# Reaching across the Border with the SBRP

The border between Mexico and the United States is an artificial line dividing a geographical region that is otherwise ecologically, economically, and culturally integrated. Despite its artificiality, the border between Mexico and the United States strongly affects the way environmental and human health problems are addressed in the region where these two nations meet. Historically, relations between the United States and Mexico have been unbalanced, with the former controlling vastly more monetary resources and technical expertise than the latter. Although Mexico's environmental laws are comparable to those of the United States, they are less consistently enforced. Similarly, the United States has conducted environmental assessments in its border states, but this is yet to be done in the Mexican border states. These imbalances have made it difficult to identify and mitigate existing environmental health problems and prevent new ones from arising in the border zone.

Today, international initiatives to address such problems are expanding. Among these are outreach efforts as part of the NIEHS Superfund Basic Research Program (SBRP) to forge ties among researchers and policy makers in both countries. Efforts to strengthen Mexican environmental health expertise along the border are under way within SBRP programs at the University of Arizona (UA), Texas A&M University, and the University of California, San Diego. Although all three programs engage in cross-border projects and conduct basic research on contaminants of concern, the UA SBRP program emphasizes undergraduate, graduate, and community education as well.

## The Lay of the Land

The border region extends just over 60 miles each way north and south of the boundary line and stretches 2,000 miles from east to west. Four U.S. states (Arizona, California, New Mexico, and Texas) and six Mexican states (Baha, Chihuahua, Coahuila, Nuevo Leon, Sonora, and Tamaulipas) face each other across the invisible line. The region currently has a population of approximately 12 million, and the binational U.S.–Mexico Border Health Commission estimates that number will double by 2025. The border zone has numerous environmental health problems, and these are expected to worsen as its population increases.

Arsenic occurs naturally in groundwater throughout the desert region, increasing the risk of diabetes mellitus, reproductive disorders, and bladder, skin, and lung cancers. Mine tailings—some 300,000 acres' worth in Arizona alone, according to A. Jay Gandolfi, a professor in the UA College of Pharmacy and Toxicology—leach metals including lead and mercury into surface waters. As a result, residents are threatened with anemia, convulsions, and learning and motor disabilities in the case of lead, and central nervous system damage (including tremors and confusion) and behavior and memory problems in the case of mercury.

In the border zone, agricultural workers are exposed to pesticides such as paraquat, atrazine, and 2,4-D through cultivation of apples, nuts, cotton, wheat, and other crops. Pesticides also contaminate water sources. According to the Pesticide Action Network North America, paraquat can cause pulmonary edema, kidney damage, and coma; atrazine, while not acutely toxic, may be an endocrine disruptor; and 2,4-D can trigger abdominal pain, nausea, skin and eye redness, and loss of consciousness, among other effects.

**Collaborative energy.** Mariano E. Cebrián Garcia (top), Dean E. Carter (bottom), and A. Jay Gandolfi (not pictured) are the driving forces behind the newly established U.S./Mexico Binational Center for Environmental Studies.

A. Jay Gandolfi

With increases in trade spurred by the North American Free Trade Act (NAFTA) has come more transboundary vehicle traffic—and waits of sometimes several hours at checkpoints. People waiting at these checkpoints are exposed to internal combustion products from idling engines, such as polycyclic aromatic hydrocarbons, which can retard growth and intelligence, induce cancer, and disrupt endocrine function.

NAFTA has also encouraged the growth of more than 3,000 factories (*maquiladoras*) along the border, which manufacture everything from pharmaceuticals to leather products to cell phones. These factories may use or generate hazardous materials such as solvents and heavy metals. Under NAFTA, U.S. companies are required to transport their hazardous waste back to the United States for disposal. Mexico's National Institute of Ecology estimates that a million tons of hazardous waste cross the border every year. This large-scale passage of hazardous waste is "not a minor problem," says Gandolfi.

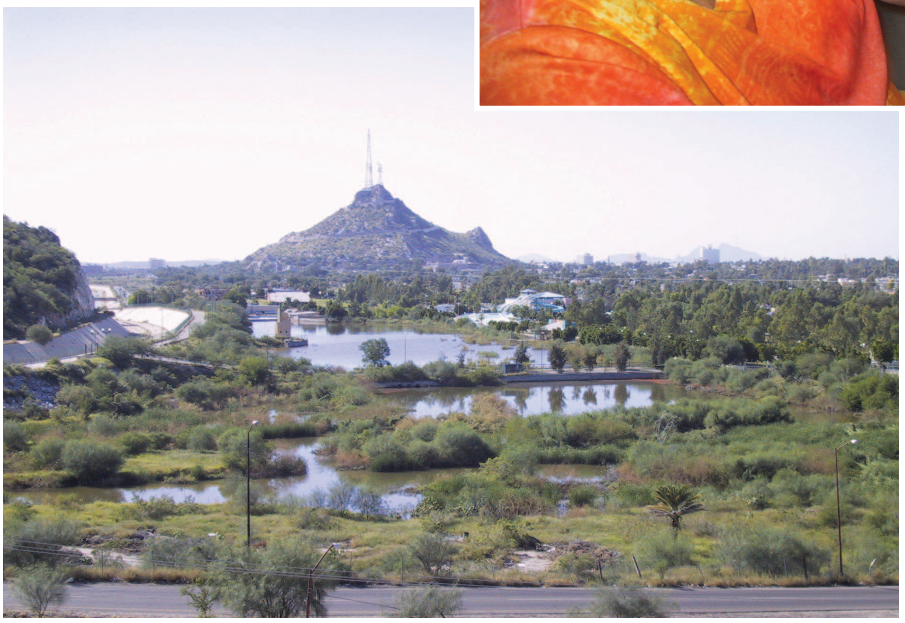
## Bolstering Education

The UA SBRP program's outreach to Mexico is "an 'overnight success' that has taken ten years," says William Suk, director of the NIEHS SBRP. Two aspects of the outreach effort are crucial, Suk says. "One is the synergy of the research infrastructure on both sides of the border. The other is the clear realization on the part of policy makers on both sides of the border that these are real health and environmental issues that bear a direct impact on the well-being of their citizens."

At the UA College of Pharmacy and Toxicology, Gandolfi and professor Dean Carter have spent the last decade developing the U.S./Mexico Binational Center for Environmental Studies (BCES) in collaboration with their Mexican colleague, toxicologist Mariano E. Cebrián Garcia of the Center for Research and Advanced Studies at the National Polytechnic Institute in Mexico City. UA recently signed a memorandum of understanding with the Mexican Ministry of Science and Technology to establish the BCES. The center will expand existing efforts to train

Mexican researchers, assist in technology transfer, conduct collaborative research, and help border communities apply that research to improve environmental health within the border region.

In all, UA has been working on binational environmental health issues for nearly two decades, guided by Carter, the outgoing director of the UA SBRP program. With support from the NIEHS, the UA program has trained numerous Mexican toxicology students and conducted toxicology and risk assessment workshops in Mexico for Mexican officials and technical experts. Carter's group has also developed a website (**http://superfund.pharmacy.arizona.edu/outreach.html**) featuring a downloadable basic environmental toxicology textbook written in Spanish. The textbook averages 40,000 hits per month, according to Gandolfi. Two more online Spanish-language textbooks are in development, one on risk assessment and the other on remediation techniques. The website, says Carter, "is really a whopping success" and is being used not only by the Mexican environmental health community, but also by similar communities throughout Latin America.



**Managing metals.** Water contaminated with metals is a priority environmental health issue in the border region, where potable water is often scarce. Cooperative studies of exposed populations by the UA SBRP and Mexican scientists have increased environmental health infrastructure and awareness of this issue in border states.

A. Jay Gandolfi

The Mexican federal government supports capacity building in the environmental sciences, according to Cebrián. Academics and policy makers are working hard to strengthen degree programs in toxicology and environmental health, both by enhancing courses within Mexican universities and by sending students to the UA program. The Mexican effort includes acquiring the latest biomedical and remediation technology to entice graduates trained in the United States to return to Mexico.

Cebrián also anticipates adding environmental studies and "green" technologies to Mexican engineering curricula and expanding environmental studies at universities in the border states. At present, many environmental studies programs are located in Mexico City and southern states, far from the border, which many Mexicans call the "frontier," emphasizing its distance from the nation's academic and political resources.

## A Strong Footing to Solve Problems

Given the imbalances between the countries, it would be easy for the United States to act toward Mexico as if "we're your friendly neighbors to the north, and we know what's best," as Suk puts it. But the SBRP and BCES have stressed all along that "both sides have an equal footing," Suk says. As a result of this footing, Gandolfi says, UA was recently awarded a three-year U.S.–Mexico Training, Internship, Exchanges, and Scholarship grant from the U.S. Agency for International Development, which involves multiple colleges at UA associated with the SBRP as well as eight universities and institutes in Mexico. Gandolfi says, "This is the start of support from multiple sources to address our common environmental problems."

Carter credits the NIEHS for its strong support of the BCES and emphasizes that environmental health along the border "is a long-term problem and requires a long-term solution." The border's not going to get any smaller, says Carter—but neither is the commitment to identify, study, and mitigate threats to environmental health along that invisible, but very real, line. **–Valerie J. Brown**

beyond the BENCH

# Health Lessons from Reality TV

*EnviroMysteries: Breaking the Mold* is the creation of a partnership between Maryland Public Television and the Community Outreach and Education Program of the Environmental Health Sciences Center at the Johns Hopkins Bloomberg School of Public Health that brings together two strong assets: cutting-edge environmental health knowledge and educational creativity. The result is a quality, award-winning video and accompanying educational website that teach high school students about the impact of indoor air pollution on human health.

Targeted to 5th- through 9th-grade students, the 30-minute video teaches viewers about mold exposure, asthma, and scientific inquiry. It tells the story of a young girl, Kee, who captures a spot on *Realville*, a reality TV show where she lives with several housemates. Among these are Dara, who takes long showers, splashes water everywhere, and even uses Kee's towels. After experiencing a serious asthma attack during her stint on *Realville*, Kee becomes motivated to learn more about asthma and its possible links to environmental exposures. As she learns more, she eventually tracks down the trigger for her attack: *Stachybotrys* mold growing behind the bathroom walls in the *Realville* house. By following Kee's experience, viewers learn about asthma, its environmental triggers, and how to reduce or prevent exposures to those triggers.

The video is accompanied by a website at **http://enviromysteries.thinkport.org/breakingthemold/**, where teachers will find educational resources including lesson plans based on national curriculum standards, a list of suggested reference books, a directory of pertinent websites, and a glossary of respiratory health terms. The site also provides discussion points to help teachers engage students as they watch the video. Together, the video, educational resources, and classroom activities empower students to assume an active role in investigating environmental issues that can affect their health today and in the future. **–Liam R. O'Fallon**

## Headliners | Breast Cancer

NIEHS-Supported Research

### Estrogen Suppression by Compounds Found in Red Wine and Grape Seeds

Eng ET, Ye J, Williams D, Phung S, Moore RE, Young MK, Gruntmanis U, Braunstein G, Chen S. 2003. Suppression of estrogen biosynthesis by procyanidin dimers in red wine and grape seeds. Cancer Res 63:8516–8522.

Many epidemiologic studies have shown that eating a diet high in fruits and vegetables is associated with reduced cancer incidence, with multiple studies focusing on wine and grape consumption. In this study, NIH grantees including first author Elizabeth T. Eng of the Beckman Research Institute of the City of Hope have identified a class of compounds called procyanidin B dimers as the most abundant aromatase inhibitors in red wine, suggesting that these compounds may be responsible for red wine's observed chemopreventive effect against breast cancer.

Other studies have shown that the production of estrogens in breast cancer tissue plays a major role in tumor progression—approximately 75% of postmenopausal patients have estrogen-dependent cancers. Aromatase, a P450 enzyme, synthesizes estrogen by converting androgen substrates into estrogens. Aromatase is highly expressed in breast cancer tissue, and suppression of *in situ* estrogen formation by aromatase inhibitors is considered a viable means of preventing and treating breast cancer in postmenopausal women. Previous research from this and other laboratories has shown that extracts from red wine inhibit aromatase activity.

High concentrations of procyanidin B dimers had already been found in grape seeds. Eng and colleagues found, through laboratory analyses, that the most potent procyanidin B dimer competed with the androgen substrate for binding with aromatase. Additional *in vitro* studies showed that the dimers were able to reduce androgen-dependent tumor growth, indicating that these chemicals reduce the production of estrogens from the androgen substrates.

This study, and earlier work by the same team, demonstrates that procyanidin B dimers in red wine could be used as chemopreventive agents against breast cancer by inhibiting the conversion of androgens to estrogens in breast tissue. The researchers estimate that a single four-ounce glass of red wine daily could provide enough procyanidin B dimers to inhibit aromatase activity in the average postmenopausal woman. **–Jerry Phelps**

Left to right: Maryland Public Television; Digital Vision