Pteris vittata, a species of brake fern

BOTANY

Arsenic-Eating Fern

The plant's genes hint at ways to clean up soil and water

Arsenic-contaminated groundwater and soil affect millions of people worldwide; the substance can cause skin lesions, cancer and other illnesses if it gets into drinking water and crops. But the Chinese brake fern, *Pteris vittata,* naturally accumulates arsenic levels that would kill most other organisms—and somehow it continues to thrive. The mechanism behind this tolerance has long been a biochemical puzzle.

Now plant researchers Jody Banks and Chao Cai, both at Purdue University, and their colleagues have explained how it happens. By splicing the fern's genes into other plants, Banks says, bioengineers might one day harness its abilities to help clean up contaminated areas.

Banks had noticed that three of the fern's genes become more active when it encounters arsenic. To test whether they are behind its tolerance, she used a common biological technique to turn each gene "off" in several samples—which died when exposed to the poison. Then she and her team used a microscope to track the proteins these genes encode in the species, reconstructing how the proteins work together to collect and neutralize arsenic as it moves through the plant's fronds.

One of the proteins, GAPC1, is found in many organisms and uses phosphate to help break down sugars for energy. Arsenate, the form of arsenic found in soil, is toxic because it replaces phosphate in this process, blocking energy production. But in the fern, GAPC1 has a slightly different structure that allows it to chemically bind arsenate. Another protein called OCT4, encoded by one of the other genes, helps to shuttle the trapped arsenate across membranes into tiny structures called vesicles within the cell. Inside the vesicles the protein GST—encoded by the third gene—transforms arsenate into a form called arsenite. The vesicles transfer this compound to parts of the plant where it safely accumulates as a defense against hungry insects, the researchers found. Their study was published in May in *Current Biology.*

In 2016 biochemist Barry Rosen of Florida International University, who was not involved in the new study, identified a process for trapping and neutralizing the poison in an arsenic-tolerant bacterial species, *Pseudomonas aeruginosa,* that used nearly identical genes. Whereas the fern traps arsenite in specialized cells, the bacteria pump it back out into the environment. "Demonstrating that this very novel mechanism applies to plants as well as bacteria," Rosen says, "shows that organisms have evolved a way to get around the major way that arsenate is toxic." —*Rachel Berkowitz*

PUBLIC HEALTH

Mapping HIV

Toward a more localized picture of the virus's prevalence in Africa

HIV/AIDS is a primary cause of death in sub-Saharan Africa. It is no longer always a death sentence, thanks to lifelong antiretroviral therapy, but getting treatment to patients is a challenge. Now researchers have conducted one of the most geographically specific analyses to date of HIV prevalence in 47 sub-Saharan countries. The study could help authorities better target treatment and prevention efforts.

"We hope that it will be useful to people on the ground who are in one particular area and add to what they already know about their community," says lead author Laura Dwyer-Lindgren, an assistant professor of health metrics sciences at the University of Washington. "We also hope it will be useful more centrally, at the country level, for figuring out places where the number of people in need is not matched by the resources."

Dwyer-Lindgren and her colleagues created a database of HIV prevalence based on population surveys and data gathered from clinics where women are seeking prenatal care. They used these data to estimate the proportion of people (aged 15 to 49) with HIV from 2000 to 2017 in five- by five-kilometer geographical grids (*maps*), as well as the number of people living with the virus.

HIV prevalence varied widely from region to region—for example, from 15 percent in Botswana's Ghanzi district to 28 percent in its North-East district in 2017. Prevalence also decreased in some areas, such as Mozambique's Manica district, and increased in others, including its Guijá district.

Having this level of statistical granularity is useful for directing treatment and prevention. "It's a really neat study in that it has synthesized the data over the years that we've been trying to grapple with," says Ayesha Kharsany, a senior scientist at the Center for the AIDS Program of Research in South Africa (CAPRISA), who was not involved in the new work. "We've been very successful making sure that people go on to treatment," she says, but "we need

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