BIOMONITORING

Measuring Chemicals in People

MAY
2004

Association of Public Health Laboratories

ABOUT APHL

The Association of Public Health Laboratories (APHL) works to safeguard the public's health by strengthening public health laboratories in the United States and across the world. In collaboration with members, APHL advances laboratory systems and practices, and promotes policies that support healthy communities. The association's founding members are directors of state public health laboratories. Others include state laboratory staff, city and county laboratory directors, and international representatives. APHL is a non-profit, 501(c)(3) organization.

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INTRODUCTION

Public health professionals, policymakers, and the public are increasingly concerned about human exposure to chemicals in our environment. We all know that while chemicals have dramatically improved our quality of life, chemical residues are widespread in our water, soil, and air. This widespread environmental presence raises critical questions that need to be addressed. We need to determine the actual concentrations of dangerous chemicals in our bodies as a result of environmental exposure, how long these chemicals stay in our bodies, how often are we exposed to them at various stages of life, the ages at which significant exposures occur, which population groups have elevated exposures, and what relationship the presence of certain chemicals in our bodies has on the development of disease, abnormality, or death.

The Association of Public Health Laboratories (APHL) believes the best way to address these important questions regarding human exposure is through biomonitoring, a rigorous scientific process that measures levels of environmental chemicals in human tissues and fluids. While knowing what chemicals are present in the environment is important, it is even more important to determine through biomonitoring whether they are actually present in the human body as a result of environmental exposure. Such data are essential to demonstrate casual relationships between chemical exposure and human health.

The material that follows explains (1) the importance of biomonitoring, which has been employed by the Centers for Disease Control and Prevention (CDC) for many years to help protect the public's health, and (2) the case for building biomonitoring capacity at the state level in addition to CDC.

Many states have spent the last two years working with local partners to develop biomonitoring plans. These states are now ready and eager to implement their plans to address state-specific chemical/public health issues.

At APHL, we believe the ability of state public health laboratories to protect the public's health depends in part on our ability to quickly and effectively measure chemicals within people who may have been exposed. The role of our public health laboratories is to provide health professionals with the analytical data they need to make decisions about protecting the public's health, based on good science. Biomonitoring is good science that provides *unique* information to enable the medical community and state public health laboratories to carry out their missions.

Norman Crouch, PhD
President

Ronald H. Laessig, PhD
Environmental Health Committee Chair

DEFINITION OF BIOMONITORING

The measurement of chemicals *in* the human body, specifically in blood, urine, serum, saliva, or tissues. Measuring chemicals in human tissues is the "gold standard" for assessing human exposure to pollution.

The results of biomonitoring are used to help make decisions about how best to protect people from diseases, birth defects, disabilities, dysfunction, or death.

CDC AND BIOMONITORING

For more than 25 years, the Centers for Disease Control and Prevention's (CDC) Environmental Health Laboratory has used biomonitoring to help protect the public's health. Here are a few examples of its work.

LEAD

In 1976, the Agency measured lead levels in children's blood as part of a large national survey. Almost 90% of children ages 1-5 presented high levels of lead, which impairs learning ability. Lead in gasoline was shown to be a major contributor to blood lead levels — lab data showed that gasoline contributed to blood lead levels 10 times more than previously thought. CDC's lab work persuaded the Environmental Protection Agency to order the removal of lead additives from gasoline.

METHYL PARATHION

In 1996, CDC employed biomonitoring to assist the State of Mississippi in dealing with a health crisis brought on by the illegal spraying of outdoor pesticides inside homes. Methyl parathion, a pesticide approved only for outdoor-use, was sprayed inside more than 2,600 homes in Pascagoula and Hattisburg, Mississippi. Two children died and many people became sick. Often, residents did not know whether their house had been sprayed or their children had been exposed to the pesticide.

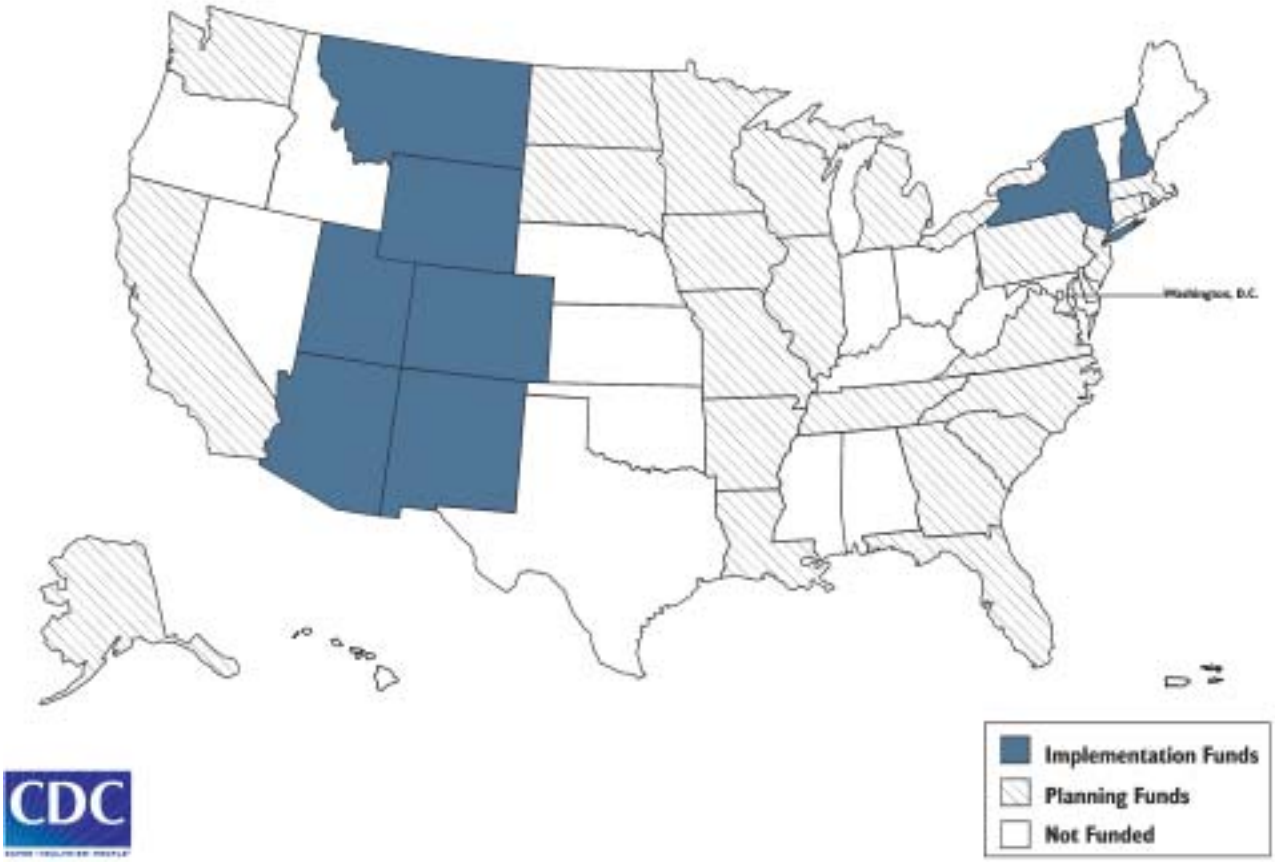
CDC measured the pesticide levels in the residents' bodies and provided this information to the State Health Department. The Health Department used this data to identify individuals in need of medical treatment and those who needed to be moved out of their homes until the homes could be decontaminated. The Health Department was able to take immediate action to preserve the public's health based on sound scientific data. An estimated $50 million was saved by using biomonitoring instead of environmental testing.

MERCURY

In January 2004, CDC provided assistance to the Nevada Health Department in assessing the exposure of 235 children and staff at a rural middle school after a student came to school with a large amount of liquid mercury. Exposure to high levels of metallic, inorganic or organic mercury can permanently damage the brain, kidneys, and developing fetus. The Environmental Health Laboratory measured levels of mercury in the urine of the most highly exposed children and determined that only the boy who had brought the mercury to school had a mercury level that was above levels in the general population. As a result of the Lab's work, health officials were able to determine that no additional testing was needed and medical treatment was not required.

FEDERAL BIOMONITORING FUNDING BY STATE

State Public Health Laboratory Biomonitoring Planning and Implementation Grants (Fiscal Years 2002, 2003, 2004)



FEDERAL BIOMONITORING FUNDING BY STATE

State Public Health Laboratory Biomonitoring Planning and Implementation Grants (Fiscal Years 2002, 2003, 2004)

State	Planning Grant (FY 02)	Planning Grant (FY 03)	Implementation Grant (FY04)
Alabama			
Alaska	$100,000	$136,504	
Arizona	$ 75,000	$ 75,000	$119,654
Arkansas	$262,069	$263,513	
California	$300,000	$300,000	
Colorado	$ 75,000	$ 75,000	$206,486
Connecticut	$180,169	$257,963	
Delaware			
District of Columbia	$172,843	$172,770	
Florida	$250,428	$240,428	
Georgia	$ 35,000	$ 40,000	
Hawaii			
Idaho			
Illinois	$100,000	$102,715	
Indiana			
Iowa	$104,148	$114,866	
Kansas			
Kentucky			
Louisiana	$100,000	$ 99,990	
Maine			
Maryland			
Massachusetts	$269,129	$299,999	
Michigan	$203,062	$206,073	
Minnesota	$226,592	$228,592	
Mississippi			
Missouri	$171,359	$174,622	
Montana	$ 75,000	$ 75,000	$ 99,275

State	Planning Grant (FY 02)	Planning Grant (FY 03)	Implementation Grant (FY04)
Nebraska			
Nevada			
New Hampshire	$184,483	$173,741	$296,855
New Jersey	$181,540	$122,244	
New Mexico	$225,000	$ 43,295	$195,027
New York	$231,602	$263,470	$774,755
North Carolina	$149,950	$142,450	
North Dakota	$ 18,320	$ 16,568	
Ohio			
Oklahoma			
Oregon			
Pennsylvania	$227,533	$208,190	
Rhode Island	$158,447	$158,447	
South Carolina	$ 67,470	$115,248	
South Dakota	$ 2,000	$ 4,000	
Tennessee	$212,959	$255,252	
Texas			
Utah	$ 75,000	$ 75,000	$171,171
Vermont			
Virginia	$204,205	$ 186,817	
Washington	$107,373	$ 88,415	
West Virginia			
Wisconsin	$179,319	$ 179,319	
Wyoming	$ 75,000	$ 75,000	$116,215
Total Funds	**$5,000,000**	**$4,970,491**	**$2,679,913**

Note:

New Mexico, Arizona, Colorado, Montana, Utah, and Wyoming are members of a biomonitoring consortium that received a $907,828 *implementation* grant.

Minnesota, North Dakota, South Dakota, Iowa, and Wisconsin are members of a biomonitoring consortium that received two years of *planning* grant funding totaling $496,072.

South Carolina and Georgia are members of a biomonitoring consortium that received two years of *planning* grant funding totaling $257,718.

THE STATES AND BIOMONITORING

State health departments are frequently called upon to investigate geographic clusters of cases of cancer, birth defects and illness to find out whether they can be attributed to exposure to environmental chemicals. They also are asked to help in investigations of industrial accidents. States currently lack the ability to do the biomonitoring testing needed to address these concerns. Instead, they must rely upon assistance from CDC's Environmental Health Lab. While the CDC Lab does outstanding work, it does not have the resources and time to address each state's unique health issues.

States need the capability and capacity for biomonitoring. Most states have spent the last two years developing biomonitoring plans, and they are eager to implement those plans. Here is what some states plan to do with biomonitoring funds:

CALIFORNIA

California, like other states, went through an extensive planning process to determine which biomonitoring projects to address. Health officials, directors of environmental health, community activists, tribal groups, state epidemiologists, local public health laboratory directors, representatives of private labs, and others provided input. After extensive consultation, California developed a list of ten areas of interest.

Initially, the Lab will focus its efforts on 1) integrating genetic and environmental factors to better understand autism in children; 2) studying pesticide exposure in farm workers and their children, with subsequent tracking of developmental issues in the children; 3) examining the kinds of compounds that persist in breast milk, with a special focus on polychlorinated biphenyls (PCBs) and polybrominated diphenyl ethers (PBDEs); and 4) determining chemical levels in blood specimens from mothers of children with birth defects using banked blood specimens collected from pregnant women through the California maternal screening program.

FLORIDA

Florida ranks first in the nation in the use of "restricted use" pesticides in agriculture. In addition, tourism is a major industry in Florida, and it leads to the use of tremendous volumes of pesticides to maintain picture-perfect attractions and more than 1,200 golf courses. Pesticides also are used in homes, schools, and businesses. Organophosphates have been widely used for such applications and its active agent has been associated with a variety of ailments in humans. Florida's lab will test for organophosphate pesticides, pyrethroid insecticides, and a variety of herbicides.

The Environmental Protection Agency has identified 53 Superfund National Priority List sites in Florida. State health and environmental officials are aware of the public's concern about rising rates of asthma, birth defects, childhood cancer, neurological disease, developmental disabilities, and immune system diseases such as lupus, but their ability to investigate possible environmental associations is limited. Florida would like to use biomonitoring testing to determine if residents living near Superfund sites have above-normal levels of heavy metals that could be related to a variety of health issues.

IOWA

Recent studies have identified arsenic at elevated levels in private wells in north central Iowa. The extent of the exposure has yet to be determined, and may be wider than presently known. Monitoring urine, blood, nails or hair for arsenic exposure would provide specific information about individuals who are exposed and need further evaluation.

Iowans living near confined animal feeding operations are concerned about the impact of exposure to hydrogen sulfide or ammonia on their health. Monitoring urine levels of this sulfate and/or ammonia to assess exposure will help identify those who have experienced the greatest exposure to these chemicals, and pave the way for study of associated health effects.

NEW HAMPSHIRE

A third of New Hampshire residents rely on private wells for drinking water. It is estimated that approximately 13% of these wells have arsenic levels above 10ug/L, the allowable limit for public water supplies under the Safe Drinking Water Act. Because these wells are unregulated, residents drinking water drawn from them may not know the level of contaminants, putting themselves unknowingly at risk. The New Hampshire Lab plans to collect clinical samples as well as environmental water samples from areas of the state known to have high arsenic levels in the bedrock. Residents will be informed of the test results and provided with information about arsenic. Follow up a year later with the original participants will survey any actions that they have taken to reduce their exposure and will collect another round of environmental and clinical samples.

Research conducted on the common loon has shown that some of the highest mercury levels in the nation were detected in loon eggs and blood in certain lakes located in New Hampshire. Since 1994, New Hampshire has had a statewide mercury-based fish consumption advisory that applies to all freshwater bodies throughout the state, and provides recommendations on the amount of fish that can be safely consumed. Despite efforts to educate the public, it is unclear how many residents are aware of the advisory and to what extent it is being followed. The New Hampshire Lab will collect and analyze approximately 200 blood specimens to determine levels of mercury in residents. The data will help the New Hampshire health department target high-risk individuals for education efforts. Mercury fact sheets and other educational materials will be provided to participants.

The New Hampshire Lab also plans to track phthalates and PBDEs in humans, both of which possess endocrine disrupting properties at high levels. The Lab plans to test for phthalate metabolites in the urine of cosmetologists, and analyze for levels of PBDEs in both serum and breast milk.

NEW MEXICO

New Mexico has some of the nation's highest levels of arsenic in drinking water, caused by widespread ash falls from volcanic activity in the Quaternary period as well as mining, milling, and smelting operations. With biomonitoring capacity, the New Mexico Lab will test human samples to determine residents' arsenic levels. Residents would then be given information about the health risks associated with high arsenic levels.

Farm workers in the cotton, green chili, and peanut fields are constantly exposed to pesticides. The New Mexico Lab would like to collect baseline and targeted-population biomonitoring information for levels of pesticide exposure.

New Mexico is the lead state in the Rocky Mountain biomonitoring consortium, which comprises Arizona, Colorado, Montana, Utah and Wyoming.

NEW YORK

The Wadsworth Center, New York's Public Health Laboratory, worked with public health professionals, researchers and advocates to identify an extensive list of important environmental exposure questions and corresponding biomonitoring projects. One such project will be a collaborative effort by the Lab, the NYC Department of Health and Mental Hygiene and the NYS Department of Health Center for Environmental Health to evaluate mercury exposure in children of New York City neighborhoods. These communities have significant Latin American and Caribbean populations, members of which are believed to practice religious and cultural traditions that use elemental mercury. Blood and urine specimens will be collected from 400 children during their visits to participating neighborhood clinics. The study will provide information to the clinic patient community about mercury health effects and concerns. Parents of children with elevated mercury levels will be advised about reducing home mercury exposure, and offered an opportunity for another confirmatory test, medical follow-up, and an environmental assessment of the home.

Another collaborative project supports a comprehensive statewide Adult Tobacco Surveillance System that will increase capacity to evaluate tobacco control efforts, and evaluate the impact of New York State's new Clean Indoor Air Law that took effect in July 2003. Biomonitoring will provide quantitative exposure estimates through analysis of cotinine (a marker of tobacco smoke exposure) in saliva specimens collected from approximately 1,000 non-smokers throughout New York State. The component of the study will determine if saliva cotinine, and self-reported symptom and behavior variables will decline over time following the implementation of the state law banning smoking in bars and restaurants.

For many years now, residents of west Harlem have expressed concern about the effect of urban air pollution on the health of children in the community. Wadsworth Center has offered to collaborate with the Mailman School of Public Health at Columbia University and the community group West Harlem Environmental Action, to use biomonitoring to study traffic related exposures and their impact on respiratory health among adolescents in predominantly Latino or African American NYC neighborhoods. The pilot project may involve the analysis of PAH metabolites in urine specimens taken from a small subset of an overall cohort of 1,200 students.

OHIO

Ohio's economic base includes a number of heavy industries that generate hazardous wastes. These include steel mills, metal plating and machining facilities, manufacturing plants, chemical refineries, and chemical production facilities. As by-products these industries produce numerous hazardous metals and organic compounds, and these often find their way into the environment.

Ohio residents, particularly in the southwest and northeast portions of the state, are concerned about the public health threats these chemicals may pose to their communities. Hazardous waste sites adjacent to residential communities in Ohio are often blamed for real or perceived excess cases of cancer, reproductive failure, respiratory problems, and other ailments. Public health officials want to

address these concerns in a timely and scientific manner. It is often difficult to tie disease incidence in a community to an environmental exposure, but effective means of measuring exposure and the development of background levels of contaminants would help health officials address these concerns.

PENNSYLVANIA

Pennsylvania's first biomonitoring initiative focuses on screening children at high risk of exposure to lead based paint. It would involve expanding the Childhood Lead Poisoning Prevention Projects to include the cities of Altoona and Johnstown.

Pennsylvania also would like to determine whether levels of environmental chemicals are higher in the farm worker community. Specifically, the state would like to measure exposure to heavy metals, organophosphate and carbamate pesticides.

Additionally, the Pennsylvania Lab would like to determine whether or not children living in the vicinity of coal-fired power plants have an unusually high heavy metals body burden.

VIRGINIA

Virginia intends to test for selected metals. The state has 31 Superfund sites, at least three mercury polluted rivers, and the multiply polluted Elizabeth River. Agriculture makes widespread use of imported and domestically generated biosolids and arsenic contaminated chicken manure as fertilizer, and the state has significant mining activity. Implementation of the state's plan would create the ability to identify isolated areas or populations at risk from metal contamination. If abnormal results are found, the health department will do a follow-up investigation.

WISCONSIN

Taconite iron ore processing and fossil fuel combustion (coal-fired power plants account for 70% of the state's electricity) are major sources of airborne mercury. Airborne mercury eventually reaches the state's lakes, enters the food chain, and contaminates fish. Eating fish is the primary exposure to methyl mercury and is a potential source of exposure to PCBs, organochlorine hydrocarbons (OCs), and PBDEs. Wisconsin has issued statewide fish advisories to protect its residents–particularly children and pregnant or potentially pregnant women–from mercury exposure. The state would use biomonitoring to investigate the extent of human exposure to mercury.

Wisconsin is also a major agricultural state, pesticide use is common, and the state consumes over 5 million pounds of herbicides annually. Potatoes grown in Wisconsin usually are treated with fungicides, which may affect human health. Farm workers as well as rural residents who live or work near farm fields are concerned about aerial pesticide spraying, and about agricultural chemicals in their drinking water. The Wisconsin Public Health Lab would like to help address these community concerns by testing targeted populations for pesticide exposure.

THE POTENTIAL HEALTH EFFECTS OF CHEMICALS

Chemical	Common Sources of Chemicals	Human Exposures	Potential Health Effects
Arsenic	Arsenic is a naturally occurring element widely distributed in the earth's crust. Arsenic compounds are used to preserve wood and are used as pesticides. Arsenic cannot be destroyed in the environment; it can only change its form. Erosion of natural deposits; runoff from orchards, runoff from glass & electronics production wastes.	Eating food, drinking water, or breathing air containing arsenic. Breathing sawdust or burning smoke from wood treated with arsenic. Living in areas with high natural levels of arsenic in rock.	Inorganic arsenic is a human carcinogen. Sore throat or irritated lungs, nausea and vomiting, decreased production of red and white blood cells, abnormal heart rhythm, damage to blood vessels, and death. Some people who drink water containing arsenic in excess of the MCL over many years could experience skin damage or problems with their circulatory system, and may have an increased risk of getting cancer.
Lead	Lead is a naturally occurring bluish-gray metal found in small amounts in the earth's crust. Human activities include burning fossil fuels, mining, and manufacturing, the production of batteries, ammunition, metal products (solder and pipes), and devices to shield X-rays. Lead does not break down, can travel long distances by air, and usually sticks to soil particles.	Eating pieces of old paint that contained large amounts of lead. Eating food or drinking water that contains lead. Spending time in areas where lead-based paints have been used and are deteriorating. Working in a job where lead is used. Using health-care products or folk remedies that contain lead. Hobbies in which lead is used (for example, stained glass).	Central nervous system damage, kidney damage and reproductive system damage. A child who swallows large amounts of lead may develop blood anemia, severe stomachache, muscle weakness, and brain damage. Even at much lower levels of exposure, lead can affect a child's mental and physical growth. In pregnancy: premature births, smaller babies, decreased mental ability in the infant, learning difficulties, and reduced growth in young children.

Chemical	Common Sources of Chemicals	Human Exposures	Potential Health Effects
Mercury	Mercury is a naturally occurring metal. Mercury combines with carbon to make organic mercury compounds, like methylmercury, produced mainly by microscopic organisms in the water and soil. More mercury in the environment can increase the amounts of methylmercury that these small organisms make. Metallic mercury is used to produce chlorine gas and caustic soda, and is also used in thermometers, dental fillings, and batteries. Mercury salts are sometimes used in skin lightening creams and as antiseptic creams and ointments. Inorganic mercury (metallic mercury and inorganic mercury compounds) enters the air from mining ore deposits, burning coal and waste, and from manufacturing plants. Erosion of natural deposits; discharge from refineries and factories; runoff from landfills and croplands It enters the water or soil from natural deposits, disposal of wastes, and volcanic activity. Methylmercury builds up in the tissues of fish. Larger and older fish tend to have the highest levels of mercury.	Eating fish or shellfish contaminated with methylmercury. Breathing vapors in air from spills, incinerators, and industries that burn mercury-containing fuels. Release of mercury from dental work and medical treatments. Breathing contaminated workplace air or skin contact during use in the workplace (dental, health services, chemical, and other industries that use mercury).	Kidney damage. Nervous system damage. Methylmercury and metallic mercury vapors are more harmful than other forms, because more mercury in these forms reaches the brain. Exposure to high levels of metallic, inorganic, or organic mercury can permanently damage the brain, kidneys, and developing fetus. Effects on brain functioning may result in irritability, shyness, tremors, changes in vision or hearing, and memory problems. Short-term exposure to high levels of metallic mercury vapors may cause effects including lung damage, nausea, vomiting, diarrhea, increases in blood pressure or heart rate, skin rashes, and eye irritation. Very young children are more sensitive to mercury than adults. Mercury in the mother's body passes to the fetus and may accumulate there. It can also can pass to a nursing infant through breast milk. Mercury's harmful effects that may be passed from the mother to the fetus include brain damage, mental retardation, incoordination, blindness, seizures, and inability to speak. Children poisoned by mercury may develop problems of their nervous and digestive systems, and kidney damage.
Vinyl chloride	Vinyl chloride is a colorless, flammable gas. It is a manufactured substance that is used to make polyvinyl chloride (PVC). PVC is used to make a variety of plastic products, including pipes, wire and cable coatings, and the furniture and automobile upholstery. Vinyl chloride also results from the breakdown of other substances, such as trichloroethane, trichloroethylene, and tetrachloroethylene. Vinyl chloride is also known as chloroethene, chloroethylene, and ethylene monochloride. Vinyl chloride in the air can break down within a few days to other substances, some of which can be harmful. Small amounts of vinyl chloride can dissolve in water. Vinyl chloride formed from the breakdown of other chemicals can enter groundwater.	Breathing vinyl chloride that has been released from plastics industries, hazardous waste sites, and landfills. Breathing vinyl chloride in air or during contact with your skin or eyes in the workplace. Drinking water from contaminated wells.	Vinyl chloride exposure causes liver cancer. Breathing high levels of vinyl chloride can cause dizziness. Breathing extremely high levels can cause death. People who work with vinyl chloride have developed nerve damage and immune reactions. Sometimes, the bones in the tips of their fingers have broken down. People who breathe vinyl chloride for long periods of time can have changes to the structure of their livers.

Chemical	Common Sources of Chemicals	Human Exposures	Potential Health Effects
Polychlorinated Biphenyls (PCBs)	No known natural sources of PCBs. Manufacture of PCBs was stopped in the U.S. in 1977. PCBs entered the air, water, and soil during their manufacture, use, and disposal; from accidental spills and leaks during their transport; and from leaks or fires in products containing PCBs. PCBs can still be released to the environment from hazardous waste sites; illegal or improper disposal of industrial wastes and consumer products; leaks from old electrical transformers containing PCBs; and burning of some wastes in incinerators. PCBs do not readily break down in the environment and thus may remain in air and soil for long periods of time. PCBs are taken up by small organisms and fish in water. They are also taken up by other animals that eat these aquatic animals as food. PCBs accumulate in fish and marine mammals, reaching levels that may be many thousands of times higher than in water.	Eating food (especially fish or shellfish), drinking water, or breathing air contaminated with PCBs.	Skin conditions such as acne and rashes. Liver damage.
DDT, DDE, and DDD	DDT (dichlorodiphenyltrichloroethane) is a pesticide once widely used to control insects in agriculture and insects that carry diseases such as malaria. Banned in 1972 in the U.S. because of damage to wildlife, but still used in some countries. DDE (dichlorodiphenyldichloroethylene) and DDD (dichlorodiphenyldichloroethane) are chemicals similar to DDT that contaminate commercial DDT preparations. DDE has no commercial use. DDD was also used to kill pests, but its use has also been banned. One form of DDD has been used medically to treat cancer of the adrenal gland. DDT entered the environment when it was used as a pesticide; it still enters the environment due to current use in other countries. Sticks strongly to soil; builds up in plants and in fatty tissues of fish, birds, and other animals.	Eating contaminated imported foods from countries that still allow the use of DDT to control pests. Breathing contaminated air or drinking contaminated water or breathing or swallowing soil particles near waste sites and landfills that may contain higher levels of these chemicals. Infants fed on breast milk from mothers who have been exposed.	DDT affects the nervous system. A study in humans showed that women who had high amounts of a form of DDE in their breast milk were unable to breast feed their babies for as long as women who had little DDE in the breast milk. Another study in humans showed that women who had high amounts of DDE in breast milk had an increased chance of having premature babies.

Chemical	Common Sources of Chemicals	Human Exposures	Potential Health Effects
Trichloro-ethylene (TCE)	Trichloroethylene (TCE) is a nonflammable, colorless liquid, used mainly as a solvent to remove grease from metal parts. Also an ingredient in adhesives, paint removers, typewriter correction fluids, and spot removers. Not thought to occur naturally in the environment. However, it has been found in underground water sources and many surface waters as a result of the manufacture, use, and disposal of the chemical. Trichloroethylene dissolves a little in water, but it can remain in ground water for a long time. Trichloroethylene evaporates less easily from the soil than from surface water. It may stick to particles and remain for a long time. Trichloroethylene may stick to particles in water, which will cause it to eventually settle to the bottom sediment.	Breathing air in and around the home which has been contaminated with trichloroethylene vapors from shower water or household products such as spot removers and typewriter correction fluid. Drinking, swimming, or showering in water that has been contaminated with trichloroethylene. Contact with soil contaminated with trichloroethylene, such as near a hazardous waste site. Contact with the skin or breathing contaminated air while manufacturing trichloroethylene or using it at work to wash paint or grease from skin or equipment.	Breathing small amounts may cause headaches, lung irritation, dizziness, poor coordination, and difficulty concentrating. Breathing large amounts of trichloroethylene may cause impaired heart function, unconsciousness, and death. Breathing it for long periods may cause nerve, kidney, and liver damage. Drinking large amounts of trichloroethylene may cause nausea, liver damage, unconsciousness, impaired heart function, or death. Drinking small amounts of trichloroethylene for long periods may cause liver and kidney damage, impaired immune system function, and impaired fetal development in pregnant women, although the extent of some of these effects is not yet clear.

Sources:

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http://www.atsdr.cdc.gov/toxpro2.html#Final Toxicological Profile Information Sheet Accessed March 3, 2004

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