OREGON STATE UNIVERSITY AGRICULTURAL EXPERIMENT STATION

OREGON'S AGRICULTURAL PROGRESS

Taste Tests

also:

Digging Soil
Top Seed
Zumwalt Prairie
Ethanol Economics
Space Tools on Earth

OREGON'S AGRICULTURAL PROGRESS

WINTER 2009, VOL. 55, NO.1, OREGON STATE UNIVERSITY

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Cover photo: Sensory testing at the Food Innovation Center, by Lynn Ketchum.
Contents photo: Old man's whiskers, by Lynn Ketchum.
Back cover photo: Zumwalt Prairie, by Lynn Ketchum

Oregon's Agricultural Progress is published by the Oregon Agricultural Experiment Station (Bill Boggess, interim director). Send comments or questions to the editor, Extension and Experiment Station Communications, OSU, 422 Kerr Administration Building, Corvallis, OR 97331-2119. Written material may be reprinted provided no endorsement of a commercial product is stated or implied. Please credit *Oregon's Agricultural Progress,* Oregon State University. To simplify terminology, trade names of products or equipment sometimes are used. No endorsement is intended nor is criticism implied of products not mentioned.

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Private funds, provided by the Agricultural Research Foundation, help pay for color reproduction in *Oregon's Agricultural Progress*.

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The life of food begins as a seed in soil and ends as nourishment on our plates. In between, there's a big story.

In this issue of Oregon's Agricultural Progress, we look at where food begins, in soil and seeds. We meet the scientists who find their passion in studying the soil beneath our feet. We celebrate 100 years of seed research that has made Oregon seed certifiably among the best in the world.

And we witness the moment when food arrives on our taste buds, observed by scientists who can tell us what we like to eat—and why.

Food is a big story. It is a big industry in the state and an essential (and delightful) part of life in Oregon. These stories of seeds, soil, and savor preview a larger exploration of Food in Oregon that we will continue in our next issue.

We also head east, to the Zumwalt Prairie, where cattle and conservation work together; and to the John Day River, where tools designed for space exploration take the pulse of earthbound watersheds.

In many ways and in many places, agricultural research makes life better in Oregon.

Peg Herring

New method pinpoints meth hot spots

Public health officials have a new tool for fighting methamphetamines.

"There are a lot of people analyzing the issue of methamphetamine, but they do it from different angles," said OSU toxicologist and physician Daniel Sudakin. "Some focus on health problems, others focus on hazardous chemical releases from meth labs."

Sudakin used statistics from four sources to identify counties with the most meth-linked incidents per capita, a new approach toward studying a significant public health concern.

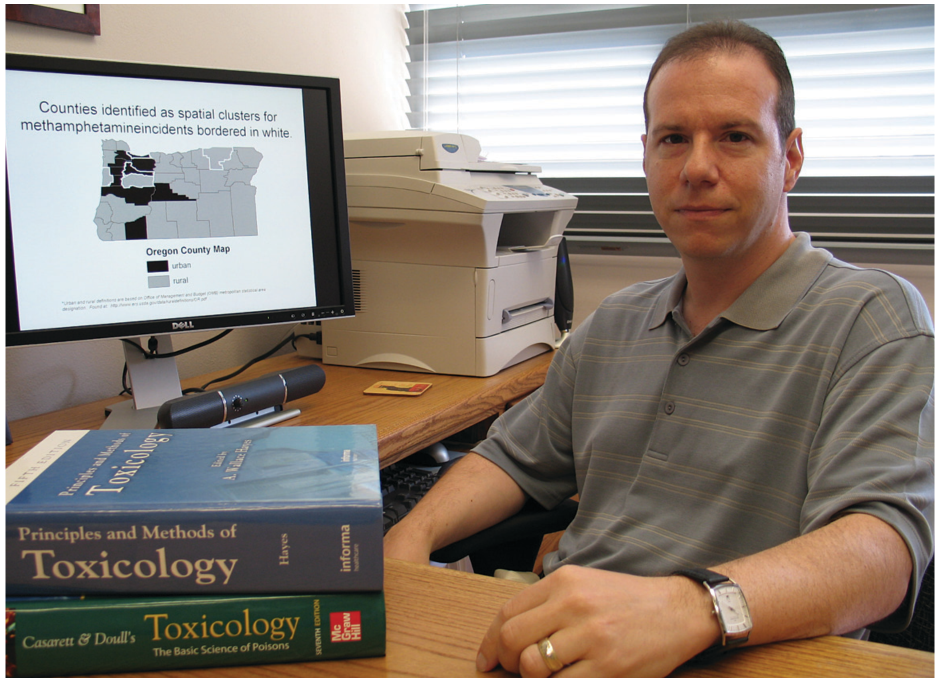
"This method gives us a bigger picture of what's going on across the state," Sudakin said. "It also includes rural areas, which tend not to be studied as much as urban areas in terms of meth use and production."

The study gathered countywide data on 2,570 meth-related incidents documented from 1998 to 2007 by the Oregon Poison Center, the Oregon Narcotics Enforcement Association, the Oregon State Police's Medical Examiner Division, and the Oregon Public Health Division's Hazardous Substances Emergency Events Surveillance System.

The data included deaths connected with the stimulant; the discovery of places where meth was made; the release of dangerous fumes and chemicals from these "labs"; the accidental ingestion of toxic chemicals used to make the addictive drug; the haphazard dumping of waste from the labs; and calls to the Oregon Poison Center regarding overdoses and other meth-related concerns. (The study, however, didn't include crime-related data like arrests for possession of meth.) Sudakin then analyzed the data using software that epidemiologists use to map the spread of diseases.

The analysis found that on a per-capita basis, these problems were most common in sparsely populated, rural Umatilla County when compared with other counties and the state overall. After Umatilla, Sudakin's study identified Multnomah, Marion, Linn, and Lincoln counties as having significant meth-related problems per capita.

Sudakin's study found that meth labs in Oregon have decreased since 2006, when Oregon became the first state in the country to require a prescription to obtain cold medicines containing pseudoephedrine, which is used to make meth. ■



TIFFANY WOODS

Daniel Sudakin oversees the National Pesticide Medical Monitoring Program and the National Pesticide Information Center, cooperative agreements between Oregon State University and the U.S. Environmental Protection Agency.

LYNN KETCHUM

Turning a cancer bodyguard into a Cancer Killer

TOM WEEKS

If you're a cancer cell, you want a protein called Bcl-2 on your side because it decides if you live or die. It's usually a trusted bodyguard, protecting cancer cells and allowing them to grow and form tumors. But sometimes it turns into a cancer cell's assassin.

Scientists knew it happened, but they didn't know how to prompt such a betrayal. Now they do.

"Now we can force this protein to backstab the cancer cell where it

Isolated white oak trees provide critical habitat in farm fields

The magnificent white oak trees that stand alone in farmers' fields may provide a critical resource to a wide range of bird species in the Willamette Valley.

Craig DeMars, an Oregon State University graduate student in fisheries and wildlife, found that large, isolated white oak trees, hundreds of years old, act as "habitat magnets," concentrating tree-dependent bird species.

DeMars compared bird use of oaks in agricultural lands to use in reserve areas. He found that as many as 47 species of birds use the isolated white oaks to perch, feed, sing, and nest, both on and off reserves. The larger the trees, the more kinds of birds used them, especially where trees were sparse in the surrounding landscape.

The Willamette Valley's white oak savanna habitat is only about one percent of what it was 200 years ago, said DeMars, who bases the number on old photos and journals. "For birds associated with oak savanna habitats, a single isolated tree in an agricultural field may be a critical resource for nesting, safe refuge, and foraging as well as providing a high perch for singing."

As he drove back roads to find old, so-called *legacy* white oaks to study, DeMars was worried about how landowners would react to a biologist asking to come onto their land to study birds. He found most were "quite interested," he said; only one said no.

DeMars found that most landowners treasured the trees for their beauty and longevity; these trees have become part of life on many farms. "I grew up with that tree," one farmer told DeMars. ■

resides," said Siva Kolluri, a cancer biology researcher in the environmental and molecular toxicology department at OSU. With colleagues at the Burnham Institute for Medical Research and elsewhere, Kolluri has developed a peptide that converts the Bcl-2 protein from a cancer cell's friend to its foe.

The findings could lead to the development of cancer-fighting drugs that target Bcl-2, Kolluri said. Bcl-2 is an attractive drug target because its levels are elevated in a majority of human cancers and it is responsible for cancer cells' resistance to many chemotherapeutic drugs and radiation.

Linda Wolff, a leukemia researcher at the National Institutes of Health's Center for Cancer Research, said the researchers' discovery is "rare" in the world of cancer research. She added that it's important for two reasons.

"First, it may lead to a therapy that could potentially be used against many types of cancer," she said. "Because it targets Bcl-2, and Bcl-2 is expressed in many types of cancers, it could be useful in breast cancer and other carcinomas and leukemia, for example. The second reason it's important is that although the peptide they studied causes cancer cells to die, its effect on normal cells seems to be quite minimal. A big problem in cancer research has been getting therapies that don't kill normal cells." ■

Natural beauty trumps remoteness for rural communities

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Remoteness is the main cause of disparities between communities that flourish and those that do not, according to agricultural economists at Oregon State University. The greater the distance between a community and its closest urban neighbor, the less likely it is to prosper.

But the enhancement of natural amenities—a lake for boating or greenways for hiking—can tip the scales in favor of a remote community. According to economists JunJie Wu and Munisamy Gopinath, the physical characteristics that make a location a nice place to live can offset the degree to which remoteness matters in terms of attracting new households and enticing businesses to locate in rural areas.

In the past, economic sustainability was linked to physical services (such as transportation, water, sewer, power, sanitation, communication) and social services (such as education, available technology, and health care). Add the knowledge and skill in a community's population and you get what Wu calls "accumulated capital." When these factors were favorable, wages were supposed to be high, housing was affordable, most people were employed, and communities thrived. Or so it was thought.

Yet "it's hard to tell sometimes why some communities do so well while others suffer," said Wu.

Wu and Gopinath found that about 80 percent of the variations between thriving and failing communities is accounted for by the degree of remoteness. Nonetheless, natural amenities turn out to have a positive effect on wages, employment, and housing prices.

This has implications for the design of policies to promote economic development in rural communities, the researchers say.

Nationwide, the communities where wages are lowest are mostly in remote areas. The models developed by Wu and Gopinath can be used to highlight ways that public investments can enhance accumulated capital in these areas, and thus entice businesses to locate there.

As information technology advances, the U.S. population is becoming more footloose, and communities that are rich in natural amenities are becoming more attractive to many people. In turn, communities with knowledgeable, skilled work forces are attractive to new businesses, and towns with high-valued amenities are among the fastest growing in terms of population and income.

Public policies that support ecological conservation and environmental protection can contribute to economic sustainability if they enhance high-valued natural amenities. Used in this light, the research can augment the development of policies that are good for both the environment and rural communities. ■

Tending to the growth of farmers' markets

Farmers' markets continue to grow in popularity in communities across Oregon. But just like the fruits and vegetables on display, these markets require careful planning and tending.

OSU researchers polled 53 Oregon farmers' market organizers to learn how they manage their markets. Organizers of successful farmers' markets are those who plan ahead for future growth, explained Garry Stephenson, an OSU Extension small farms specialist and one of the authors of the study.

"Keeping farmers' markets open and operating efficiently is important both for the farmers that sell at these markets and the communities these markets serve," said Stephenson.

Stephenson and his colleagues found that markets of different sizes use different management tools. Small markets anticipating growing into a medium-sized market should be prepared to add a salaried manager, rather than a volunteer, to handle market operations. Medium markets might add site maps or boards of directors as they grow. Larger markets might add paid staff to manage budgets and operations.

The report, "Understanding the Link Between Farmers' Market Size and Management Organization" (SR 1082-E) is available online at no charge. ■

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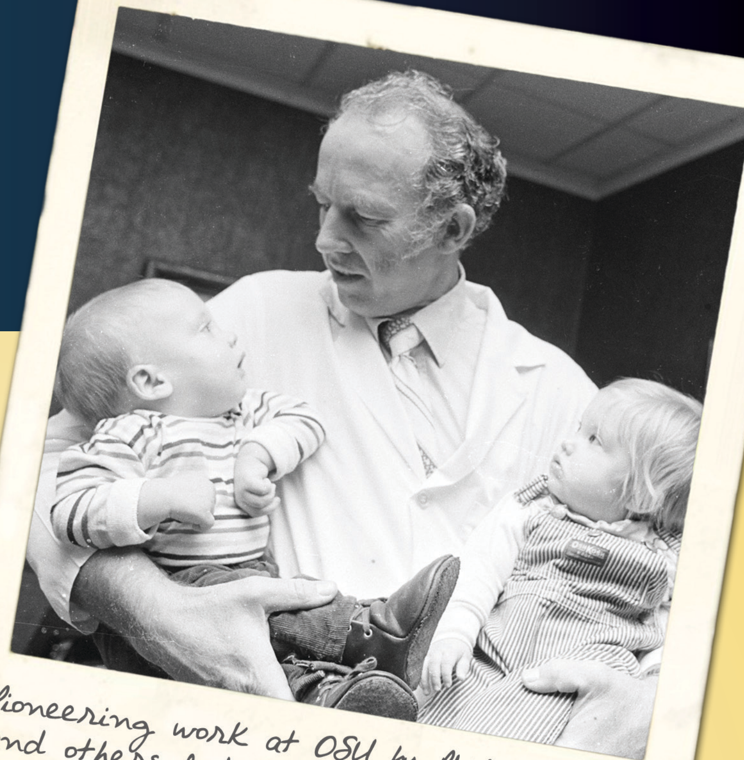
Studying Selenium

How generations of OSU scientists have helped make lives healthier.



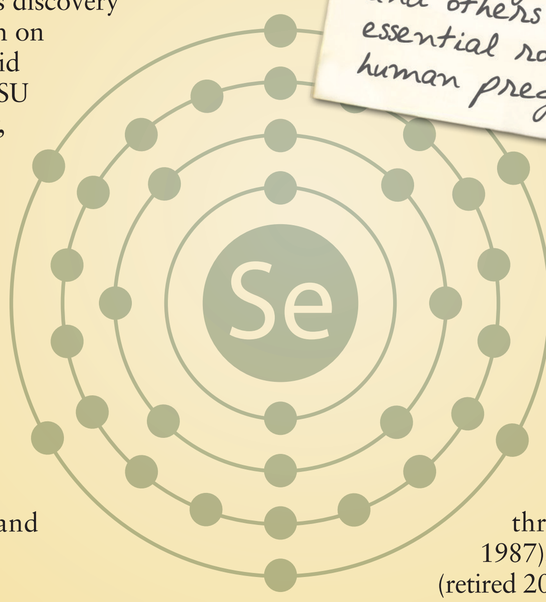
Pioneering work at OSU by Phil Whanger and others led to understanding the essential role of selenium in healthy human pregnancies.

DAVE KING

Fifty years ago, ranchers in central Oregon were losing livestock to white muscle disease. OSU animal scientist Jim Oldfield wanted to know why.

The disease is characterized by calcified muscle lesions that appear in newborn calves and sheep, causing heart failure and death. Oldfield planned a study to see if vitamin E supplementation might help. At the last minute, he decided to test selenium too.

The selenium worked; the vitamin E didn't. Oldfield's results were a breakthrough. "This discovery initiated a large volume of research on selenium that continues today," said Phil Whanger, a recently retired OSU professor of agricultural chemistry, and part of a dynasty of OSU scientists studying selenium.



Much of Whanger's research focused on one of the important antioxidant enzymes that require selenium for activity. White muscle disease results when cattle and sheep have diets deficient in selenium and aren't able to make enough of these enzymes in their cardiac and skeletal muscle. Whanger's work led to studies of pregnant women and the role of selenium in healthy human births.

Animals get selenium from the plants they eat; plants get selenium from the soil. Most of Oregon's soils are selenium deficient, according to Wayne Mosher, who worked for more than 30 years in Douglas County as an OSU Extension livestock agent. "We found that selenium supplementation can create a huge difference for ranchers," he said. For example "on the Warm Springs Reservation, one rancher's calf crop was only about 40%. Another rancher who was supplementing with selenium and minerals had more like 100%."

Jean Hall, an associate professor at OSU's College of Veterinary Medicine, is the next generation of selenium researchers. She's studying selenium as an immunonutrient in sheep, to find out if supplementing above the currently recommended levels can boost their natural immunity (in this case, their resistance to foot rot), and if organic selenium is better absorbed than inorganic selenium.

Hall is in frequent contact with all three professors emeritus—Oldfield (retired 1987), Mosher (retired 1979), and Whanger (retired 2001)—who continue to participate in current research efforts. "They may be retired, but they still contribute so much."

There is a strong positive correlation between selenium supplementation and cancer prevention in humans—especially prostate cancer. There is also an increasing body of evidence suggesting that selenium can regulate thyroid function and improve immune function, both in livestock and in humans.

Mosher and Whanger are believers. Whanger takes selenium supplements and Mosher credits selenium for his good health. And then there's Jim Oldfield, who, at age 87, still keeps regular office hours in the Animal Science Department and invites science writers to coffee. ■

by Megan McKenzie

Taste of the

ALL PHOTOS LYNN KETCHUM

The kids at Clark-at-Binnsmead Elementary School are wide-eyed with anticipation. They've assembled in the school's cafeteria to lend their expert opinion to the question of school lunch. In particular, the grown-ups in charge want to know which the kids prefer: hamburgers made from local Northwest-grown natural beef or pre-cooked standard-issue USDA patties.

Town

Sensory testing reveals what we like to eat, and why.

by Peg Herring

Ann Colonna, who runs Oregon State University's Sensory Science Program at the Food Innovation Center, is conducting the taste test. Colonna works with food industries from throughout the U.S. to test new products with consumers. On any given day, she might be testing products from baby food to wine with consumers who range from busy families to high-end gourmands. For this test, her target consumers are 9- to 11-year-olds in an elementary school cafeteria. Weeks earlier, she tested another group of school-age kids to determine if they could tell the difference between the two kinds of burgers. "They can *definitely* tell the difference," she said. "So, this test will see which burger they prefer."

In the adjoining kitchen, Cory Schreiber pulls a large tray of baked burger patties from the school's oversized oven. Baking pre-packaged burgers was not in Schreiber's repertoire at his Wildwood Restaurant, where he worked as one of Portland's premiere chefs and led Oregon's local food movement. Now he works for the Oregon Department of Agriculture and leads their Farm-to-School Program, getting fresh local food into Oregon school lunch programs.

He loads each patty onto identical buns (no ketchup, mustard, pickles, or onions) then cuts the burgers into quarters and places each sample on a paper plate labeled with a random number code. Half are local beef with a sprinkle of salt, the other half are USDA school-lunch commodity beef with added flavors and color. Only Colonna and Schreiber know which is which.

Ann Colonna manages sensory testing at the Food Innovation Center, where she helps food companies test their products with discriminating consumers. Megan Aul (below right and on the cover) assists with the tests in the FIC test kitchen.

ALL PHOTOS LYNN KETCHUM

Meanwhile, Colonna prepares the testers. "You think you like some food because you like the ads for that food. But what if you get the chance to compare that food with other food just like it—and you don't know which is which? You might be surprised by which one you really like best."

Schreiber enters the cafeteria with a tray full of samples and distributes two numbered plates to each of the eager testers. "We want to know which one you like best, and why." Then he sticks out his tongue. "This," he explains, "is what you'll use to decide what you like."

The kids take their job seriously. Prompted by Colonna and Schreiber, they examine the burgers, sniff them, lick them, and nibble a bit off each one, back and forth, contemplating the taste and texture of each sample, and recording their responses on a paper ballot. When it comes time for each tester to vote for his or her preferred burger, Colonna notes some peeking at next-door-neighbor responses.

"The tests we conduct at the lab are far more controlled," she said, referring to the state-of-the-science facilities at the Food Innovation Center in Portland's Pearl District.

"We design people-oriented tests and our clients use the results to create people-oriented products."

There's 1,001 ways to make surimi. Taste tests reveal which is preferred by a variety of consumers, valuable information for the new and growing Oregon surimi industry.

That's where Colonna tests products against some of the most discriminating tasters anywhere: Oregonians.

Surrounded by some of the finest food produced in the world—wine, seafood, fresh fruits, and meats—Oregonians know good food. And Portland is the beating heart of the local food movement in Oregon.

"Portland is a great place for testing new food products," said Michael Morrissey, the director of the Food Innovation Center. "There's a large population here representing many different groups with varied tastes; it's a gathering place for alternative food systems and people who pay attention to the food they eat."

The Food Innovation Center is the first urban agricultural experiment station in the United States. A partnership between OSU and ODA, the center was created in 2000 to enhance the profitability of Pacific Northwest food industries. It began by helping small-scale start-up companies find success through innovation and entrepreneurship. More recently, larger, established Oregon food manufacturers have come to the Food Innovation Center for help with product development, sensory testing, packaging design, and marketing.

The food industry is highly competitive. Profits are made or lost depending on consumer response to subtle differences in products and marketing. Sensory science provides an objective, experimental approach to measure consumer response towards particular products before they go to market, providing real-life data that industries can use to guide their product development and marketing decisions.

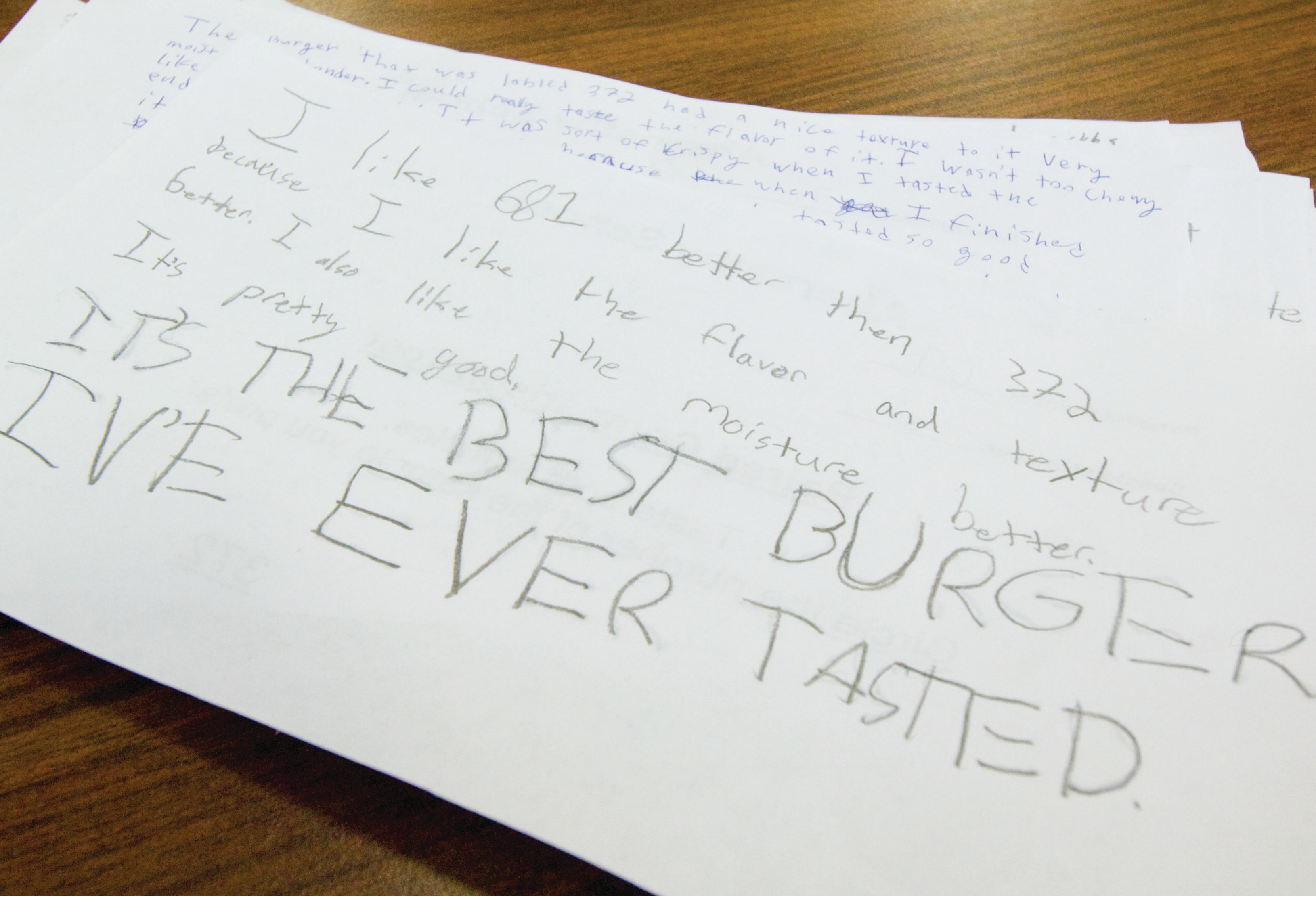
"We design people-oriented tests, and our clients use the results to create people-oriented products," explained Colonna. If the subject is surimi, Colonna will find out exactly who, why, when, where, and how much people like to eat surimi, using all the appropriate scientific measures and controls. In almost all cases, sensory testing is done

Random numbers and uniform samples help standardize sensory testing. Most important is matching the product with the consumer. In this case, school kids tested school-lunch burgers and recorded their responses.

confidentially; food companies don't necessarily want their competitors to know that they are testing a new recipe or developing a new product. Colonna meets with the client to determine if she will be testing the product (how does it taste?) or testing the marketplace (who likes this product and is likely to buy it?).

After she's determined the goals and designed the tests, she gathers her volunteers. Colonna maintains a list of more than 5,000 volunteer tasters in the Portland area. She screens her prospective consumers so they match the critical market for the particular product but are not associated with the food industry in any way.

ALL PHOTOS LYNN KETCHUM



"It helps a lot if testers have strong opinions about what they like."

Does she look for consumers with distinctively discerning taste? "No!" she asserts. "We don't want people who are too practiced, too fluent with the vocabulary of taste. We want volunteers who represent regular people." But, she adds, it helps a lot if testers have strong opinions about what they like.

On another day, Colonna was testing pears for the Northwest Pear Bureau. She recruited 120 volunteers and divided them into groups of ten to come to the Food Innovation Center for testing. After a brief welcome, volunteers were seated in individual testing booths—little cubicles painted white and brightly lit, equipped with a desk, a computer, and a pass-through window. On the other side of the window, the sweet smell of pears perfumed the laboratory and plates of ripe fruit lined the stainless-steel countertop.

The window opened and a sample of pear was delivered on a numbered cardboard plate. The computer prompted each person to taste the pear and answer the first—and most general—question: "Overall, how much do you like the taste of this sample?" The questions continued, asking the testers to rate each sample on a 9-point scale, digitizing their opinions about grainy or smooth, soft or firm, tough-skinned or tender.

After the aroma sniffing, lip smacking, and thoughtful scoring were completed and the volunteers departed, Colonna analyzed a pile of computerized opinions. With each test, she provides her clients with a binder-size report that synthesizes the preferences into a sort of consumer-based blueprint for marketplace success.

"The consumer testing helped us answer a number of questions regarding flavor, consumer preferences, packaging, and marketing," a recent client remarked, "and we believe the (sensory) information provided certainly gave us a clearer road map to making successful decisions."

The results from the elementary school's burger preference test were much simpler and less definitive. Votes split down the middle: half the kids preferred the USDA burgers ("it tasted like bacon"); and half preferred the local beef ("it tasted like what we have at home"). The kids went home that day encouraged to think about *why* they're eating what they're eating. A good question for us all. OAP

the good se

OSU lab certifies the highest quality of Oregon seed

By Judy Scott

They sit, 16 patient people, fixated on a parade of seeds marching under their magnifying lenses. Seeds tumble rhythmically past the watchful gaze of these analysts poised to whisk away any seed that is short of perfect.

Some seeds are heart-shaped, others appear to have tails and hairs. Some are richly colored in hues of ochre, umber, and crimson, as if dripped from an artist's palette. Each parade includes 2,500 seeds of a single variety, sampled from bags of harvested, clean commercial seed. It might be a parade of bentgrass seed the size of a comma or fava bean seed 100 times as big.

Only a trained eye can decipher which seeds are pure and which are from other crops or weeds or are simply flecks of chaff. But knowing that difference, and eliminating all impurities, ensures that a shipment of vegetable seed contains no surprises.

Seed analyst Jackie Martain inspects a seed sample with microscopic help, pulling out weed seeds, inert matter, and other crop seeds.

LYNN KETCHUM

The seeds arrive at this final inspection through a meticulous procedure, as the pure offspring of several generations. They have been grown on uncontaminated land, isolated from other crops, inspected in the field, harvested, cleaned, bagged, and randomly sampled to represent the lot. With their genetic purity and germination rates established, and after a battery of other tests are performed by Oregon State University Seed Laboratory, the seeds ship across the nation and the world in bags permanently stenciled with their certification.

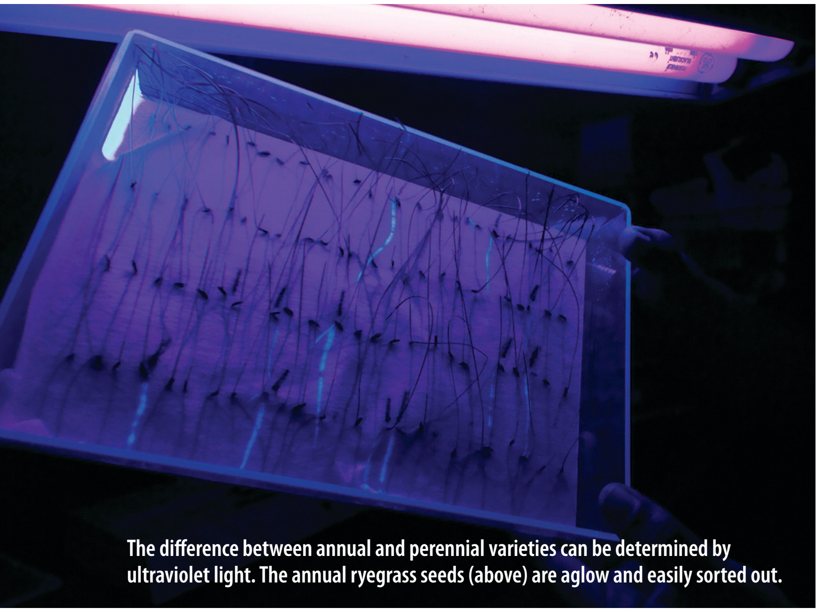
They are Oregon Certified Seed. There are none finer on Earth. "Oregon certified seeds are known the world over as the highest quality," according to Dan Curry, director of Seed Services at OSU.

Cool, wet winters are the foundation of our seed-loving, temperate climate, and dry summers make all the difference. The result: seeds of many colors that mature and "dry down" in the Willamette Valley, while others such as garlic, carrot, and potato prefer the colder winters and dry summers of Central Oregon.

"It's surprising to find such a successful seed industry in a small area, but we do have a big footprint, worldwide," Curry said. In fact, the OSU seed certification program has been authorized by the U.S. Department of Agriculture to participate in certification activities for international shipment of seed using the Paris-based Organization for Economic Cooperation and Development.

Adriel Garay, manager of the seed laboratory, credits the people involved for Oregon's stellar certification reputation. "All players in the process of producing certified seed are experts in their fields," he said. "Breeders, growers, cleaners, shippers, inspectors, analysts—a lot of people know what they're doing." There's been plenty of time to streamline the process; the lab celebrates its 100th birthday this year.

Last year, Oregon grossed $530 million in seed sales, primarily grass seed. But Oregon is a leader in the production of many other kinds of seed, including 95 percent of the nation's carrot seed and much of the nation's beet and clover seed. In addition, Oregon produces among the highest quality vegetable and flower seed, small grain seeds such as barley and oats, and most recently, native grass seed.



The difference between annual and perennial varieties can be determined by ultraviolet light. The annual ryegrass seeds (above) are aglow and easily sorted out.

"Time is our biggest challenge. More than 60 percent of our samples come within two to three months in late summer and have to be shipped immediately for fall planting. Testing has to be timely."

ALL PHOTOS LYNN KETCHUM

Like well-bred quarter horses, certified seed has pedigrees, and each generation has a chance to move up the hierarchy. Breeder seeds are the first generation, then Foundation seed, Registered seed, and finally Certified seed. Growers must cultivate them in exactly that order.

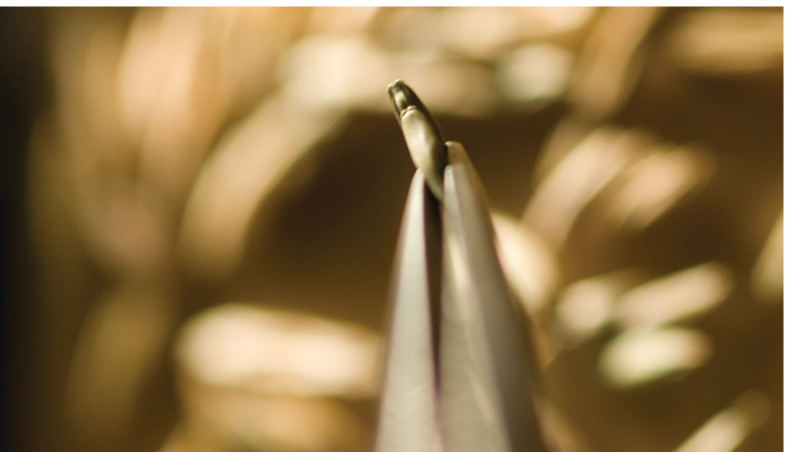
As part of the process, growers must follow strict requirements for cultivating. The seed must be planted in rows on land that has not previously grown another variety of seed, which could affect genetic purity. The fields must be isolated from other fields growing any closely related variety by at least 165 to 900 feet, depending on the class of seed.

Seed Certification Service personnel inspect the plants where they grow. They walk through the fields or fly over in a helicopter, scouting for disease, insect damage, weeds, and other threats to the purity and pedigree of the seeds.

After harvest, seeds can be conditioned and stored only at warehouses that ensure against contaminating one kind of seed with another. The identity of the seed must be maintained with a permanent lot number stenciled on each new, clean bag. At that point, seed samplers from the OSU Extension Service draw samples for testing at the seed laboratory on campus.

"Our results have to be not only accurate, but delivered in the shortest time possible," Garay said. "Time is our biggest challenge. More than 60 percent of our samples come within two to three months in late summer and have to be shipped immediately for fall planting. Testing has to be timely."

To speed up the process, the lab has adopted a new "Ergovision" system that uses a three-dimensional, high-resolution view and uniform flow of seeds, as well as ergonomic conditions for the analysts. "Now growers get results in four to six days," said Sherry Hanning, a longtime analyst and purity supervisor at the seed lab.



Perennial ryegrass seed (above) is not the smallest seed tested for certification. Sizes range from bentgrass seed, about the size of a comma, to fava bean seed 100 times as big.

Carrot seeds on the stalk (below) and in the hand (previous pages) are from Bill Durette's fields in central Oregon.

To test for purity, Hanning inspects 2,500 seeds in each sample, pulling out weed seeds, bits of soil or twigs, and seeds from other crops. She weighs the contaminating material and computes the percentage of each. The required purity level depends on the type of seed and its market. Orchard grass must be at least 90 percent pure, while tall fescue must be 98 percent pure to earn the blue tag of certification.

Ben Withrow calibrates the seed blower that separates good seeds from bad. Empty seeds are dyed green and live seeds red. Air flow is checked every morning to make sure seeds go their separate ways, based on their weight.

Additional procedures test for viability, either by germinating a sample of seeds or by using a biochemical test to determine the number of live seeds in a sample based on enzyme activity in the embryo. An X-ray test can determine if the seed is empty, immature, or damaged. Vigor tests assess the potential of seeds to produce normal seedlings under less-than-optimum conditions.

These tools, developed to support an agricultural industry, are also being used to support restoration of natural areas using native plants. The OSU seed lab has tested the seeds of about 150 kinds of native species. Requests are increasing as governmental agencies such as the U.S. Forest Service and U.S. Fish and Wildlife Service use native species to re-vegetate landslides, burns, and degraded areas. In addition, conservation groups need certified, genetically diverse native seeds—wildflowers for the most part—or local prairie restoration projects.

"We see seed certification as a valuable resource," said Amy Young, conservation biologist for the Native Seed Network of the nonprofit Institute for Applied Ecology. "Weeds are a big problem at a lot of the sites we are trying to restore. Seed certification not only allows us to promote high-quality seed, but makes us aware of undesirable weed species in the seed harvested from our production fields." OAP

Judy Scott is a public affairs communicator at OSU's Department of Extension and Experiment Station Communications.

the Zumwalt Labor

OSU and The Nature Conservancy study how wildlife and cattle co-exist on Oregon's largest private nature sanctuary.

By Tiffany Woods

Photos by Lynn Ketchum

If you venture out toward Enterprise in Oregon's stunning northeastern corner, you'll find a little-known gem of natural beauty. But you've got to travel far into the countryside, beyond the snow-capped Wallowa Mountains, past fields of stacked hay, tractors tucked into red barns, and farmyards sheltered by old apple trees. Keep going until the pavement turns to gravel.

You're now in the Zumwalt Prairie, the most extensive swath of native bunchgrass prairie in North America and a haven for birds of prey. Spalding's catchfly, a wildflower that is

atory

federally listed as threatened, blooms here; and Snake River steelhead, also threatened, spawn in the prairie's streams. About 50 species of butterflies flitter about, and elk, mule deer, and bobcats find shelter in the rolling fields and wooded slopes. And, cattle graze here.

The prairie, most of which has been used as summer pasture for cattle since the 19th century, is a living laboratory for Oregon State University and The Nature Conservancy. The latter bought 33,000 acres of the more than 200,000-acre plateau to protect and restore natural habitats. The two organizations are working together to study the impact of cattle grazing on plants, insects, soil, and ground-nesting birds to discover how production agriculture and conservation can coexist.

Here's a look at some of the research they're doing.

Hoary balsamroot (previous page) and old man's whiskers (right) are some of the wildflowers that bloom on the Zumwalt Prairie. OSU ecologist Sandy DeBano (top) counts and identifies insects on the Zumwalt to see how the cattle impact them. One way she counts them is by trapping them in cups of water placed in the ground. She has help from OSU researchers Mahmut Dogramaci and Chiho Kimoto, who suck up insects with a vacuum worn as a backpack. Researchers are also studying the impact of cattle on vesper sparrows. They monitor the growth rate of the nestlings by weighing each one and measuring their beaks, legs, and wings with calipers.



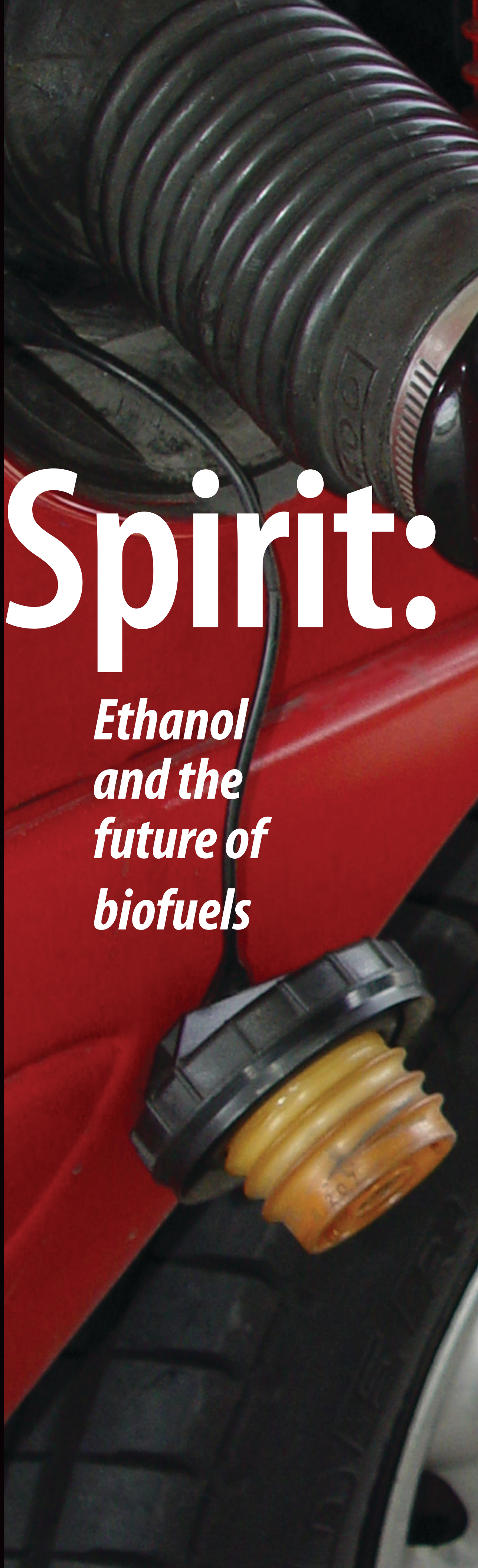
(above) About 430 cows, calves, and yearling heifers are taking part in the grazing study. While they munch, Tim DelCurto (far left), the superintendent of OSU's Eastern Oregon Agricultural Research Center, uses a tape recorder to take verbal notes on what and how much the cows eat in a 20-minute period. The research all comes full circle when OSU student Brittany Kelly (far right) examine the contents of the cow's first stomach by reaching through a surgically made opening called a fistula. Six of the cattle have these devices. In some cases, their chewed food contains yarrow (center), a landing pad for this fritillary butterfly.

The researchers will have most of the studies complete by the end of 2009. They will make the findings available to ranchers in the region to help them evaluate the sustainability of their ranching operations.

Once known as bootlegger's moonshine, ethanol is now the rising star of alternative energy. What does that mean to the price of food and fuel?

Distilled Spirit:

Ethanol and the future of biofuels



BY PEG HERRING

Made from corn and mixed with gasoline, ethanol has been touted as the fuel of choice to drive Americans toward energy independence, lower greenhouse gas emissions, and rural prosperity. But when grain prices began to rise last year and a food shortage hit the poorest regions of the world, that drive toward a cleaner, greener future took an unexpected turn. Ethanol is now at the center of a high-octane debate about the future of alternative fuels and how to get there from here.

The debate focuses on state and national policies designed to jumpstart the development of renewable forms of energy. These government policies invest millions of taxpayer dollars in the commercialization of biofuel industries through subsidies and mandates for mixing ethanol into gasoline.

A lot of new research explores home-grown alternatives to petroleum, alternatives such as canola-based biodiesel and forest thinnings spun

IMAGE: STOCK.XCHNG, PHOTO ILLUSTRATION: TOM WEEKS into cellulosic ethanol. But today, only corn-based ethanol has an established technology that can deliver the volume that is required to meet the federal Renewable Fuel Standard. That standard, part of the Energy Independence and Security Act, mandates the use of 36 billion gallons of renewable fuel by 2022 and offers direct subsidies of 51 cents for each gallon. This "blender's credit," which goes directly to oil companies, was reduced to 45 cents per gallon on January 1.

A few states support federal policies with subsidies of their own and Oregon is among them, requiring that all gasoline pumped in the state contain 10 percent ethanol. At the moment, most of Oregon's ethanol fuel is made from corn imported from the Midwest. As food costs soared along with record-breaking gasoline prices, some people were quick to blame government support for the ethanol industry.

A recent conference at Oregon State University brought together economists from around the nation to discuss the price of food and energy and the economic effect of policies that subsidize development and use of biofuels.

The picture is more complicated than corn feeding cars instead of people. It combines the falling value of the dollar, the rising price of petroleum, droughts in many grain-growing parts of the world, and an increased demand for both food and fuel in many developing nations. Using various sources of information, the economists at the conference blamed the rise in biofuel production for anywhere between one and 30 percent rise in food costs worldwide. And a recent World Bank report linked biofuels to as much as 75 percent of the rise in world food prices. So, debates are wide ranging about the impact of biofuels and what the best policies should be for Oregon, the nation, and the world.

Harry deGorter, a Cornell University economist at the conference, argued that biofuel support policies are unintentionally subsidizing gasoline consumption. Existing federal and state tax credits for biofuels may total over $20 billion per year by 2022, he said, effectively canceling the goal of reducing consumption of imported oil. "That makes about as much sense as bailing out a sinking boat while simultaneously drilling holes in the hull."

To be sustainable, biofuels must compete with fossil fuels in cost effectiveness, according to Mark Partridge from The Ohio State University. For example, in the fossil fuel industry, supplies of raw materials can be stored indefinitely underground and the existing network of production and delivery depends on relatively few jobs. Costs are low. According to Partridge, biofuel production cannot be a jobs-creation program if it is to compete sustainably with the current efficiency of fossil fuels. Ethanol plants hire relatively few workers and therefore may not be effective in creating jobs and boosting rural economic development.

The biofuel boom and rising food prices have boosted the price of agricultural land, according to John Penson, a Texas A&M University economist. In little over a year, land values have doubled in parts of the U.S., including Oregon.

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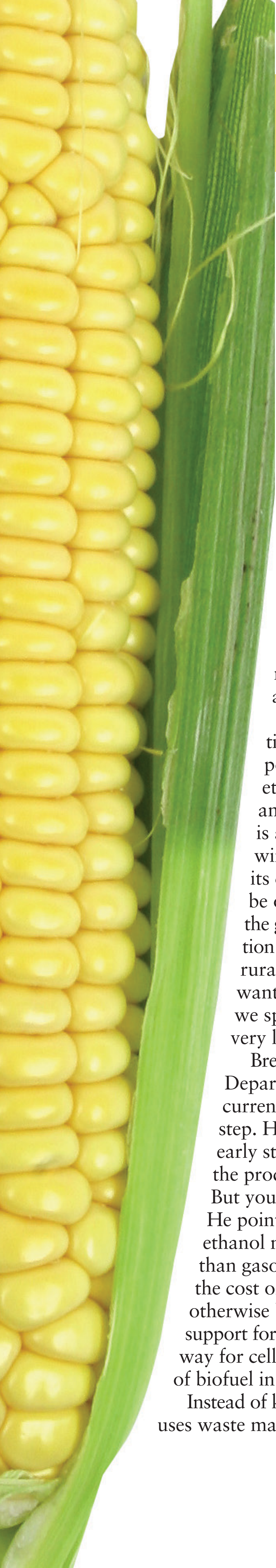
Debates are wide ranging about the impact of biofuels and what the best policies should be for Oregon, the nation, and the world.

LYNN KETCHUM



Support for corn-based ethanol is paving the way for cellulosic ethanol, the next generation of biofuel in Oregon.

Such steep and rapid rises in land values can force an unsustainable debt burden for farmers, Penson said, if they borrow money against high-priced land and crop values suddenly fall. A similar situation in the 1970s led to many farm bankruptcies across the U.S.

Increasing corn prices will result in more acres planted in corn, which may have significant impact on the environment, according to JunJie Wu, an Oregon State University economist. "Biofuels are touted as sustainable and clean," Wu said. "And yet corn is one of the most water- and chemical-intensive crops." He suggested that increased reliance on corn-based ethanol could lead to increases in nitrate water pollution, soil erosion, and loss of soil carbon.

OSU economist Bill Jaeger questioned the effectiveness of energy policies that focus on corn-based ethanol, which he says requires large amounts of energy to produce. "It is as if policy-makers have chosen a winning technology before evaluating its consequences," he said. There may be other, more effective ways to reach the goals of energy independence, reduction of greenhouse gas emissions, and rural prosperity, Jaeger said. "We don't want to find out years from now that we spent billions of dollars but achieved very little toward our goals."

Brent Searle, an economist at Oregon's Department of Agriculture, argued that current policies are an important first step. He compared the ethanol industry to early stages of the computer industry, when the products were big, clunky, and slow. But you have to start somewhere, he said. He pointed to new studies that show that ethanol now has a lower carbon footprint than gasoline and that biofuels helped hold the cost of fuel below what it would have otherwise been. Most important, Searle says, support for corn-based ethanol is paving the way for cellulosic ethanol, the next generation of biofuel in Oregon.

Instead of kernels of corn, cellulosic ethanol uses waste materials left over from cutting timber, pruning vineyards, or harvesting corn. The mechanism needed to break down these tough fibers and extract ethanol-making sugars is being explored by researchers, including OSU food chemist Michael Penner, whose pioneering work uses grass-seed straw as a feedstock ethanol.

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LYNN KETCHUM

OSU researchers are exploring new sources of energy that do not compete with food crops, sources such as cellulosic ethanol made from leftover straw or biodiesel made from algae.

And on the horizon, beyond cellulosic ethanol, is a third generation of biofuel that does not require farmland at all. OSU bioengineer Ganti Murthy is exploring the capacity of algae to produce both ethanol and oil, with the idea that energy could someday be generated from pond scum on wastewater.

As science and technology evolve, so do industries and policies and possibilities. "Food and fuel are part of a complex shifting international landscape in which Oregon is one part," said OSU economist Munisamy Gopinath, who helped bring together the conference. "Our role as economists is to provide information about this complex landscape so others can make informed policies to guide Oregon's future." OAP

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SPACE TOOLS

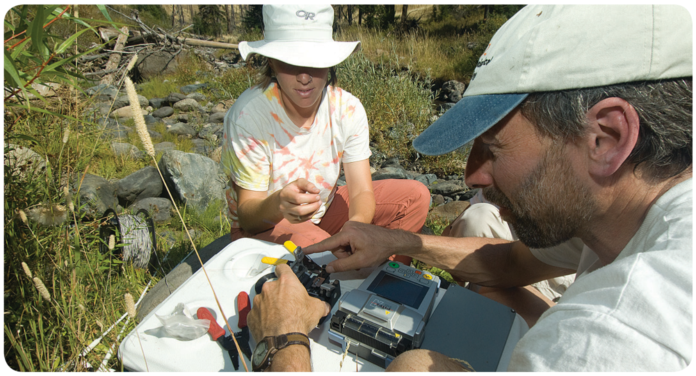
Scientists use NASA technology to measure the consequences of global climate change

by Megan McKenzie

Who knew that technology developed for space would end up being the best tools to study ecosystems here on Earth? John Selker got it early on. As a professor of biological and ecological engineering at Oregon State University, he's been pioneering the use of NASA spinoffs like sensors, wireless, and fiber optics to measure both natural and managed earth-bound environments. His real mission now, he says, is to find new and better ways to apply these spiffy technologies in his own work, and for other researchers, educators, and information-providing businesses.

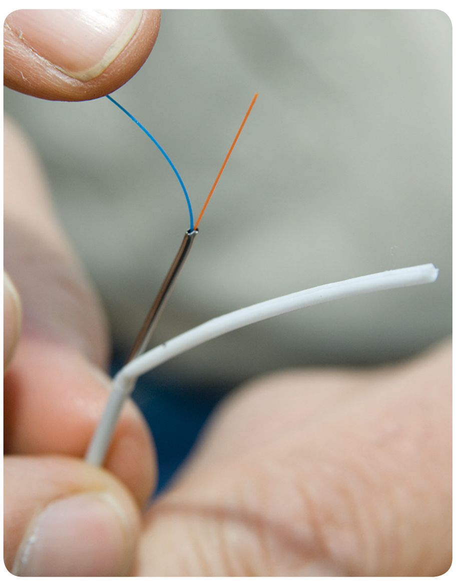
Lots of NASA technologies have been successfully commercialized, as in memory foam or Speedo Racers. But the ones used for environmental monitoring have wider ramifications, according to Selker.

And he sees urgency in measuring environmental change. With greenhouse gas levels rising, glaciers are melting, sea levels are rising, and weather patterns are changing in ways that vary unpredictably. But until recently, the high cost of field sensors made it difficult to track these changes. Measuring more than one thing in more than one place at a time was a vast and spendy challenge. The new environmental monitoring systems make it possible to track various factors at play and to figure out how one thing affects another.



Chances are, fiber optics power your telephone, your TV, and your Internet connection. John Selker has adapted this same technology to take the pulse of rivers, forests, and mountains.

ALL PHOTOS THIS PAGE LYNN KETCHUM



OSU graduate students Julie Gabrielli (foreground) and Aida Arik place a fiber optic cable into Big Boulder Creek to measure water temperature all along this tributary of the Middle Fork of the John Day River.

Selker started out by using fiber optics to measure water temperature over long distances (such as the length of a river). This technology—called distributed temperature sensing (DTS)—uses the same sort of fiber optic communication cables that make your telephone work. Temperatures are measured at one-meter intervals over several miles. An intense laser pulse is sent down the cable and temperatures are computed from the light that bounces back. The warmer the fiber, the more blue-shifted light returns.

"It's like listening for the echoes," Selker said.

With distributed temperature sensing, scientists can track tiny changes in temperature, as small as one hundredth of one degree Celsius. If you consider this amount of precision and the huge number of points that can be monitored, DTS provides something like 10,000 times the resolution possible a few years ago, according to Selker.

Another NASA innovation has improved the ability for scientists to collect all those measurements without walking from sensor to sensor in rain, snow, sleet, or hail. Using networks of radio-linked stations, data from sensors can now be gathered remotely. These stations don't cost much to buy or to run, and they can send signals over long distances, pumping out quality data that can be updated as they are received.

The sensors themselves are smaller, work better, and are much less expensive than ever before, according to Selker. He uses cameras and microphones and infrared thermopiles (originally developed for electronic ear thermometers).

Applying these new tools, Selker has joined other scientists to measure the nighttime respiration of forests in the Cascade Mountains, snowmelt in the Sierra Nevada, water quality in Lake Tahoe, contaminated water in the Czech Republic, and glacial melt in the Swiss Alps. He's also looked at the success of salmon habitat restoration efforts in the John Day and Walla Walla rivers.

"The strongly collaborative community of scientists at OSU puts us leagues ahead in these cross-disciplinary efforts," said Selker, noting the expertise in both systems ecology and the new technologies. He lights up when he talks about helping other researchers figure these systems out. "There's a lot of new cool stuff available," he said, "stuff that's guaranteed to help researchers learn how earth systems are changing." OAP

Megan McKenzie is a science writer in Corvallis, Oregon.

Dig It

BY TIFFANY WOODS

Imagine this: You're a potato farmer, but you start to notice something odd about your sandy soil. When you spray water on the mounds piled around each plant, the droplets roll off the soil like water off a duck's back. It's as if someone had sprayed a water repellent on your field. You dig into the top of one of the mounds and see that it's bone dry. You scoop up a handful and dust trickles through your fingers. You realize that your plants aren't getting the water they need to survive.

Actually, this is happening around Hermiston in northeastern Oregon, where agriculture relies heavily on irrigation. The cause and a solution haven't been found, but soil scientists at Oregon State University are looking into it. As they well know, in Hermiston and elsewhere, soils can be a mystery.

"Leonardo da Vinci said we know more about the movement of the celestial bodies than we do about the soil underfoot," said John Baham, a soils professor at OSU. "We know about the planets, atmosphere, oceans, and forests, but when you get down to the stuff below our feet, it's a mysterious world."

OSU's own soil detectives are trying to demystify this subterranean universe. In labs, in the classroom, and in the field, they're looking at soil and asking, "What's going on down there?"

"We know about the planets, atmosphere, oceans, and forests, but when you get down to the stuff below our feet, it's a mysterious world."

TIFFANY WOODS

OSU soil instructor James Cassidy takes a soil core sample near Corvallis.

TIFFANY WOODS

(left to right) Phillip Iverson, Daniel Meyers, and Andrew Brooks get their hands dirty in a soil pit on OSU's campus. The three are members of the university's soil judging team.

James Cassidy is one of them. On the first day of his class this fall, he strolled in, left hand in his pocket, wearing black sneakers, a plaid sport coat, and a rainbow-striped shirt buttoned up to his Adam's apple. He had pens in his lapel pocket and two earrings in his left ear.

Cassidy used to play bass in platinum-record Information Society, a band that had millions of teenagers dancing to "What's on Your Mind (Pure Energy)" in the 1980s. These days, soil is what's on Cassidy's mind, a subject he has spent considerable energy studying.

"I hope it doesn't come as a shock to you, but I'm not a soil expert," he said right off the bat, gesturing exaggeratedly with his right hand, like lawyers do when questioning a witness.

"Soil is the fundamental natural resource that makes everything possible," said Cassidy, the current president of the Oregon Society of Soil Scientists. "Millions of people have profited from soil and died and been buried in it and never thought what it was."

Part of Cassidy's job is to get students excited about what's under their feet. He does it with a bit of theatrics honed from years as a performer. He likes to shock, telling students to develop a taste for grub worms and corpses because they'll be the food of the future. Amid such antics, he makes sure students leave his class with a solid understanding of the fundamentals of soil.

"Soil is truth," he told them. "It's indisputable that we depend on soil for our survival. We're not going to live on Mars. If I'm wrong about that, I'll give you 10 extra credit points."

Soil, he said, is rotting rocks. It's the space, often about 6 feet deep, between the Earth's rocky bones and its weathered skin. It is the meeting place where air, water, minerals, and organic matter come together. It's a habitat, alive with bacteria, fungi, nematodes, protozoa, earthworms, and voles. It helps plants grow, recycles nutrients, purifies water, provides habitat for soil organisms, serves as an engineering medium, and even archives ancient information (the oldest recipes for beer were written on clay tablets, Cassidy said.)

To really understand soil, you've got to become a kid again. You've got to play in it, get your jeans dirty, roll mud snakes in your palms, smell it, even taste it. That's where Will Austin comes in. He's the adviser for OSU's soil judging team. Yup, soil judging.

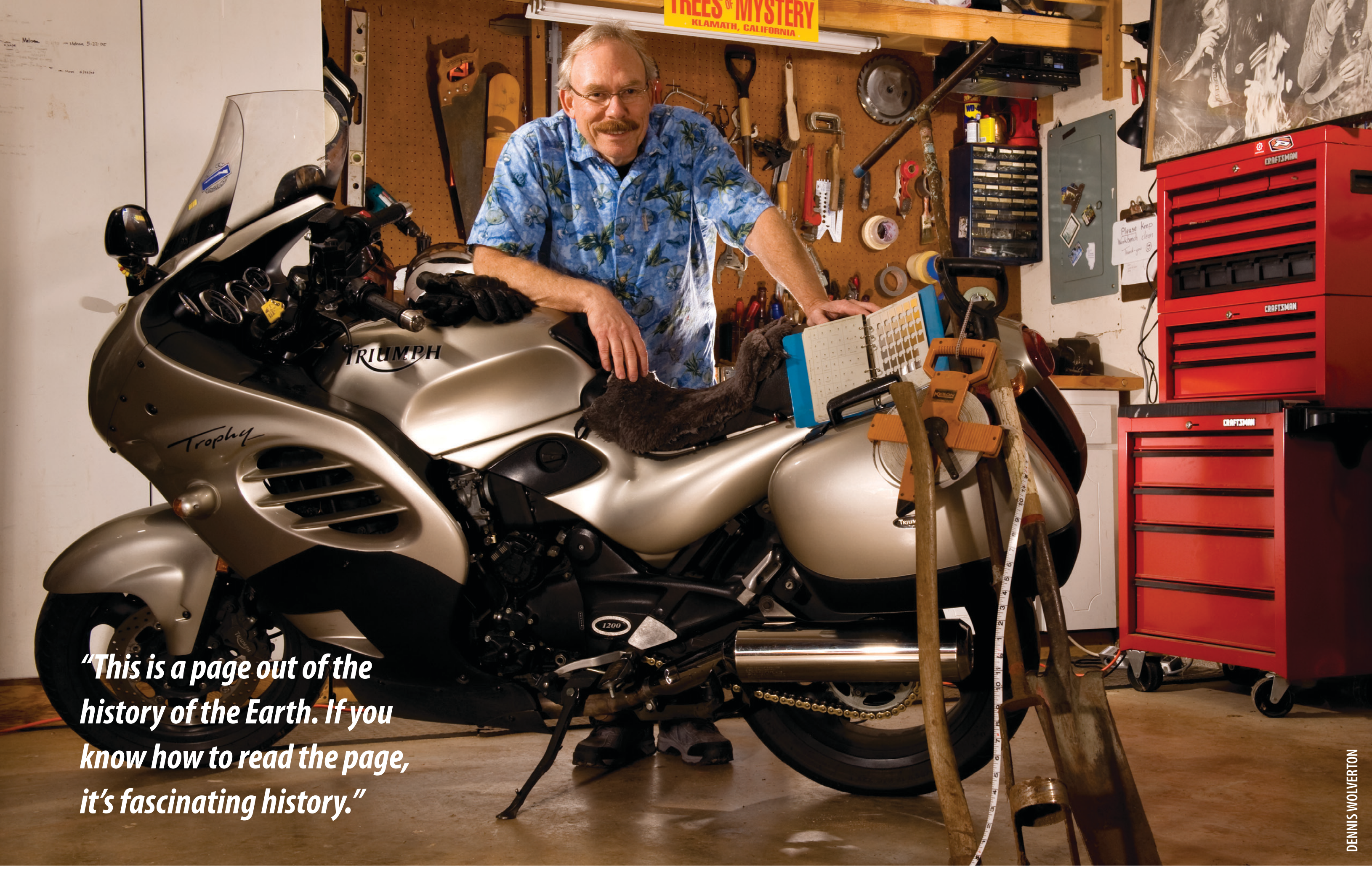
Austin spends weekends and weeknights with an eclectic group of soil judging students who wear shirts that say "SOIL" and "You dig?" One year, they tie-dyed shirts with the reddish-brown stain of Oregon's unofficial state soil, Jory.

Soil judging works like this: You stand chin-deep in a pit the size of a car and face a wall of soil. The clock is ticking. You've got less than an hour to figure out how many different layers of soil there are and where those layers begin. And for each of those layers, you

James Cassidy, seated here in OSU's converted electric tractor, was the bass guitarist in Information Society, which earned a platinum record in 1988. Today, in addition to playing an 1868 calf-skin banjo, Cassidy teaches soil science at OSU and advises its Organic Growers Club.

DENNIS WOLVERTON

"Soil is truth. It's indisputable that we depend on soil for our survival. We're not going to live on Mars. If I'm wrong about that, I'll give you 10 extra credit points."



When he's not advising OSU's soil judging team, Will Austin can be found tinkering in his garage with his 1999 Triumph Trophy 1200. Each summer he takes it for a spin on an approximately 3,000-mile solo road trip.

must determine the precise color, the exact texture (is it sandy clay, loamy sand, clay loam, silt loam?), and the structure (blocky, columnar?). And that's just the start. Meanwhile, you're staring at this wall thinking this just looks like a bunch of dirt.

On a Sunday morning in October, Austin and the team gave it a whirl in their first practice of the school year. A regional competition was only three weeks away that would pit OSU against the University of Idaho and Utah State University.

Tools in hand, students hopped into the pit. "OK, let's see what kind of damage we can do," said Austin, a former mountain climber and a laid-back, Jimmy Buffett kind of guy who looks most at home in a Hawaiian shirt and riding his Triumph. He handed out scorecards.

This can be intimidating for the uninitiated. Austin recalled one student breaking into tears upon being faced with a wall of soil and a checklist of demands to identify horizons, boundaries, textures, colors, and something called redox concentrations. Students must measure hydraulic conductivity, rooting depth, water retention, slope, surface runoff, and more. Basically, these smarty pants are trying to answer questions like: Can you grow crops in it? Can you build a house on it? Can you bury a septic tank in it?—questions they would need to answer someday as crop consultants, wetland specialists, or hydrologists.

The team got to work, squirting water on the wall of the pit to help define the layers. They jabbed at the pit wall with knives. They rolled mud balls in their hands. They held dirt clods next to a book of color samples as if trying to match a piece of fabric with a color swatch at The Home Depot.

Austin asked his team to look at what's above ground, too, for clues to what hides below the surface. He surmised that the area was once the bottom of a lake formed by the Missoula Floods, and the floor of the pit probably dated back 40,000 years. That's when it hits you. You're touching soil walked upon by woolly mammoths.

"This is a page out of the history of the Earth. If you know how to read the page, it's fascinating history. Plants change, but soil is always here," Austin said.

OSU soil scientist Jay Noller has read that book. He postulates soil types by observing landscapes—both on foot and with the help of technology. He and his research team are using satellite images and flyover photos to map the soils in Malheur County in the first soil survey of the area. The results will help farmers, ranchers, and policymakers decide how best to use the land.

Noller also teaches students to classify soils, which are ranked in a system similar to plants, with orders at the top of the hierarchy and series at the bottom. There are 12 orders of soil in the United States, everything from tundra to desert. Oregon is known to have at least 10 of those orders, and Noller has found the other two. He located a

OSU soil scientist Jay Noller, at home in his art studio, paints what he finds underground, often mixing soil into his pigments. In 2007, he painted a 24-foot mural of a global soilscape that was selected as a centerpiece for Burning Man, an international artists' festival in Nevada's Black Rock Desert.

parking lot-sized piece of Gelisols containing permafrost on the flank of Crater Lake. And he found Oxisols, weathered soils from the tropics, in the John Day Fossil Beds National Monument. As for soil series, there are more than 3,200 of them in Oregon, Noller said.

You can find 27 of Oregon's soil series displayed in a string of monoliths hanging on the wall of a campus lab. It looks as if someone had sliced the state from east to west with a 6-foot knife. The monoliths carry names that you might find in a phonebook, names like Frohman, Hankins, Morrow, Dupee, Steiwer. On the Ochoco monolith, you can see how the salt drained through the soil and accumulated in the bottom layer. The top half of the Blacklock, found on Oregon's coast, is gray and sandy then abruptly turns earthy brown. The silty Nehalem, found in floodplains, has roots poking out and dead grass matted at the surface.

Noller thinks about these soil series when he's driving. As the landscape zips by, he can't help but wonder what's below the surface. At a forested terrace above the beach, it's not the trees he sees but the Blacklock below. Back home in his art studio, Noller captures those soil profiles on canvas.

While Noller examines soil on a landscape scale, Dave Myrold examines it on a microscopic scale, working in a world in which a human hair would be the size of a school gymnasium. A soil microbiologist, he studies bacterial genes in soil.

One billion bacteria can be found in a teaspoon of soil, he said. Those bacteria consist of tens of thousands of different species. With new technology, researchers like Myrold are getting a better picture of soil diversity, quickly breaking open bacterial cells and isolating their DNA.

"Just as criminal investigators get DNA from semen, we're extracting it from the soil," Myrold said. With equipment that can do hundreds of thousands of genes simultaneously, you could conceivably sequence everything that's in one teaspoon of soil. "That's way-cool technology, but what does it mean?" Myrold said. "Just because you have 10,000 species of bacteria, why does it matter?"

For many bacteria, it may not matter. But some species have specific, valuable functions, he said. The bacteria might be able to degrade pollutants in the air, make antibiotics, or generate electricity.

Whatever their potential uses, the bacteria are just one of the thousands of critters who've set up housekeeping in the soil, making it all the more complex and mysterious. "What is above ground is a sideshow compared to what is going on below," Cassidy told his class. "Yet, people are blind to soil. We are so immersed that we don't get it, like a fish in a tank that doesn't know it's in water." OAP

Tiffany Woods is a communication specialist at OSU's Dept. of Extension and Experiment Station Communications.

OSU Chemist Tracks Pollutants Across the Globe

By Tiffany Woods

Staci Simonich pulled a plastic bag out of a freezer in her lab at Oregon State University. Inside was what looked like a filthy paper towel: an air filter, coated with dark gray particles that she and millions of other people inhaled during the Summer Olympics in Beijing.

"It was the most polluted place I had ever been," Simonich said, "and the filters were the dirtiest I had seen in 20 years of air sampling." From late July through September, Simonich and colleagues at Peking University collected particles out of the air atop a seven-story building in China's capital. The goal: to measure the results of the Chinese government's efforts to clean up the city's smog-shrouded sky.

"There was improvement, but not as much as we were expecting. The particle levels were three times higher, on average, than at the Atlanta Olympics."

Staci Simonich spent weeks at the Summer Olympics in Beijing collecting air quality samples with colleagues at Peking University. On some days, smog enveloped the city, the National "Bird Nest" Stadium, and the Olympic torch.

Simonich's research in China is just a portion of the work she does as a toxicologist and chemist at OSU. She specializes in studying how pollutants travel through the world's atmosphere, tracking chemicals that hitchhike on airstreams from Asia and blow across the Pacific Ocean to mountains in the western United States. She also is a member of a National Academy of Sciences committee that is studying air pollutants entering and leaving the United States.

She got her first whiff of science as a child growing up among the paper mills in Green Bay, Wisconsin. Her parents encouraged her interest, giving her a microscope and telescope as Christmas presents, not typical gifts for a girl in the 1970s. What she really wanted was a chemistry set "to make things that blow up."

She got her first experience as a chemist while an undergraduate at the University of Wisconsin-Green Bay, collecting samples of polluted air in the area. Later, she traced pesticides in tree bark to map how chemicals travel around the globe. To conduct the study, she asked people all over the world to send samples of bark to her. Her work was published in the journals *Science* and *Nature*, a rare accomplishment for a young scientist.

She worked for six years helping Procter & Gamble create chemicals that would clean better without hurting the environment, then she came across an ad for a job at OSU. It was just what she wanted: a beautiful state, quality of life, the opportunity to train students, appealing research. "My heart raced," she said.

Since coming to OSU, Simonich has tracked the movement of various airborne chemicals derived from pesticides, flame retardants, and stain-repellants, some that had been banned decades earlier because they were harmful to human health. She has collected samples from atop Oregon's Mt. Bachelor and traced the chemicals back to China, Japan, North and South Korea, Siberia, California, Washington, and parts of Oregon.

Understanding the source of airborne chemicals will help regulators in the United States know which ones they have the authority to control, Simonich said. It will also help them understand how the use of fossil fuels in Asia impacts the quality of the air in the United States.

When Simonich isn't testing air samples or spending time with her two young children, she can be found surfing on the Oregon Coast.

"I may be the only chemistry and toxicology professor with a surfboard on her Prius," she said. "I want to know why surfing isn't an Olympic sport."

If it were, she might be carving waves in addition to monitoring air quality at the Olympics. ■

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Visit Oregon's Agricultural Progress online at:
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