prevent introductions from region to region. Meanwhile, the international community has failed to prevent a stream of species from flowing around the world, with the exception of a 1951 agreement to prevent introductions of plant pests.

President Clinton's executive order creates a federal interagency Invasive Species Council whose members include the secretaries of state, treasury, defense, the interior, agriculture, commerce, and transportation, along with the administrator of the U.S. Environmental Protection Agency. The council will develop a comprehensive plan to minimize the economic, ecologic, and human health impacts of invasive species and determine additional steps to prevent their introduction and spread. An advisory committee will provide information for the council, including recommended actions at local, state, and regional levels. The management plan, due in July 2000, will review existing programs and authorities to control nonindigenous species and recommend measures that legislatures and health agencies should take. The council will also establish a study on exotics in federal territories and waters. The council also must find methods of establishing greater international cooperation to prevent species from the United States from invading other countries, while stopping invaders to this country at their sources overseas.

Simberloff is optimistic about the executive order, calling it a good start. The effectiveness of the initiative, he says, partly depends on congressional appropriations. President Clinton's budget for Fiscal Year 2000 proposes an increase of $28.8 million in funding to fight invasive species. Windle worries that the executive order will be too little too late, and that not enough money will be available for hiring new staff. "People who need [funding]," she says, "are poor, strapped state resource agencies."

The executive order itself is not specific on how the problems of invasive species will be solved. "The machinery it sets up could have a big influence" on slowing the spread of alien species throughout the United States, says Simberloff.

Have Virus, Will Travel

Outdated sewage treatment technology is failing to prevent groundwater and surface waters from being contaminated with human pathogens, according to Joan Rose, a water pollution microbiologist at the University of South Florida at St. Petersburg who studies the movement of waterborne human viruses. In a presentation at the annual meeting of the American

ehp net

Instructions for Breathing Easier

It is common for air pollutants to be 2–5 times more concentrated inside homes than outdoors, according to the U.S. Environmental Protection Agency (EPA), and sometimes indoor air can be over 100 times more polluted. For many people, the most unhealthy air they breathe all day is indoor air. And, because people may spend as much as 90% of their time indoors, many public health officials are warning people to take steps to reduce their exposure to indoor air pollutants. A 1998 presidential proclamation and the designation of October as Home Indoor Air Quality Awareness and Action Month have helped bring national attention to these issues.

Recently, public health workers from the EPA, the U.S. Department of Agriculture, state agencies, and academia allied themselves to spread information on indoor air pollution and how to avoid the health problems associated with it. The result of their efforts is the Healthy Indoor Air for America's Homes Web site, located at http://www.montana.edu/wwwcxair. The site provides information on the most common indoor air pollutants, how to detect and avoid them, and how to educate others about them.

The pollutants that lurk indoors can come from a wide variety of sources including combustion appliances, furnishings, household products, and pets. Because modern, energy-efficient buildings tend to be tightly sealed, with very little fresh air entering from outdoors, these pollutants can reach high levels inside.

Indoor pollutants can lead to a variety of health problems. The formaldehyde found in many sealants and in the adhesive of particleboard can leach into the air and cause fatigue, nausea, and asthma. Invisible radon gas found in bedrock and some building materials may cause lung cancer, while lead from deteriorating paint may hamper the mental development of children.

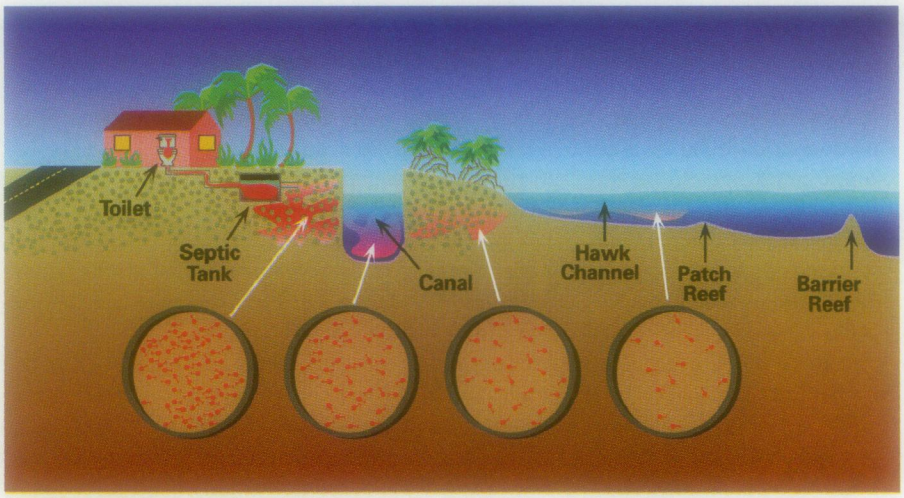
Healthy Indoor Air for America's Homes

Information on some of the most serious and widespread contaminants of indoor air, including those mentioned above, can be found on the Healthy Indoor Air home page. Available here are brief descriptions of the top 10 indoor air pollutants with links to more detailed fact sheets. The Signs link on the home page leads to a list of ways to tell if a home or office has air quality problems.

Besides providing information about pollutants, the site is also a resource for health care workers and concerned citizens who want to educate their neighbors about indoor air issues. Notes and materials for conducting a series of lectures on indoor air quality are available via the Trainer's Source link on the home page. Details about ordering other teaching materials, including a recently updated manual and video series, are also available here. For those who wish to spread information to the public through local media outlets, the site offers scripts for public service announcements, newspaper ads, and graphics.

The Web site is hosted by Montana State University. More information about the indoor air program and its administrators is available by following the Healthy Indoor Air for America's Homes link on the home page. The information available under this link includes a list of program managers located in each of the 50 states, the District of Columbia, and Puerto Rico who can be contacted by telephone or e-mail for help with indoor air problems.

Other Internet sites that address indoor air pollution are accessible by selecting Lots of Links on the home page. The EPA link takes visitors to that agency's indoor air quality site, where publications are available on additional topics such as how to minimize air quality problems when building a home and what to be aware of when selecting an air cleansing device. Information about the EPA's hotline, which gives people live access to indoor air quality experts, is also available on this site. Other external links take visitors to information about lead poisoning (supplied by the U.S. Department of Housing and Urban Development) and to Home*A*Syst, a University of Wisconsin site dealing with pollutants and health hazards in the home.



Chad Edmisten, University of South Florida at St. Petersburg

Speedy travels. Research from the University of South Florida at St. Petersburg shows that bacteria can travel quickly from septic tanks to coastal waters, where they can infect human swimmers and aquatic species.

Association for the Advancement of Science in January, Rose described her use of tracer organisms to follow the movement of pathogens from septic tanks and shallow injection wells (devices used to dispose of inadequately treated sewage in the Florida Keys).

The tracer is a bacteriophage, or virus that infects a specific bacterium. The tracer may be flushed down a toilet connected to a septic system or pumped into a shallow injection well. After the tracer virus is released, the researchers take water samples from the surrounding surface water and groundwater. The virus can be detected because water samples containing it kill target bacteria colonies. Polymerase chain reaction (PCR) is sometimes used to confirm the detection.

The highly specific tests show that viruses can migrate quickly in some circumstances. During heavy rains in the Keys, Rose and colleagues detected the tracer in coastal waters 12–24 hours after flushing it down a toilet. "Last year, we identified the presence of naturally occuring viruses one-half mile from shore in shellfish beds four hours after El Niño hit Florida," Rose says.

In the June 1997 issue of *Water Research*, Rose and colleague John Paul, also of the University of South Florida, reported studies of two injection wells (one 12 meters deep, the other 27 meters deep) in the Keys. Within eight hours, tracers placed in the wells were found in groundwater (which is not used for drinking in the Keys). Within 53 hours, they were found in the surrounding ocean waters at a maximum distance of 106 meters. The average rate of migration varied at different Keys study sites, reaching, for example, 19.6 miles per hour on Key Largo versus 1 mile per hour on the middle Keys site.

Rose also studies the presence of human viruses in marine waters. In a study published in a 1998 report of the Sarasota Bay National Estuary Program to the Florida State Health Department, Rose's group found enteric viruses—those that live in the human gastrointestinal system—in 90% of samples from canals and coastal waters in Sarasota. According to Rose, the more than 120 enteric viruses found in untreated wastewater can cause a wide variety of diseases, including diarrhea, paralysis, and conjunctivitis. In addition, hepatitis A virus, which causes severe liver disease, and coxsackievirus B, a cause of myocarditis (inflammation of the heart muscle), commonly appear in studies of marine waters, she says. Although the levels of viruses detected were low and thus the probability of illness was also low, Rose says, people can become ill from exposure to low levels.

The major source of this contamination is septic tanks, underground concrete containers that are meant to allow sewage to partially decay before releasing it to the environment. Florida has 1.6 million septic tanks, 80% of them in coastal areas. The tanks lack the aeration and decomposing organisms found at water treatment plants. Also, although septic tanks should be flushed periodically, this isn't always done. In addition, the porous limestone that is present in many of the Keys allows water containing fecal matter to travel rapidly, and Rose has found that the tides pump viruses in and out of subsurface rock as they raise and lower the water surface.

By measuring the movement of viruses, Rose has confirmed what many people have suspected. "The rapidity with which these organisms are moving is staggering," says Jay Grimes, a professor of microbiology and director of the Institute of Marine Sciences at the University of Southern Mississippi in Ocean Springs. "[Rose] has been one of the first to document and measure it," he says.

Although relatively few people actually become ill as a result of exposure, anyone who swims or otherwise comes in contact with contaminated water is at risk of being infected. And if the aquifer accepting the sewage is connected to the aquifer supplying an area's drinking water, pathogens can enter the drinking water supply.

The overall toll of the pathogens leaking from septic tanks is uncertain because few viral outbreaks are thoroughly investigated. The predominant route of infection is apparently through eating shellfish. S. E. Weingold reported in the September 1994 issue of the *Journal of Food Protection* that 40% of enteric viral outbreaks in New York can be traced to eating shellfish. Rose says most or all of these viruses probably originated in poorly treated sewage. The effects of enteric viruses are highly variable, but as more people are immunocompromised (by age or by diseases such as AIDS) and as coastal populations continue to increase, the toll of inadequate sewage treatment could also increase.

Despite gathering evidence of problems, Florida continues to issue permits for new septic systems. Rose says, however, that when the viral problem is documented, most people want it fixed. The best but most expensive fix is connecting homes and businesses to a sewage treatment plant, which drastically reduces the number of pathogens in the wastewater and sludge it produces. The problem, of course, is the price—the town of Sarasota calculated the cost of installing a new sewage system at $10,000 per household, but decided to go ahead with the new system anyway.

The research of Rose and others demonstrates a need to update the techniques used to detect sewage contamination in oceans, fresh water, groundwater, and drinking water systems. The century-old technique now in use measures nonpathogenic fecal coliform bacteria. Since these organisms originate in human feces, their presence in water has been presumed to indicate inadequate sewage treatment.

But experts say fecal coliforms do not always correspond with pathogen levels and that it's time to develop protocols for identifying microbes based on their DNA with, for example, PCR or DNA chips. Hospital laboratories, Grimes notes, "are doing rapid, direct molecular tests [for pathogens] with samples of blood and feces." Water, he says, is a much less complicated medium to test.