Environment and Health A to Z

National Institute of Environmental Health Sciences

No two people live in the exact same environment.

The SOIL beneath our feet, the AIR we breathe, and the WATER flowing through our pipes and waterways can all differ greatly, depending on where we live. On top of that, each of us eats different foods, shares our space with different plants and animals, and has access to different medicines and technology.

Except for identical twins, the genetic information that each of us carries deep inside our cells is also unique. Even brothers and sisters have different DNA, because they inherit a different combination of genes from their parents.

Think of your genes and your environment as two sides of the same coin. Together, they play equal roles in your health. Your genes can make you more or less likely to get sick. At the same time, your environment can either protect you or place you at greater risk of developing certain illnesses.

You cannot do much about your genes, but you can take steps to promote a better environment to help live a longer, healthier life. According to some estimates, nearly a quarter of the deaths around the world may be prevented by reducing environmental risks.

Knowledge Is Key

The **National Institute of Environmental Health Sciences (NIEHS)** explores the connections between the environment and health, gathering scientific knowledge to help prevent human disease. The **National Toxicology Program (NTP)**, headquartered at NIEHS, is responsible for testing substances that are of concern to public health, to help ensure that the products we use, the air we breathe, and the water we drink is safe.

Keep reading to see some of the things we have learned so far about how the environment affects our health,

from A to Z.

Allergies and Asthma

Millions of people in the U.S. have allergies. They suffer from sneezing, sniffles, and itchy eyes triggered by pollen, dust, pet dander, and other substances. Some people have more severe reactions that result in sudden asthma attacks that leave them gasping for air, a condition known as allergic asthma. These asthma attacks often occur after periods of heavy exercise or during abrupt changes in weather. Doctors can test to find out which substances or activities are causing allergic reactions and prescribe medications to help relieve most symptoms. NIEHS researchers have shown that simple steps, such as washing bedding in hot water, putting dustproof covers on pillows and mattresses, and vacuuming and steam cleaning carpets, can significantly reduce indoor allergen levels and asthma symptoms.

Botanicals and Essential Oils

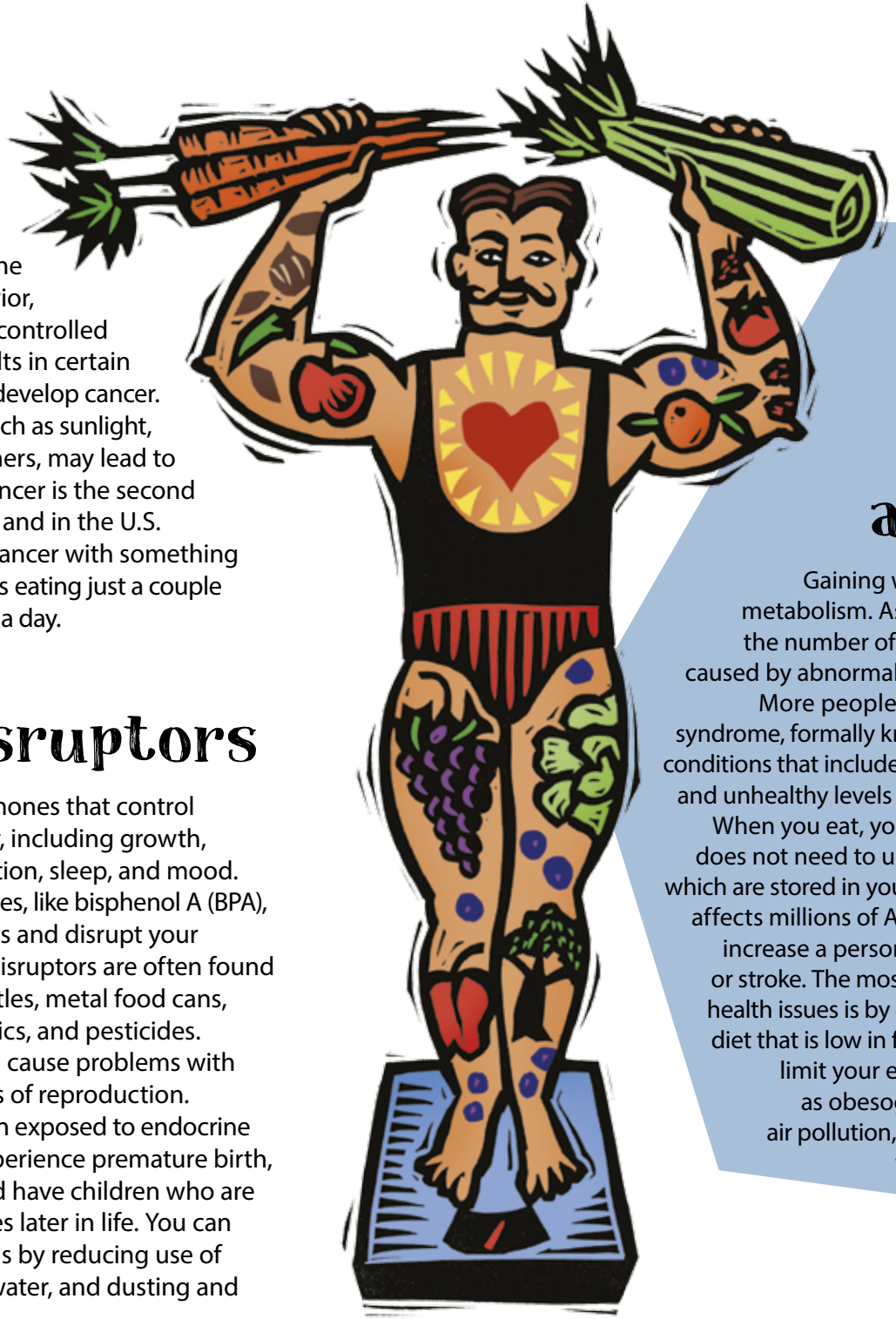
A botanical is a plant or plant part valued for its medicinal properties, flavor, or scent. Essential oils are concentrated plant extracts that retain the natural smell and flavor of their source. Botanicals are sold in many forms, including fresh and dried products; liquid and solid extracts; tablets, capsules, and powders; and tea bags. They are often called botanical dietary supplements or herbal products. Some of the most common botanicals used for health are echinacea, green tea extract, garlic, and aloe. Like other dietary supplements, botanicals and essential oils are not required by federal law to be tested for safety and effectiveness before they are marketed, so the amount of research conducted on various botanical ingredients varies widely. NTP is conducting many studies to identify the potential health effects of short-term and long-term exposure to botanicals and essential oils. For your own safety, talk to your doctor before trying any new products, and do not assume that natural means safe.

Cancer

Cancer is caused by changes, or mutations, to genes that control the way our cells function, especially how they grow and divide. Rather than responding properly to the signals that control normal cell behavior, cancer cells grow and divide in an uncontrolled manner. Some people can inherit faults in certain genes that make them more likely to develop cancer. Other times, environmental factors, such as sunlight, cigarette smoke, air pollution, and others, may lead to mutations or contribute to cancer. Cancer is the second leading cause of death, both globally and in the U.S. You may reduce your risk of getting cancer with something as simple as a lifestyle change, such as eating just a couple more servings of fruits and vegetables a day.

Endocrine Disruptors

The endocrine system produces hormones that control practically every function in the body, including growth, metabolism, development, reproduction, sleep, and mood. Many natural and man-made substances, like bisphenol A (BPA), can mimic your body's own hormones and disrupt your endocrine system. These endocrine disruptors are often found in everyday items, such as plastic bottles, metal food cans, detergents, flame retardants, cosmetics, and pesticides. Exposure to endocrine disruptors can cause problems with fertility, pregnancy, and other aspects of reproduction. NIEHS research has shown that women exposed to endocrine disruptors during pregnancy may experience premature birth, deliver lower birth weight babies, and have children who are more likely to develop certain diseases later in life. You can limit your exposure to these chemicals by reducing use of plastic containers, filtering drinking water, and dusting and vacuuming often.



Diabetes, Metabolic Syndrome, and Obesity

Gaining weight can wreak havoc on your metabolism. As waistlines continue to expand, the number of people with diabetes, a disease caused by abnormally high blood sugar, is growing. More people are also developing metabolic syndrome, formally known as syndrome X, a group of conditions that includes diabetes, high blood pressure, and unhealthy levels of cholesterol and triglycerides. When you eat, your body converts any calories it does not need to use right away into triglycerides, which are stored in your fat cells. Metabolic syndrome affects millions of Americans and can dramatically increase a person's risk of having a heart attack or stroke. The most effective way to reduce these health issues is by exercising and eating a healthy diet that is low in fat, sugar, and salt. You can also limit your exposure to substances known as obesogens, such as cigarette smoke, air pollution, and pesticides, that can affect the buildup of fat in the body.

Flame Retardants

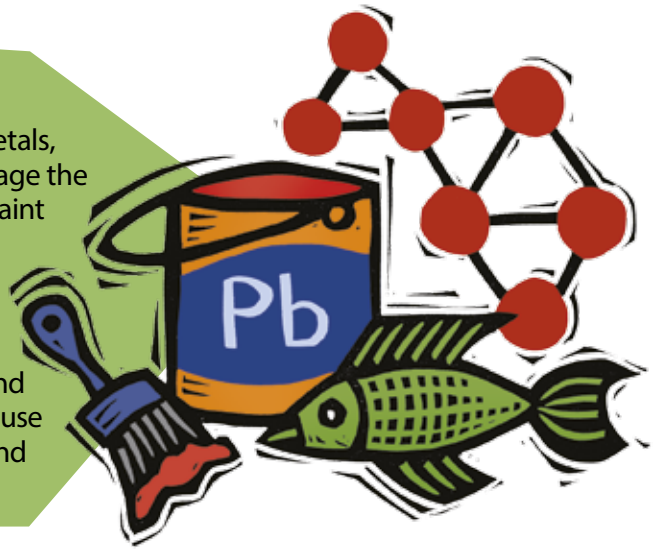
Flame retardants are a form of endocrine-disrupting chemicals that are added or applied to materials to slow or prevent the start or growth of fire. These chemicals have been used in many consumer and industrial products since the 1970s, and are often found in upholstery, carpet, children's clothing, toys, and electronics. Many flame retardants have been removed from the market or are no longer produced. However, because they do not easily break down, they can remain in the environment for years. They can also bioaccumulate, or build up, in a person's body over time. Exposure to flame retardants has been associated with a wide range of health effects, including lower IQ, reduced fertility, thyroid issues, and cancer. People can help protect themselves by avoiding products known to contain flame retardants.

Genetics and Epigenetics

Many illnesses result from the interaction between a person's genes and exposure to environmental agents. The exact sequence of your DNA serves as a blueprint for your body, and can determine how susceptible you are to environmental insults, such as sunlight, mold, and arsenic. These exposures can alter your DNA, possibly leading to illness or disease. Exposures can also change the way genes are turned on and off, influencing whether disease-promoting or disease-protective genes are active. A rapidly growing field of science, known as epigenetics, studies how various chemicals and proteins attach to DNA to activate or silence genes, without changing the underlying DNA. NIEHS co-led a national effort to map out where chemical compounds attach to DNA, for more than 100 different tissue and cell types. By comparing maps from healthy cells or tissues with those exposed to environmental agents, scientists have been able to further understand how epigenetic processes influence disease.

Heavy Metals

Some metals, such as iron and zinc, are essential nutrients in the right amounts. But certain heavy metals, such as lead, mercury, cadmium, and arsenic, can be hazardous to your health. Lead, which can damage the brain and nervous system, was banned from gasoline and paint years ago. However, it still exists in paint in older buildings, and in some industrial and consumer products. Mercury is a naturally occurring element that is present in the environment. However, airborne mercury, such as that caused by coal-fired power plants and burning of waste, can make its way into waterways and be consumed by fish. Eating these fish can cause mercury to enter our bodies. Since the body cannot get rid of mercury, it gradually builds up and may damage organs, such as kidneys, liver, and brain. Arsenic is found just about everywhere in the environment and can get into well water. In large amounts, arsenic can cause organ failure and possibly even death. Public water supplies are typically monitored for heavy metals and other contaminants. If your home has a well, you can have your water tested to make sure it is safe.



Immune Response

A healthy immune system defends the body against disease and infection. But, when the immune system fails to function as it should, it can attack healthy cells, tissues, and organs. This can lead to an autoimmune response, such as severe and chronic inflammation, that can be debilitating and even life-threatening. More than 80 autoimmune diseases have been identified, including rheumatoid arthritis, type 1 diabetes, lupus, and multiple sclerosis. The causes of autoimmune disease remain largely unknown. However, scientists are finding some answers. NIEHS-funded researchers found that exposure to pesticides, fertilizers, and solvents, which are used in thousands of products, including paint thinners, cleaning supplies, and nail polish, may contribute to the development of rheumatoid arthritis.

Job-Related Illnesses

Every job has certain hazards, and many die from job-related illnesses every day. Many of these illnesses are caused by exposure to environmental agents present in the workplace. For example, factories and scientific laboratories may contain toxic chemicals, dyes, and metals. Doctors and other health care workers are often exposed to radiation. People who work in airports may suffer hearing loss from loud noise. Workers can help protect themselves from hazards by wearing special clothing or using goggles, gloves, ear plugs, or other safety equipment. The NIEHS Worker Training Program funds the training of workers on how to stay safe as they respond to the aftermath of terrorist attacks, such as those on September 11, 2001; natural disasters, such as hurricanes; disease outbreaks, such as Ebola; and other public health emergencies, such as when elevated levels of lead were found in the drinking water in Flint, Michigan.

Kidney and Liver Diseases

The kidneys and liver help keep the body healthy. Every day, your kidneys filter about 200 quarts of blood, and remove wastes and extra water in the form of urine. If your kidneys did not remove these wastes, they would build up in the blood and damage your body. The liver performs many functions to keep the body free of harmful substances. It converts the nutrients in your diet into substances that the body can use, and supplies cells with them when needed. It also takes toxic substances and either converts them into harmless substances or releases them from the body. Millions of Americans have chronic kidney disease or liver disease. Research continues to discover how environmental factors may impact these diseases, both in the U.S. and around the world.

Lung Diseases

Lungs are the powerhouse of the respiratory system. They bring oxygen into the body with each inhale and get rid of carbon dioxide with each exhale. Damage to the lungs can result from exposure to many things in the air, such as allergens, toxic substances, metals, and molds. Research has shown that long-term exposure to air pollutants can affect the growth and development of the lungs, and increase the risk of developing asthma, emphysema, and other lung diseases. The NIEHS-funded Harvard Six Cities Study found a strong association between exposure to fine particle air pollution and early death. One of the biggest dangers to lung health is cigarette smoke, which contains hundreds of toxins, such as nicotine. There are several steps you can take to help prevent lung diseases, including not smoking, avoiding secondhand smoke, and protecting yourself from air pollutants, both inside and outside the home.

Nervous System Diseases

The nervous system, which includes the brain, spine, and nerves that connect them, controls our thoughts, feelings, movements, and behavior. When the cells of the nervous system are damaged by toxic substances, injury, or disease, the results can be devastating. Scientists have discovered hundreds of disorders of the nervous system, including developmental disorders like autism, and degenerative diseases like Parkinson's. Research suggests that air pollution, toxic substances, and advanced parental age may play a role in the increase in autism rates over the past few decades. Other studies have found that exposure to toxic substances may increase risk for neurological disorders, while diet and exercise may help prevent disease. For example, a large study of older Americans found that higher levels of moderate to vigorous physical activity may lower a person's risk of developing Parkinson's.

Microbiome

There are as many microbes, or microorganisms, living in and on us as there are human cells in the body. This collection of microbes and their genes is known as the microbiome, and it plays a critical role in human health and wellness. It protects us against pathogens, or agents that cause infection or disease; helps our immune system; and enables us to digest food. Though a person's microbiome is unique and gets established over the first few years of life, it can be shaped over time by changes in diet, medications, and environmental factors. Some microbes can alter environmental substances in ways that make them more toxic, while others can act as a buffer and make substances less toxic. NIEHS-supported researchers have found that exposure to environmental substances, such as arsenic, can disrupt the gut microbiome and increase the risk of developing disease. Several studies have shown that eating a balanced diet and avoiding antibiotics and antimicrobials, such as alcohol-based hand sanitizers, can help you maintain a healthy microbiome.

Ozone

Ozone is a gas made up of three oxygen atoms. High up in the atmosphere, ozone is formed naturally and helps shield us from the sun's harmful ultraviolet rays. At ground level, ozone is formed by a chemical reaction between sunlight and pollutants, such as those emitted by cars. It is the main ingredient of smog. Being exposed to too much ozone can cause damage to the lungs, and is especially bad for people with lung diseases. To help protect yourself from ozone exposure, check the daily air pollution forecasts in your area, and avoid spending too much time outdoors on high-ozone days.
To help reduce ozone levels, avoid excessive idling of your vehicle or, better yet, carpool or use public transportation.

Pesticides

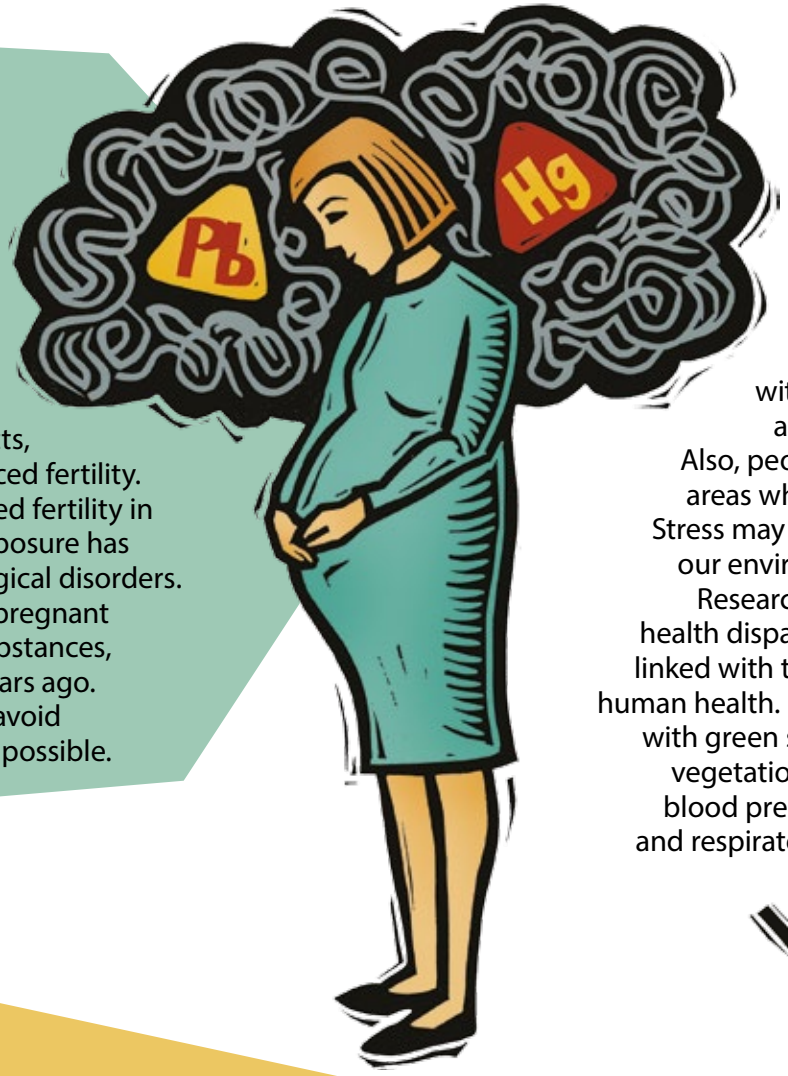
Pesticides include herbicides for killing unwanted plants, insecticides for controlling insects, fungicides for preventing the growth of molds and mildew, disinfectants for stopping the spread of bacteria, and compounds for controlling pests. Many pesticides remain in the environment long after they are applied and can get into our food and water. Scientists still do not know the long-term health effects of most pesticides. However, one study of children in California's Salinas Valley, who had been exposed to high levels of pesticides, found decreases in lung function similar to those from exposure to secondhand cigarette smoke. To help minimize your exposure to pesticides, thoroughly wash all fruits and vegetables before eating.

Quick Response to Disasters

Over the past decade, public health emergencies, including radiological threats, pandemics, and earthquakes, have tested the ability of public and private institutions to respond to natural disasters. Responders have learned important lessons from each of these events that may help provide useful information for responding to future emergencies. As a lead partner in the Disaster Research Response Program, NIEHS is helping to create tools so that researchers can gather human health, environmental, and toxicology data during disaster response. In addition, NTP has assisted in public health emergencies. For example, after the 9/11 terrorist attacks, NTP studied dust samples from the area to gauge the long-term health effects on emergency responders.

Reproductive Health

Reproductive health refers to the functioning of the male and female reproductive systems during all stages of life. Research has shown that exposure to environmental substances may cause adverse health effects, such as birth defects, low birth weight, preterm birth, and reduced fertility. Exposure to lead is associated with reduced fertility in both men and women, while mercury exposure has been linked to birth defects and neurological disorders. In an NIEHS-funded study, 99 percent of pregnant women tested positive for many toxic substances, including ones that had been banned years ago. To reduce risk, steps should be taken to avoid exposure to toxic substances, whenever possible.



Stress

Stress can impact a person's overall physical health and well-being. Those living in high-crime areas or with physical abuse may suffer from constant anxiety, making them more prone to illness. Also, people of low income are more likely to live in areas where there is higher air and water pollution. Stress may compound the harmful effects of things in our environment that may cause or worsen disease. Research has found that interventions that reduce health disparities, or health differences that are closely linked with these types of disadvantages, may improve human health. It has also been found that neighborhoods with green spaces, dense trees, bushes, or other green vegetation are associated with lower levels of stress, blood pressure, and risk of death from cardiovascular and respiratory disease, as well as better overall health.

Toxicology

Toxicology is often referred to as the science of safety. It is a field of science that helps us understand the harmful effects that chemicals, substances, or situations may have on people, animals, and the environment. Toxicology provides critical information that can be used by regulatory agencies, decision-makers, and others to put programs and policies in place to limit our exposure to these substances, thereby preventing or reducing the likelihood that a disease or other negative health outcome will occur. Thousands of chemical substances exist in our environment, but only a small fraction of these have been adequately tested. The Toxicology in the 21st Century program, or Tox21, develops new ways to rapidly test whether substances adversely affect human health, using methods such as high-throughput screening, a faster, more efficient method using robotics.

Unsafe Water

Water is considered unsafe if it contains dangerous levels of algae, bacteria, or toxic substances. Warming oceans have increased the frequency and severity of harmful algal blooms, or areas where algae grow to such large numbers that they discolor coastal waters. Toxins produced by these blooms can seriously harm people and animals. Similarly, the overgrowth of certain types of bacteria can lead to diarrhea and other intestinal problems. Although uncommon in the U.S., waterborne diseases, or infections caused by microorganisms or contaminants in water, are common in developing countries. Lack of proper sanitation increases the risk of waterborne diseases in these areas. However, developed countries are also at risk for unsafe water. For example, residents of Flint, Michigan, have been plagued with lead-tainted tap water, due to water flowing through lead pipes. NIEHS funds, and NTP conducts, many studies on chemicals found in drinking water, such as GenX in the Cape Fear River of North Carolina.

Volatile Organic Compounds

Volatile organic compounds, or VOCs, are natural and man-made chemicals. They can be found in many consumer products, such as hair spray, aerosol perfumes, cleaning agents, and paints. VOCs are considered volatile because they can evaporate at room temperature, invisibly entering the air people breathe. Exposure to VOCs can cause frequent headaches, nausea, and eye, nose, and throat irritation, and may also damage the liver, kidneys, and central nervous system. NTP research has shown that many VOCs, including styrene and formaldehyde, are likely to cause cancer in humans. You can help protect yourself by looking for products with low VOCs written on the label.

Weather Extremes

As the planet warms and sea levels rise, there are longer droughts and higher temperatures in some regions, and more intense hurricanes and snowstorms in others. This extreme weather is endangering the health of Americans in many ways. It is increasing the frequency and severity of heat waves, leading to more heat-related illnesses and deaths, and expanding the area where insects that transmit diseases like malaria and Lyme disease live. Also, it is increasing pollen, molds, and air pollution, which can worsen allergies, asthma, and cardiovascular diseases; and causing more heavy rains and flooding, which can contaminate soil and water. Scientists caution that the most vulnerable people, such as children, the elderly, the poor, and those with underlying health conditions, are at the highest risk for adverse effects from extreme changes in weather. The NIEHS Climate and Human Health program is funding research to better understand how a changing climate impacts health and well-being, and exploring strategies to adapt or lessen its impact.

X-rays and Other Radiation

Radiation is energy that travels from one place to another in the form of particles or waves. Practically every object emits some level of radiation, which falls at various points along the electromagnetic spectrum. At the top of the spectrum are the most powerful forms of radiation, gamma rays, the radiation given off by an atomic bomb. Next are X-rays, ultraviolet light emitted by the sun, visible and infrared light, microwaves, and radio waves, the source of communication used in cell phones. Given that cell phones are so prevalent, NTP undertook a study to explore whether cell phone use is a cancer risk. They found that high doses of cell phone radiation were tied to rare tumors in rats. If you are concerned about potential risks, reduce the time you spend on your cell phone, or use speaker mode or a headset to place more distance between your head and the cell phone.

Youth and Windows of Susceptibility

Health risks from environmental factors are greater during certain periods of development. These especially sensitive periods are known as windows of susceptibility. A developing fetus can adapt its metabolism, and even reprogram its genes, in response to insults like air pollution or alcohol, potentially contributing to diseases later in life. Children are also at risk, as they are exposed to proportionately larger doses of environmental toxins than adults. Adolescents are vulnerable due to hormonal changes and because their brain is still developing. The health effects of many exposures may not appear until years later. For example, women who were exposed in the womb to diethylstilbestrol (DES), a medication used from the 1940s to the 1970s to prevent miscarriages, may have double the risk of developing breast cancer than unexposed women. Research on windows of susceptibility indicate that efforts to prevent disease may need to occur decades before the first symptom appears.

Zika and Other Viruses

The environment is teeming with viruses, bacteria, and fungi, collectively known as microbes. Pathogens, or microbes that can cause disease, make up less than one percent of all microbes. One of the more alarming viruses in recent history is Zika, which has been spread across the Americas by infected mosquitoes. The effects of the virus are usually mild, but a link between Zika and birth defects has been observed in several places where the virus is common. Other viruses, including hepatitis B, HIV, Epstein-Barr, and HPV, have been shown to cause cancer. You can help protect yourself by getting vaccinated against viruses, such as hepatitis B and HPV, and not sharing food and drinks.

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