showering. Moldy and damp homes are believed to increase the risk of health outcomes such as bronchitis, asthma development or exacerbation, respiratory infections, coughing, and wheezing by an estimated 30-70%.

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## HOME SOLUTIONS

**Ventilation:** Ventilation systems can play an important role in diluting pollution concentrations that have built up indoors, by bringing in fresher air from the outdoors. For pollution generated by cooking, it is important to have ventilation that exhausts to the outdoors, most commonly in the form of an overhead range hood.

**Filtration:** Different types of filters can target different indoor pollutants. For example, MERV-rated filters target indoor particles, while activated carbon filters target organic chemicals.

**Vacuuming:** Consider a vacuum cleaner with a HEPA filter, which is designed to remove at least 99.97% of particles larger than 0.3-microns in diameter. HEPA filter-equipped vacuums (as well as damp mopping and dusting) can also help reduce the re-suspension of particles that have settled in the home, as vacuuming can cause a temporary release of fine dust.

**Home Air Quality Monitoring:** An indoor air quality monitor can help track particulate matter pollution and other air quality parameters across the home. Many consumer-grade, easy-to-use monitors are available online.

**Outdoor Air Quality Monitoring:** It is important to stay informed about the outdoor air quality in your region. If the outdoor air quality is poor, keep all windows, doors, and the fresh-air intake of the AC unit closed.





## Light Helps Regulate Critical Body Functions

Our bodies are naturally programmed to function on a cycle that matches the solar day. This cycle, known as the circadian rhythm, governs many aspects of our physiology, metabolism, and behavior. Our circadian rhythm is primarily synchronized by light, and mounting evidence indicates that the quality, type, and timing of light exposure can have a profound effect on our health, well-being, and performance.

## Inappropriate Lighting Can Negatively Impact Our Health

Light affects many functions of our body, including the sleep-wake cycle, alertness, mood, cognition, and metabolism. Long-term disruption or desynchronization of the circadian rhythm and related hormones (e.g., through exposure to bright light at night) has been linked to obesity, diabetes, depression, metabolic disorders, and breast cancer.

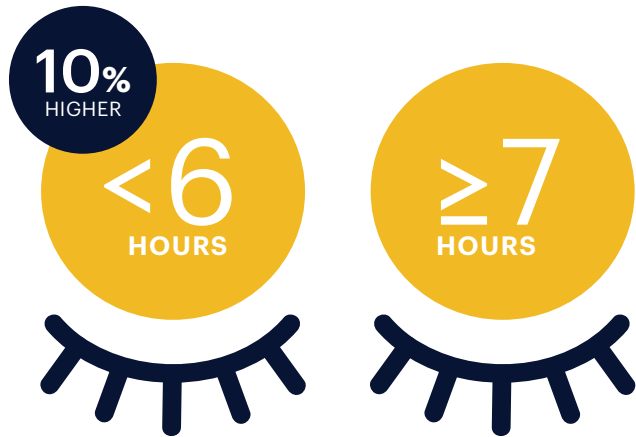
Over 1 in 3  
Americans  
aren't getting  
enough sleep



## Modern Lighting Disrupts Circadian Patterns

Our exposure to light in modern times is very different than it was in the past. Instead of bright, blue-spectrum sunlight in the morning, followed by warmer light in the evening, and finally total darkness at night, we are exposed to much dimmer levels of electric light throughout the day. This constant exposure to electric light can send the wrong signals to our brain, reducing alertness during the day, and delaying or disrupting our sleep patterns at night.

### HOURS OF SLEEP AND MORTALITY RISK





## HEALTH FACTORS

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**Daytime Light Exposure:** Regularly-timed exposure to bright light during the day helps us maintain a healthy and robust circadian rhythm; this process is called “entrainment.” Entrainment came naturally for our ancestors, but in the modern world, living indoors exposes us to lower daytime light levels. Reduced exposure to daylight is associated with cognitive function impairment and reduced work performance, as well as poorer sleep quality.

6

**Nighttime Light Pollution:** Increased use of electronic devices that emit bright light (TVs, smartphones, computers, tablets, etc.) in the hours prior to sleep, along with lifestyle trends that encourage people to engage in a 24-hour work cycle, results in exposure to lighting in the evening and at night that disturbs sleep. Inappropriate exposure to light during sleep time – even in small quantities – can have a dramatic impact on our circadian rhythm and lead to the suppression of melatonin, the key hormone that signals to the body that it is time to go to sleep.

**EVENING LIGHT EXPOSURE**

24  
LUX



SUPPRESSES  
MELATONIN BY  
50%

Inappropriate exposure to light disrupts critical body functions



**SLEEPING WITH THE TV OR LIGHTS ON,** compared with no artificial light, was associated with\*:

≥11  
LBS

≥10%  
BMI

BECOMING  
OVERWEIGHT  
OR OBESE

\*in a 5-year study of women





## HOME SOLUTIONS

**Circadian Lighting:** Specialized lighting fixtures and controls can enable indoor electric light to mimic outdoor natural light, mirroring the brightness and color of sunlight throughout the course of the day.

**Blackout Shades:** Blackout shades can be installed in the bedroom to help minimize light coming in through the windows at night.

**Night Lighting:** For nighttime navigation, special night lighting that is dim, contains minimal blue light, and is activated by motion sensors is ideal and can help reduce disruptive bright light exposure.

**Night Mode:** Although avoiding electronic devices before bed altogether is best, many devices now offer a “night” or “dark” mode option, which reduces the amount of light in the blue spectrum (the type of light that interferes the most with melatonin and sleep). This can help us better prepare for a good night’s rest.



# THERMAL COMFORT

## What Is Thermal Comfort?

Thermal comfort refers to the subjective experience of feeling satisfied with one's thermal condition. Four primary environmental variables influence our thermal comfort: air temperature, mean radiant temperature, relative humidity, and air velocity.

## Hot and Cold Matters

Thermal comfort has been ranked as one of the most important contributing factors to our overall satisfaction with the indoor environment. Over the past several years, research has highlighted the importance of providing people with control over their indoor conditions, including thermal comfort.

Thermal comfort is ranked as one of the most important contributing factors to our overall satisfaction with the indoor environment.



## Indoor Temperatures Affect Our Health

Our thermal environment is important not only for our comfort, but also for our health. Our bodies have a basic need to thermoregulate, or maintain a constant internal temperature within a specific range; if it's too hot or too cold in the home, this can be challenging. Cold indoor temperatures have been linked to respiratory and cardiovascular problems, including increased blood pressure and asthma symptoms, as well as poorer mental well-being. Hot temperatures can be similarly detrimental. In the US, extreme heat is a significant public health issue, and is the leading cause of weather-related mortality, particularly among older adults where it directly contributes to cardiovascular and respiratory disease.

Exposure to cold air can trigger asthma attacks in adults.





## HEALTH FACTORS

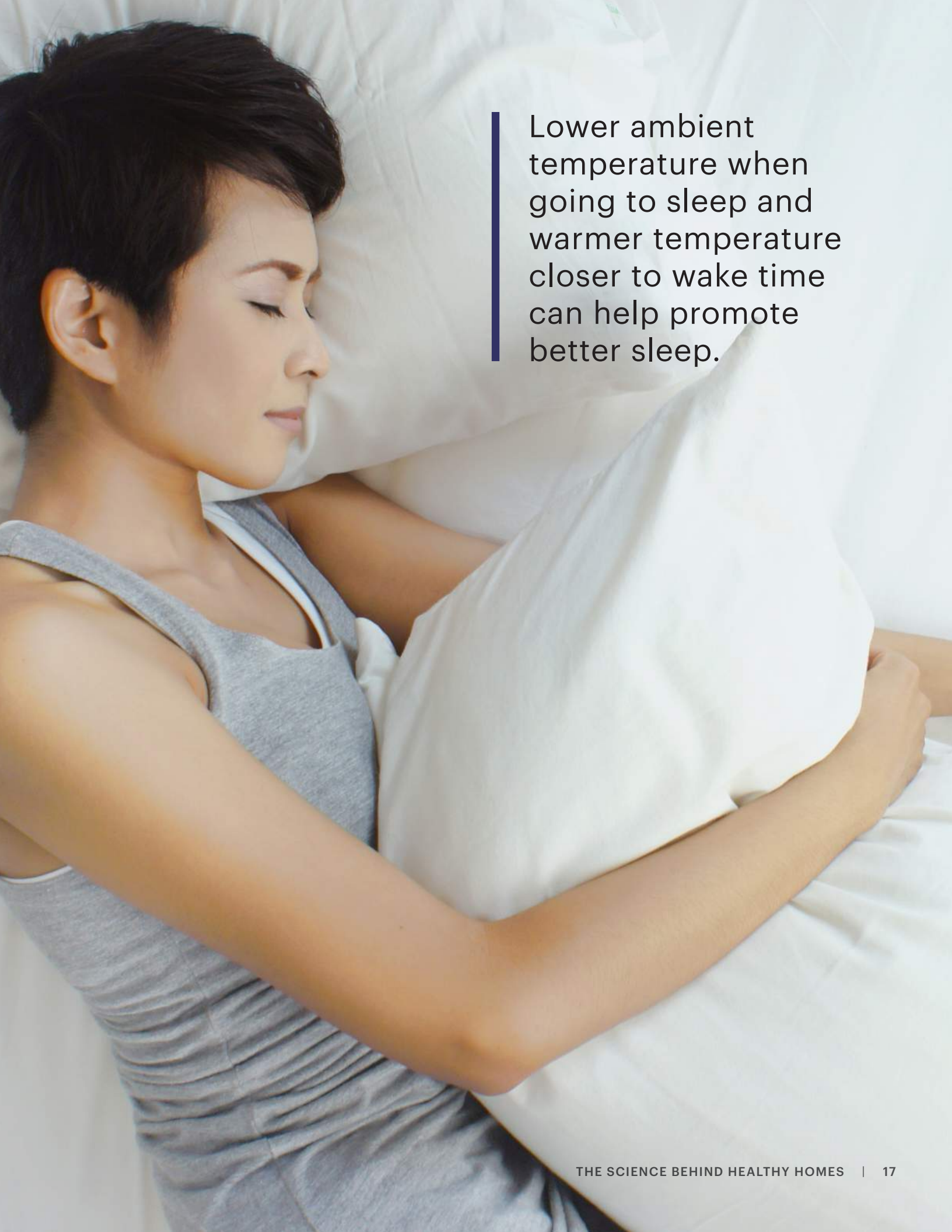
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**Excessively Hot or Cold Temperatures:** Although we have developed advanced technologies to heat and cool our homes, not every home is capable of fully regulating its indoor temperature. This may be due to inadequate infrastructure, cost, or extreme outdoor temperatures. In addition, increasingly frequent temperature extremes due to climate change amplify the risk of unhealthy indoor temperatures. When considering the growing sector of older adults—who are more vulnerable to the adverse effects of unhealthy temperatures— inability to adequately regulate indoor temperature puts a significant proportion of the population at risk.

8

**Adjustable Bedroom Temperature:** Temperature is one of the key environmental factors that contributes to our ability to fall asleep at night, as well as our ability to achieve restful sleep. As part of our 24-hour circadian cycle, our core body temperature naturally decreases during the onset of sleep and increases closer to waking. This rhythm is influenced by fluctuations in daily ambient temperature that send cues to our body to help set our circadian clocks for appropriate sleep timing. Lower ambient temperature when going to sleep and warmer temperature closer to wake time can help promote better sleep.





Lower ambient temperature when going to sleep and warmer temperature closer to wake time can help promote better sleep.



## HOME SOLUTIONS

**Reliable Heating and Cooling Systems:** In order to create living environments that are thermally comfortable and healthy, it is important to invest in reliable heating and cooling systems in our homes (as well as in energy efficiency and weatherization—see section Energy Efficiency). For countries with a cold season, the WHO Housing and Health Guidelines note 64.4 F (18°C) as a safe minimum temperature for the general population (a higher temperature may be needed for older adults, children, and those with chronic illnesses such as cardiorespiratory disease).

**Comfortable Sleep Temperature:** Cooler ambient temperature at bedtime can support better sleep. The National Sleep Foundation advises that a temperature slightly cooler than normal, around 60–67°F (15.6–19.4°C), can help us transition to sleep.

**Smart Placement of Air Conditioners:** Air flow from air conditioners can contribute to sleep disruption. Thus, it is important to consider the placement of air conditioners in relation to our beds in order to ensure that the movement of air does not disrupt sleep.

**Thermally Appropriate Bedding:** Feeling too hot or too cold at night signifies a poor bedding “microclimate”. This can interfere with getting a good night’s rest, and is associated with chronic insomnia. Choosing bedding (from mattresses and pillows to mattress encasements and sheets) that provides appropriate thermal regulation can help improve sleep quality. Although cooler room temperatures are best for sleeping, mild warming of the skin through appropriate bedding choices can also help improve sleep.



## Water Is an Essential Building Block of Life

Access to water that is free of inorganic, organic, and biological contaminants is essential to maintaining optimal health. Humans are mostly made of water; in fact, water comprises over 50% of an adult's body weight. However, water is vulnerable to pollution that can lead to harmful effects on both human and environmental health. These contaminants, especially in high doses, can be toxic and impair health and overall quality of life.

## Numerous Sources Can Contaminate Water

Even today, with our advanced treatment technologies, it is still challenging to ensure that everyone has access to water that is free of contaminants. For one thing, conventional water treatment does not always remove contaminants effectively. Furthermore, in addition to pollution from industry and agriculture, the treatment and distribution systems meant to keep drinking water safe can





also be potential sources of contamination, as pollutants can be introduced through these water distribution infrastructures. Finally, because scientific knowledge concerning new water contaminants and safe exposure levels is always evolving, it is challenging for regulations to keep pace.

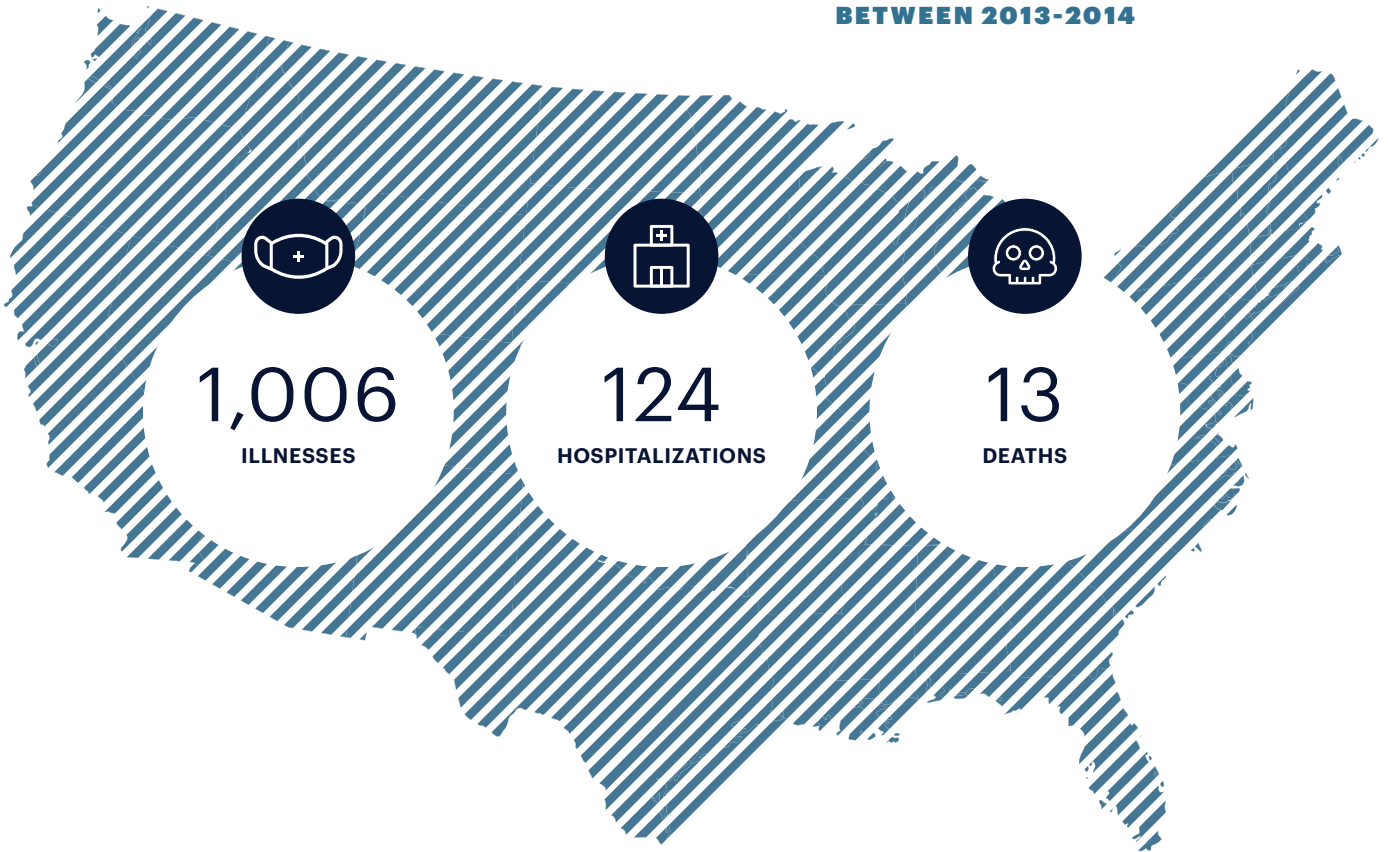
## Americans Face Ongoing Water Challenges

Despite the fact that water quality in the US is quite good compared to many other countries, there are still many risks for contamination. The American Society of Civil Engineers gave US drinking water infrastructure a “D” grade in 2017, citing its aging and deteriorating infrastructure, and the EPA estimates that over \$743 billion are needed for water infrastructure improvements. In fact, each year since 1982, up to 28% of Americans have been affected by water that is contaminated by levels that violate the health-based water quality standards. As of 2015, 18,000 US community water systems – serving almost 77 million Americans – were found to violate at least one Safe Drinking Water Act (SDWA) rule, with over 80,000 total violations. For example, 1,100 water systems serving 3.9 million people exceeded the action level established for lead under the SDWA.



# Tap Water can be Polluted by a Range of Contaminants

**42** water-  
associated  
health  
outbreaks  
**BETWEEN 2013-2014**





## HEALTH FACTORS

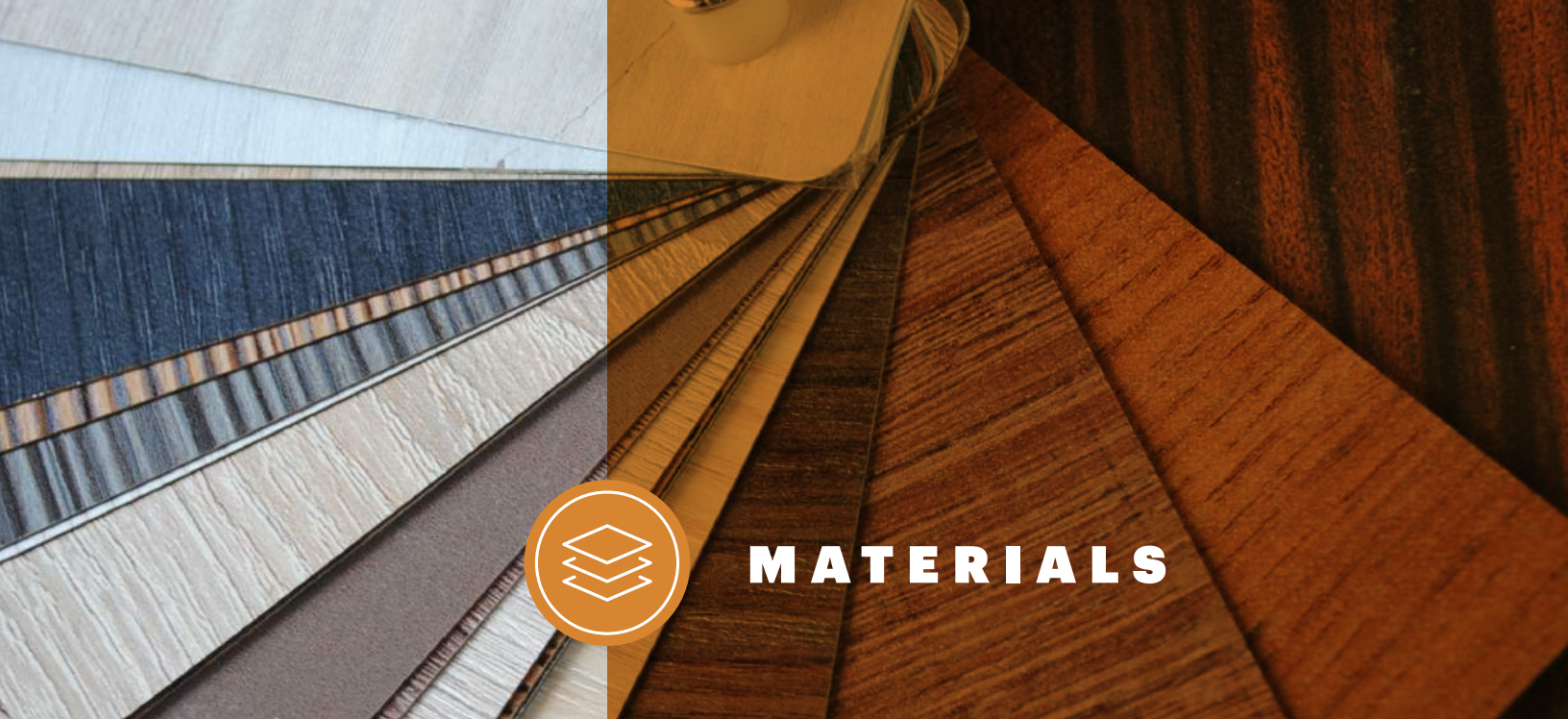
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**Water Contamination:** A number of different types of contaminants may be present in home drinking water. These include inorganic contaminants, such as asbestos, lead, and mercury; pesticides and fertilizers; organic contaminants, often from industrial sources; microbial contaminants such as parasites; and disinfectant by-products.

## HOME SOLUTIONS

**Filtration:** Filtration is one of the most effective treatment methods for mitigating water quality concerns. Different types of filters are designed for different types of contaminants. For example, activated carbon filters target chemicals, while kinetic degradation fluxion (KDF) filters help reduce dissolved metals. In addition, water filters differ in terms of their placement and can be installed either at point-of-entry (POE; meant to treat all the water that comes into the home) or point-of-use (POU; meant to treat water that comes out from a specific location).

**Water Softening:** Water can be considered “hard” when it contains certain minerals such as calcium. Home water softeners can help soften water, which may be easier on appliances and improve the taste or appearance of water.



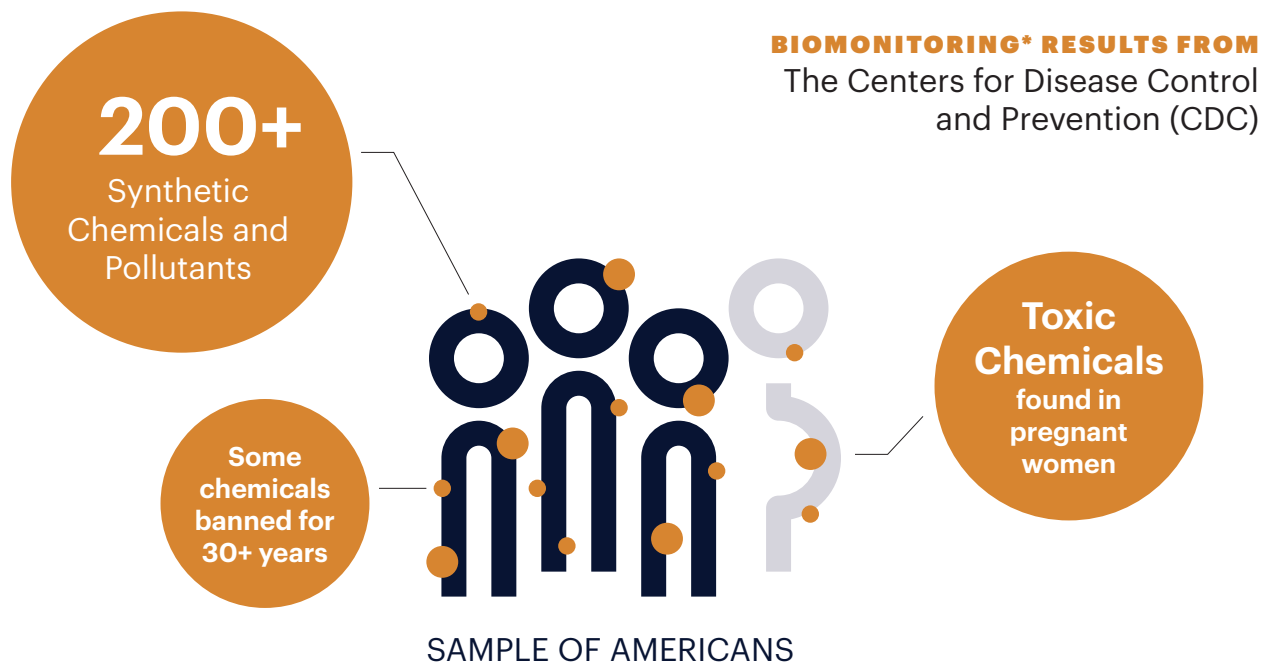
# MATERIALS

## Chemicals in Our Homes

Building materials and home products can contain a number of different chemicals. Some are benign, while others are known to be hazardous. Furthermore, pollutants from these sources can remain present indoors for a long time due to tightly sealed buildings and long-term use of materials.

### What Are the Chemicals of Concern?

- Well-known examples of hazardous building materials include lead and asbestos.
- Another common pollutant, known as volatile organic compounds (VOCs), refers to a range of organic chemicals that are emitted as gases from many common household products and building materials through a process called “chemical off-gassing”. These gases may have detrimental effects on human health, ranging from skin irritation to neurological issues, and in extreme cases, cancer.
- Semi-volatile organic compounds (SVOCs) are a related group of chemicals, which can attach to indoor surfaces. Some of these are endocrine disruptors that mimic human hormones and alter their function.



\*measurement of chemicals in people's bodies such as in samples of blood, urine, or saliva

## HEALTH FACTORS

- 10 **Cleaning Products:** Commonly used cleaning products, such as cleaning sprays, air fresheners, waxes, and polishes, may contain hazardous chemicals and pollutants including VOCs and endocrine disruptors. The use of such products has been linked to eye, nose, throat and lung irritation, as well as an increased risk of respiratory issues such as asthma.
- 11 **Furniture Materials:** Furniture (especially upholstered furniture) and floor coverings can contain harmful chemicals. For example, materials like vinyl, halogenated flame retardants, and stain-guard coatings that are often used in furnishings can contain SVOCs.
- 12 **Building Materials:** Many building components and finishings—from pipes and insulation to doors and paints—can be constructed from dangerous substances such as lead or asbestos, or can contain materials that off-gas various chemicals.



Certifications that help identify safer product alternatives include:

Greenguard Gold

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CDPH Method v1.1

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GreenSeal

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GreenScreen

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EPA Safer Choice

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BIFMA e3

## HOME SOLUTIONS

**Conscious Construction Practices:** During construction, homebuilders can avoid building products and materials with harmful heavy metals such as lead, and can utilize low-emissions options when possible.

**Non-Toxic Material Selection:** Effective, safer, and non-toxic substitutes are often available for cleaning products, furniture, and building materials. For example, some paint formulas are specifically designed to reduce or eliminate toxic material off-gassing. Product certification standards can be helpful for choosing healthy materials.

**Ventilation:** Ventilation with fresh outdoor air can help reduce concentrations of some airborne contaminants, such as VOCs.



## A Refuge for Well-Being

We spend a substantial amount of time in our homes—sleeping, eating, playing, and connecting with our family members. Integrating design details for safety and security can help ensure that our homes serve as a refuge for our health and well-being.

Injury is the leading cause of death for people ages 1-44 – and the home is the second-most-common location for fatal injury.



## HEALTH FACTORS

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**Fires:** US fire departments respond to an estimated 354,000 home fires every year. Properly installed and maintained smoke alarms play a crucial role in helping to reduce the risk of death and injury due to fire. Among home fires reported in 2012-2016, nearly three out of five related deaths were caused by either an absence of smoke alarms (40%) or smoke alarms that failed to operate (17%).

14

**Tripping Hazards:** Tripping hazards around the home can lead to risky falls, especially among older adults. In a survey of community-dwelling seniors over the age of 72, falls inside the home occurred most frequently (21.4%) in the bedroom. This was due to hazards such as dim lighting, cluttered pathways, and loose carpets and rugs.

15

**Property crimes:** In 2017, there were nearly 7.7 million property crimes in the US, with a burglary occurring every 23 seconds. A secure home brings a peace of mind. Yet, only around a quarter of all US households are predicted to have home security systems by 2021.

# Design Considerations can Reduce Home- Based Hazards

## US HOUSEHOLDS

**27%** predicted to have home security systems by 2021

## FALLS AMONG OLDER ADULTS



The number one cause of hospital admissions in the United States, and one of the most dangerous and costly health risks to senior citizens.

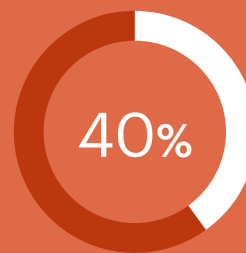
% of individuals who fall each year

**28% - 35%** 65+ years

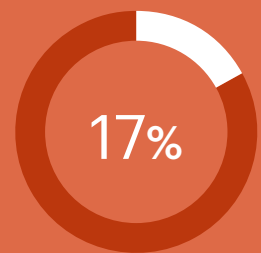
**32% - 42%** 70+ years

## AMONG HOME FIRES REPORTED IN 2012-2016,

nearly three out of five related deaths were caused by:



an absence of smoke alarms



smoke alarms that failed to operate

## Risk of Dying in a Home Fire

**54%** lower in homes that have working smoke alarms





## HOME SOLUTIONS

**Home Security Systems:** Homeowners can choose from a variety of systems that help protect the home and valued possessions from intruders; provide remote home monitoring (so that residents can keep an eye on their home while away); help protect residents from fires and carbon monoxide poisoning; and even enable medical assistance in case of emergencies.

**Window Guards:** Properly installed and maintained window guards can help prevent accidents in which children are injured or die due to falling out of a window.

**Adequate Illuminance:** Older adults are at the greatest risk for falls and associated injuries. A minimum ambient illuminance level of 200-300 lux is recommended for adults 60 years and older in all living spaces including closets and bathrooms, with brighter illuminance levels—at least 500-750 lux—when doing specific tasks.

**Clear Pathways:** We can help minimize the risk of tripping and falling by ensuring that our spaces are clutter-free, with clear pathways to safely navigate the home and well-placed furniture that does not obstruct movement.



# INTERIOR AND LANDSCAPE DESIGN

## Space Design

Our experience of a space is defined by its design. Designing spaces to be accessible and usable by every member of the household, and considering future possibilities of limited mobility or temporary limitations, can help ensure that our homes serve us best in the long-term.

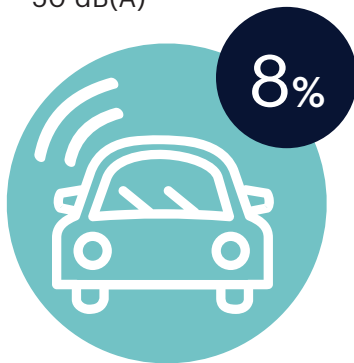
Integrating natural elements to indoor spaces can enhance our ability to focus. For instance, even just 40 seconds of observing a picture of a flowering green roof, compared to a bare concrete roof, has been shown to boost attention and task performance.



## HEALTH FACTORS

### TRAFFIC NOISE

Increases coronary heart disease risk by 8% per each 10 dB(A) increase, starting at 50 dB(A)



16

**Accessibility:** In the US, the Americans with Disabilities Act (ADA) does not cover residential private apartments and homes. This means that it is up to each of us to determine the design accommodations we want to install—such as kitchen shelving and shower accessibility—to ensure that our homes are dynamically functional and usable over the long term. As we age and become more limited in our function and mobility, or continue living with existing disabilities, designing home spaces that can accommodate these limitations is essential to helping ensure that we can function and age well in our own homes.

17

**Biophilia:** Biophilia is our innate tendency to seek connections with nature and other forms of life. Substantial evidence shows that our physical, social and psychological well-being—including mental awareness, recovery from stress, and happiness—depend on our interaction with nature. In addition, our mental health has been found to be more positively affected by visual access to land that is rich in biodiversity (i.e., has a variety of plants, birds, insects, and other species) compared to a greater area of land; in other words, quality matters more than quantity.

18

**Noise:** Noise disturbances at night have been associated with elevated stress hormone levels, disrupted sleep, and high blood pressure, which in turn can lead to cardiovascular heart disease. Noise can come from indoors; for example, having a partner who snores can contribute to insomnia. However, nighttime noise often comes from outdoors, with sources including vehicle traffic, sounds or music from business establishments, or emergency vehicle sirens.



Over half of Americans report spending too little time per week in nature (5 hours or fewer); three quarters spend 10 hours or less.







## HOME SOLUTIONS

**Sleep-Conducive Environments:** To help facilitate sleep, create a quiet, relaxing ambiance in the evening and nighttime, with sound levels that are at least 5–10 decibels (dBA) lower than daytime levels (which are usually around 55–65 dBA). Walls and windows with adequate sound insulation can help minimize noise intrusion from outdoors. White noise machines are great for masking sound, while pink noise machines that play nature sounds have been shown to improve sleep quality.

**Universal Design:** Designing spaces and their features to be accessible and equitable to all—regardless of age, ability, or size—can help create inclusivity, so that everyone feels empowered to thrive in the spaces around them. For home environments, this can mean taking into account diminishing physical capabilities that occur with age (poor vision, declining mobility), given that aging adults prefer to live in their own homes for as long as possible.

**Nature Incorporation Indoors:** Elements of nature should be incorporated into everyday life within the home. This can include potted plants and small potted trees, indoor water features such as miniature fountains, as well as allowing nature sounds to permeate indoors (e.g., enabling bird songs to be audible through open windows). Simulated elements and views of nature, such as photos of nature and audio tracks of nature sounds, can be good substitutes when authentic elements and views are unavailable.

**Outdoor Views:** Building design should take into consideration the views to the outdoors that are visible to residents. This can include views to gardens, trees, flowers, or water fountains. Spaces should also be designed in a way whereby the visual access to outdoor views is not obstructed when sitting. In addition, residential design should include exercise opportunities that are in close proximity to green spaces, and enable a visual connection to nature that can be experienced for at least 5-20 minutes per day.

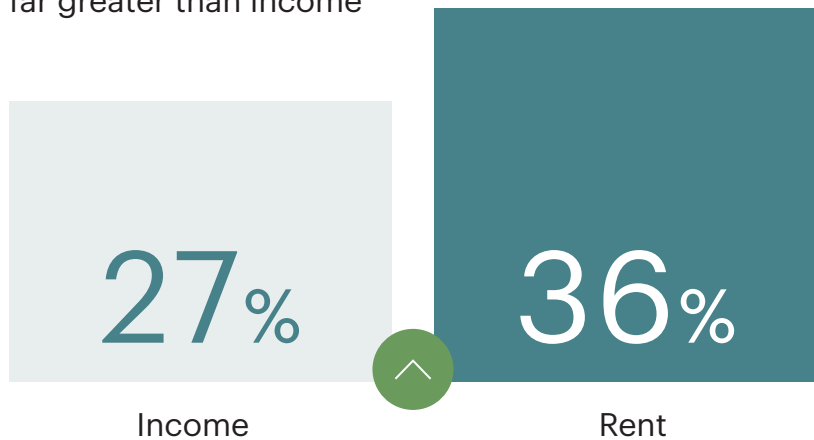


52% of low-income American families now spend over 50% of their income on housing.

## Secure Housing as a Platform for Health

Our homes serve as a platform for our health. However, a number of challenges can threaten housing security, such as difficulty paying the rent or mortgage, or natural disasters. Therefore, it is important to take these factors into consideration to help secure a stable and affordable home.

**BETWEEN 2010 - 2019,**  
median asking rent rose  
far greater than income





## HEALTH FACTORS

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**Affordability:** People are generally considered “rent-burdened” when they spend over 30% of their income on rent. Unfortunately, the percentage of rent-burdened people in the US is on the rise. Living in unaffordable housing is linked to worse overall self-rated health, hypertension, stress, and poorer mental health. Furthermore, paying an unsustainable amount of income towards housing drains financial resources that could otherwise be used for other things that support health, such as health services, prescriptions, and food.

20

**Crowding:** To cope with housing costs, many people turn to “doubling up”—moving into the homes of family or friends. This often results in overcrowding, which is associated with poorer mental health and behavioral issues such as hostility, and can be particularly detrimental for children’s educational outcomes, e.g., due to the lack of a quiet place to study.

21

**Involuntary Moves:** Many people are forced to move homes against their wishes, e.g., because of eviction or natural disasters. Residential instability can threaten people’s health and well-being; for example, it is linked to poorer mental health. Frequent moves can also contribute to poorer educational outcomes for children and adolescents. Forced moves increase the likelihood of losing employment by 11-22 percentage points.



Americans over 50 who were behind on their mortgage payments had a 9-fold risk of elevated depressive symptoms



## NEIGHBORHOOD ENVIRONMENT

### Neighborhoods Matter

It's not just what's inside our homes that matters; what surrounds them can also influence our health and well-being. Our neighborhoods impact us in many ways, including the resources we have access to, e.g., opportunities for physical activity, and the exposures we experience, e.g., air pollutants from local roads or facilities.

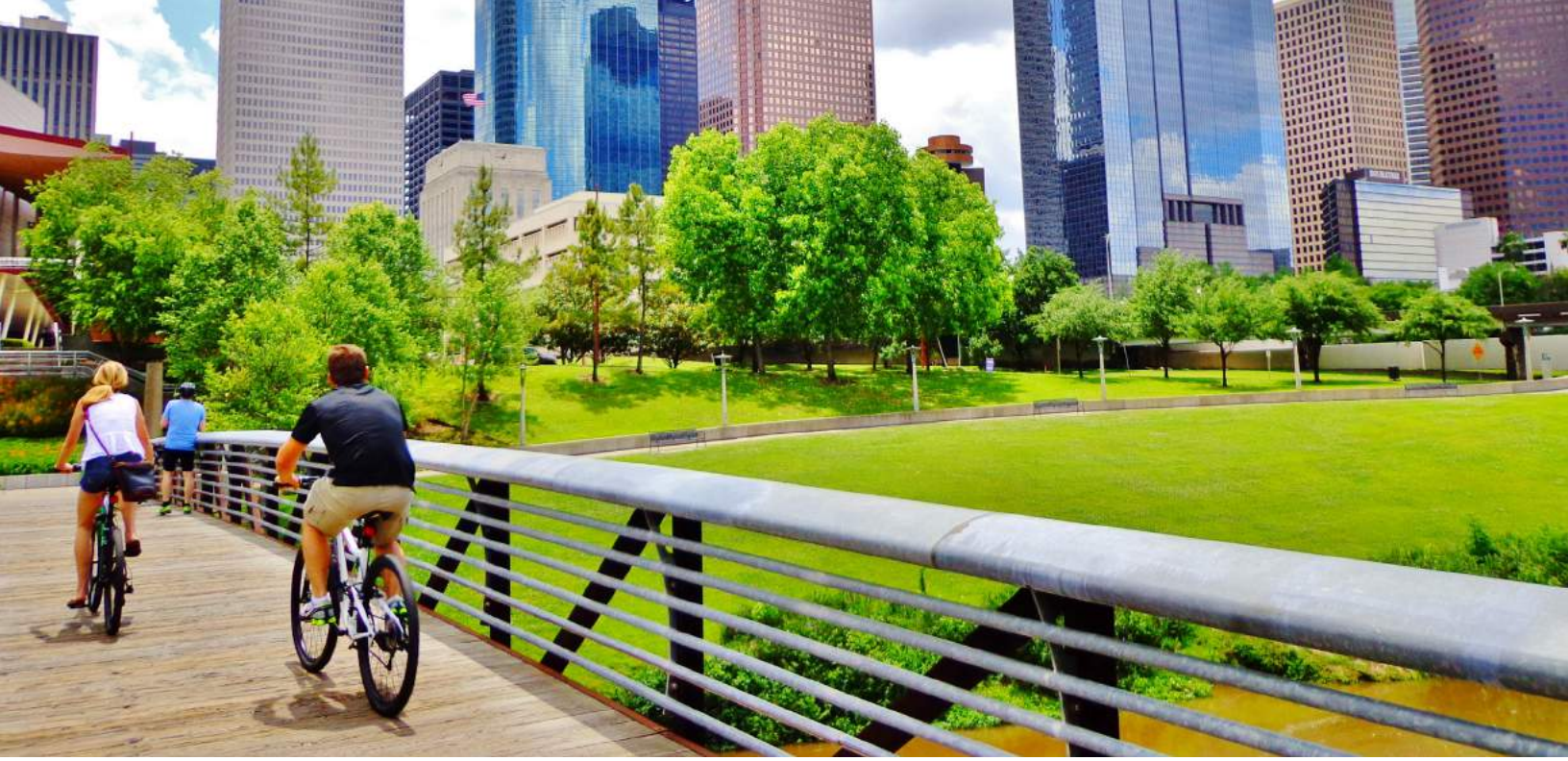
### Some Neighborhoods Are Healthier Than Others

Unfortunately, not all neighborhoods offer equal opportunities to be healthy—as indicated by the fact that life expectancy varies significantly (by 20.1 years!) across different US ZIP codes.



**DIFFERENCE IN LIFE EXPECTANCY**  
in counties across the US





## HEALTH FACTORS

22

**Walkability:** Neighborhoods can promote physical activity by integrating walkability features such as residential density; proximity of destinations such as restaurants; street connectivity; and sidewalks or trails for running, cycling and exercising. Use of such features can help reduce the risk of obesity and related health conditions.

23

**Healthy Food Accessibility:** Having affordable, healthy food options easily accessible in the community—for example, through supermarkets or farmers markets—can help promote healthy diets that are rich in fruits and vegetables, as well as reduce levels of obesity.

24

**Green Spaces:** Green spaces, such as parks and playgrounds, can support physical activity through the facilities they offer for individual and group activities and sports. In addition to its physical activity benefits, living near parks is also associated with better mental well-being – given people’s innate affinity for nature, or biophilia.

25

**Climate Resiliency:** Our built environment can help protect us from, or exacerbate, the effects of climate change, natural disasters, and extreme weather such as heat waves. For example, impervious surfaces and lack of tree cover can increase land surface temperature and therefore heat risk for residents.

# Neighborhood Design Can Impact Our Health



**PARKS ACCOUNT FOR**  
50% of vigorous physical activity  
time among people living within  
half a mile of a park

## DEATHS AVERTED WORLDWIDE

If physical inactivity were reduced by:

✓ **10%**  
>.5 MILLION

✓ **25%**  
>1 MILLION



## HEALTH LOSS IN THE US

- #1 **HIGH BODY-MASS INDEX (BMI)**
- #3 **DIETARY RISKS**
- #13 **LOW PHYSICAL ACTIVITY**



## **ENERGY EFFICIENCY**

### Healthy Home, Healthy Planet

Our homes should be healthy for us, but they should also be healthy for our planet. Energy efficiency can help minimize the harmful impact our homes have on the environment.

### Benefits Beyond Energy

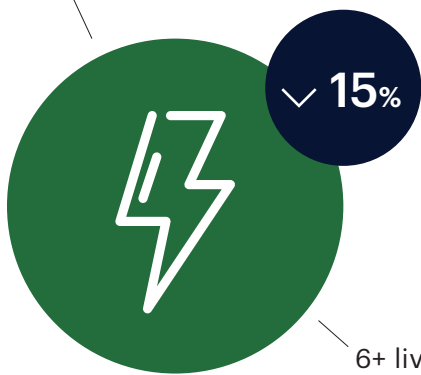
Fortunately, an environmentally friendly home can be good for both the residents and the planet. For one thing, the more energy-efficient the home, the less air pollution is generated. Moreover, energy efficiency upgrades can improve resident health more directly, e.g., via supporting thermal comfort and reducing indoor pollutants.





### ESTIMATED EFFECTS OF REDUCING ELECTRICITY CONSUMPTION NATIONWIDE

Almost 30,000 fewer asthma episodes



6+ lives saved per day

Up to \$20 billion in avoided health harms

### HOME SOLUTIONS

**Energy-Efficient Appliances:** From refrigerators and washer-dryers to lighting, appliances that are designed to use less energy are now widely available. The EPA’s ENERGY STAR program certifies energy-efficient products with high performance to help consumers make informed choices.

**Renewable Energy Sources:** Homes can be equipped to harness environmentally-friendly, renewable energy sources such as solar power systems.

**Weatherization:** Home modifications that provide better protection against the elements, such as sealing and insulating, can help improve energy efficiency. They have also been shown to improve health outcomes and reduce stress for residents.





## CONCLUSION

Our homes can shape our health and well-being in profound ways—from providing clean air for us to breathe and dynamic lighting that is in tune with natural sunlight, to incorporating elements of nature into our living spaces and creating environments that promote restorative sleep. We owe it to our health to understand **the science behind healthy homes**, as well as the strategies we can implement to improve our living environments.

Delos bridges the gap between evidence-based science and everyday awareness to support our mission of promoting enhanced health and well-being in the environments where we live, work, sleep, and play. In collaboration with the Mayo Clinic, Delos developed the Well Living Lab to study the effect of indoor environments on human health, and shares the findings of this research with the public. Through the process of continuous learning, sharing our knowledge, and research-informed development of innovative products and solutions, Delos is committed to promoting healthy home solutions for people everywhere.

**WELCOME HOME TO WELLNESS**

**#HEALTHYHOMES**

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## Building and Area Design

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