

Findings



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On the Cover

Luisa Ann DiPietro: *Bill Wiegand, Photographer*

Luisa Ann DiPietro is an immunologist at the University of Illinois at Chicago College of Dentistry. DiPietro studies wound healing and scar formation.

Stephen Eubank: *John McCormick, Photographer*

Stephen Eubank is a physicist at Virginia Tech University in Blacksburg. Eubank uses computer simulations to create models of social networks.

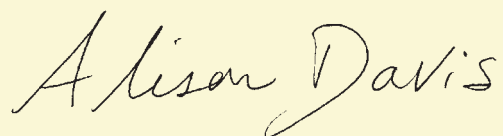
Putting together a magazine like *Findings* requires a lot of planning, and we at NIGMS choose scientists to feature months ahead. Virginia Tech physicist Stephen Eubank (see page 8) was on the books for this issue by January 2007.

Then came the April 16, 2007, campus shootings. Like the rest of the country and the world, we were shocked and saddened by the violence and loss of so many lives. I have a personal connection, too: I got a biochemistry degree from Virginia Tech, only much later deciding on a writing career as a way to bring science to many people.

Eubank joined the Virginia Tech faculty in 2005. He creates mathematical models of how people interact—during routine life as well as in disease outbreaks and other emergency situations. That his research on social networks might relate to understanding how people communicated during the Blacksburg shootings seemed an eerie coincidence.

This issue's other featured scientist, Luisa Ann DiPietro (see page 2), started out as a dentist but has devoted her career to finding ways to allow wounds to heal faster, and someday, without disabling scars.

Scientists turn questions into experiments, and experiments into new knowledge for all of us. They are citizens like you and me, and we all want a better, more peaceful world.



Alison Davis
Editor

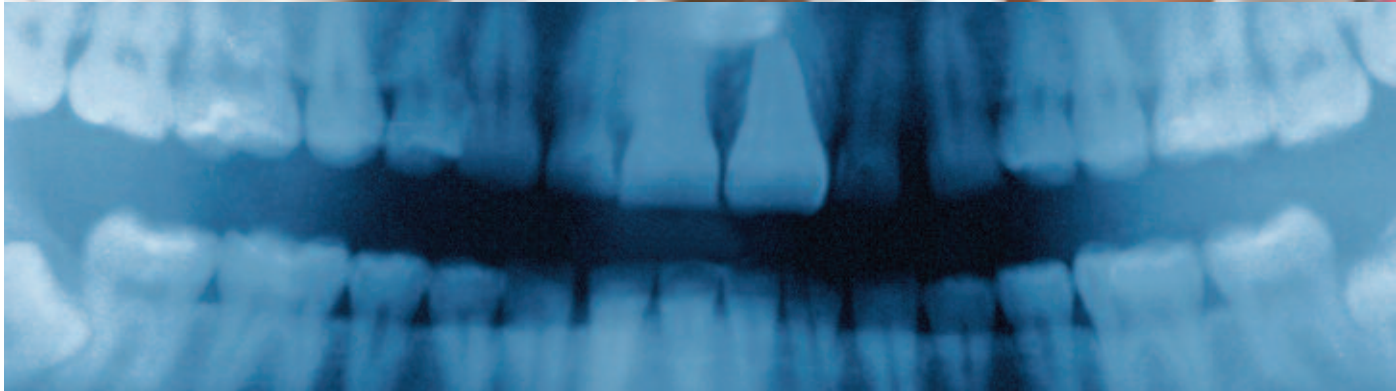
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Healthy Healing



BILL WIEGAND



**BY ALISA ZAPP
MACHALEK**

Perhaps you've never noticed, but people don't have scars in their mouths.

If you bite your tongue or the inside of your cheek, it heals without a trace. Even after serious injuries or major surgery, oral scars are very faint. That's in stark contrast to the tough, pinkish bands left elsewhere on the body by nasty bike spills or unsuccessful fence-climbing efforts.

Why is that? And, if somebody could figure it out, could we do away with scars altogether?

Luisa Ann DiPietro asks these questions every day.

And of all people, she is well suited for studies in and around the mouth. Before she became a scientist, DiPietro worked as a dentist.



Precocious Puzzlers

DiPietro, who runs a lab at the University of Illinois at Chicago College of Dentistry, says she was always drawn to math and science. Her father, a math professor, and her late mother, a librarian, both loved to learn new things.

“I grew up in an environment where it was fun to stretch your brain,” she says.

DiPietro and her three siblings especially enjoyed math puzzles introduced by their father. A particular favorite involved birthday candles.

On your birthday, DiPietro explains, the number of candles on your cake wouldn't be your age in base 10, but in another base. You'd have to figure out which one.

“We loved this,” she says. “We never realized how weird it was until my brother brought over his girlfriend.” The girlfriend wasn't quite so intrigued with the game, and she declined to participate when her birthday came around, DiPietro remembers.

Like DiPietro, her siblings are still doing science and math.

Her younger brother is a software expert at Sun Microsystems; her sister is a food chemist at Dreyer's ice cream company; and her older brother, a veterinarian, is vice president of the Institute of Agriculture at the University of Tennessee in Knoxville. All four still like puzzles.

Meanwhile, DiPietro's father, now 86, teaches one math course every semester at nearby Eastern Illinois University in Charleston, even though he officially retired about 20 years ago.



▲ Growing up, DiPietro and her siblings played math puzzles with birthday candles.

Healing Under the Microscope

Today, DiPietro studies wound healing in slippery tissues called mucous membranes that protect body openings. Found along the inside of the nose, ears, mouth, and other body cavities, these tissues heal more quickly and with much less scarring than skin.

DiPietro wants to learn how they do it.

She compares the healing of mouth and skin wounds to find the cellular and molecular differences between the two processes. In one approach, she grows human skin and mouth cells in separate plastic dishes to examine how each type responds when scraped and injured by a glass tube.

In another type of experiment, she compares the healing of tiny wounds on the tongues and backs of mice. She also works together with researchers who do similar kinds of experiments with rabbits and human volunteers.

“The long-term goal of my research is to find therapies that will improve healing for people—to turn wound healing into a more rapid, regenerative process,” she says.

Specifically, she's trying to help reduce scarring in those with extensive injuries and to speed healing in the 1 million or more Americans whose wounds heal slowly or incompletely, such as people with diabetes or vascular disease.

Research Calling

By the time she graduated from high school, DiPietro knew she was good at science, but she did not have a specific career track in mind. She enrolled at the University of Illinois at Urbana-Champaign, just 60 miles from her childhood home.

During her early years in college, she spent a lot of time considering possible career paths, which included biology, biochemistry, and even sociology.

Then one day, as a junior, she noticed a flyer on a bulletin board outside her academic advisor's office. It described a summer research opportunity sponsored by the American Dental Association.

**“I grew up in
an environment
where it was
fun to stretch
your brain.”**

On a whim, DiPietro applied, and she was accepted.

That summer, she got her first taste of research. She used biochemical techniques like mass spectrometry and liquid chromatography to examine whether the chemicals used to make dentures alter cholesterol levels in a person's blood.

It was a great fit. DiPietro liked applying the fine-detail skill of her hands—sharpened during hours of embroidery, sewing, and needle-point—toward work that she knew might help people someday. She decided to become a dentist.

After dental school, DiPietro completed a 1-year, hands-on training program in general dentistry at Michael Reese Hospital and Medical Center in Chicago. There, she worked alongside a select group of physicians, dentists, and medical and dental residents.

In the emergency room, she treated dental abscesses, replaced lost teeth, sewed up cut lips, and examined patients with facial trauma. In the clinic, she cared for patients whose

conditions complicated their dental therapy, including those with cancer of the mouth or cerebral palsy.

DiPietro saw how enthralled her colleagues were about the work. The harder the case, the more they liked it. But DiPietro didn't feel the same passion.

“Follow your heart.”

She instead called up memories of a unique—and in hindsight, life-changing—class she had taken in dental school years before.

Rather than focusing on a textbook or syllabus, this class relied solely on research publications. The students read a mix of classic scientific papers and recently published ones, then discussed their strengths and weaknesses in class.

Through this exercise, DiPietro learned how to ask scientific questions, design experiments, interpret data, and formulate theories to explain research results—just about everything a scientist does on a daily basis.

“I felt my eyes were literally opened,” DiPietro says.

Looking back, she knew that the course had done much more than teach her about biology: It had convinced her to become a researcher. She went back to school to get a Ph.D.

Body, Heal Thyself

Say you nick yourself shaving or rip open your leg skateboarding. Immediately, you feel pain and see blood. Your body kicks into high gear, sandbagging the wound, stretching a protein scaffold over it, and calling in teams of immune system cells that starts a process called inflammation.

The first cells on the scene are neutrophils, which swallow bacteria, then self-destruct by triggering an internal chain reaction of toxic chemicals. Macrophages clean up the remaining debris. Mast cells cause swelling, warmth, and redness.

All three cell types release powerful chemical messages that summon even more immune system cells to the damaged site.

As this inflammatory phase of wound healing dies down, the next step—called proliferation—powers up. Cells on the inner surface of blood vessels grow leglike appendages and crawl across the wound, ribboning the area with new vessels that bring needed oxygen and nutrients.

This process, called angiogenesis, can dramatically increase the number of blood vessels in the area.

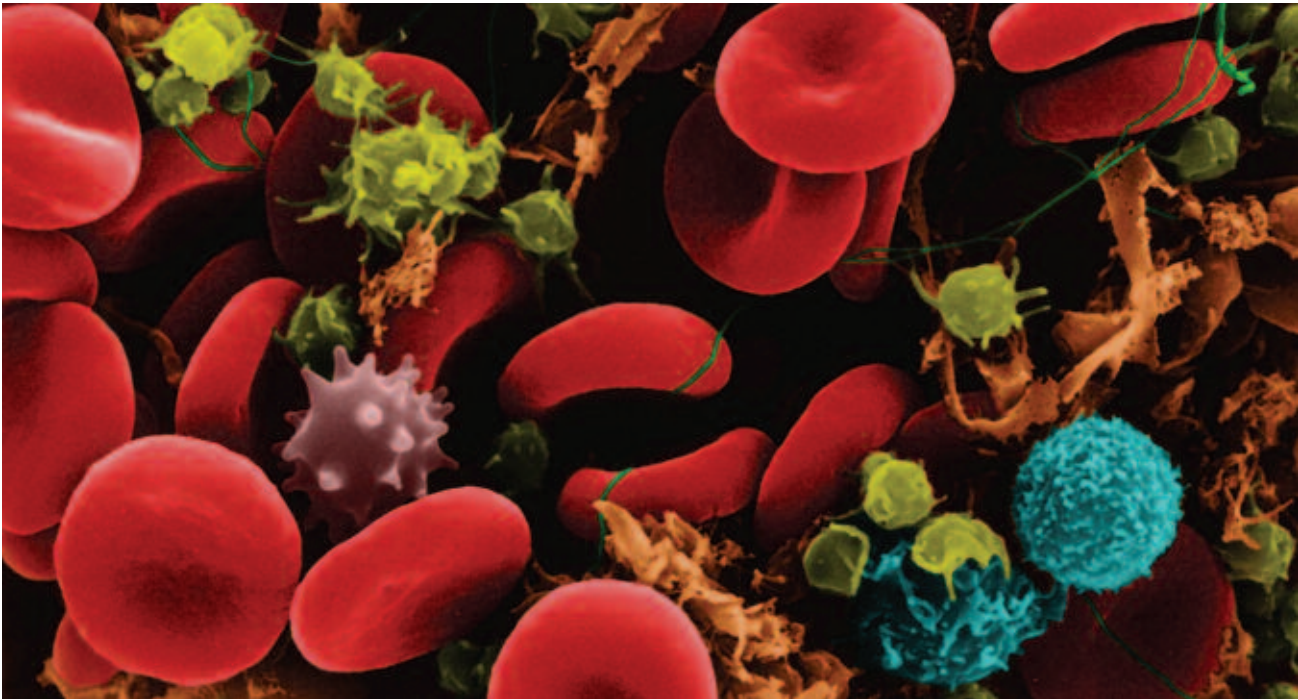
Eventually, cells around the edges of the injury pull up their roots and crawl over each other to fill in the open wound. Ropelike proteins grab the wound's edges and pull them closed like drawstrings. Finally, the area is draped with a sturdy protein mesh, and the new blood vessels, now no longer needed, die off.

During this amazing series of events, our bodies use thousands of molecules and more than a dozen cell types to heal a wound.



▲ DiPietro started out as a dentist.





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▲ To heal wounds, our bodies use a large collection of cell types, proteins, and molecules.

Too Much of a Good Thing?

The fast and furious burst of inflammation at the beginning of the wound healing process has an important purpose: It protects us against death by microorganisms. Without it, a paper cut or torn hangnail could be potentially fatal!

According to DiPietro, most wounds require some level of inflammation to clean themselves up. But in its enthusiasm to decontaminate wounds, the body turns on inflammation full blast. That's usually more than necessary to sterilize the site.

Excess inflammation often damages healthy, neighboring tissues. This happens when neutrophils spill their caustic, bacteria-killing cocktail, which—believe it or not—includes hydrogen peroxide and the body's version of chlorine bleach.

High levels of inflammation are also linked to disfiguring scars, DiPietro has found. Such scars affect more

than a person's appearance and self-esteem—they can impair the use of certain body parts, locking down joints and limbs. If they involve vital internal organs, these scars can be life-threatening.

Together, DiPietro's findings, along with those of other researchers, point to a major shift in thinking about the role of inflammation in wound healing.

In the past, inflammation was considered the vital first step in healing. Now, scientists think that it might not always be a good thing—or rather, it may be too much of a good thing.

“That's been a big surprise,” DiPietro says. “It's incredibly exciting to me to be part of this shift in our understanding of healing.”



▲ Injuries caused by accidents or surgery leave scars.

Blood Vessels Gone Wild

DiPietro has also found that the body may go overboard with angiogenesis.

Mouth tissues, which heal quickly and without scarring, grow only enough blood vessels to replace those lost due to injury. Once the area has a normal number of vessels, angiogenesis stops, says DiPietro.

But in skin wounds, she explains, the number of vessels increases by up to 10 times—way more than necessary. Most of the excess vessels die off, and the number of blood vessels in the area eventually returns to what it was before the injury.

DiPietro's research suggests that this creates an unintended effect: When healing includes this massive growth of extra blood vessels, it usually leaves a scar.

But it's still not clear what's going on, she says. Does angiogenesis itself promote scarring? Or is it the molecule that triggers angiogenesis? Or the cells that produce the signal? And so on.

DiPietro has begun to address those questions too. The answers may change the way doctors treat cuts, puncture wounds, and burns. She is excited and hopeful that her research will lead to new treatments.

"I hope that in my scientific lifetime, I'll see some of those," she says. "Very few researchers get to take their discovery [to patients]. I hope I'm one of them."



▲ Monthly lunches in DiPietro's office often include exotic ethnic foods.

Leading By Example

DiPietro knows that science is an ongoing, group effort and that each researcher relies on graduate students, postdoctoral fellows, technicians, and other scientists.

DiPietro's concern for her team is legendary. When graduate students choose which professor to work for, many are drawn to her lab.

"She's one of the best mentors I've ever seen—absolutely outstanding," says Aimee Burns, who was DiPietro's lab manager for 9 years.

DiPietro regularly meets one-on-one with each person in her lab. Students describe walking into her office in despair over a failed experiment, then marching out beaming with a new, positive outlook on their research.

She also shepherds a diverse group of a dozen or so workers into a cohesive team. Those in her laboratory

come from four continents. They include a mixed group of high school students, undergraduates, graduate students, postdoctoral fellows, medical students and residents, physicians, and volunteers.

Informal gatherings in the lab have been a big hit with her crew.

"At first, [DiPietro] was in a 9-by-9-foot office, and after one of her promotions, she moved to a bigger one," Burns says.

"She didn't know what to make of it, so she decided we should have a monthly potluck lunch in there!"

DiPietro also actively tries to increase the number of underrepresented minorities in research and clinical work.

Before moving to the University of Illinois at Chicago last year, DiPietro was a researcher for nearly 15 years at nearby Loyola University School of Medicine. There, she established a Diversity Scholars program that provides substantial support for



minority medical students to perform a short research project or take a clinical elective.

Perhaps unknowingly, she's also a role model for young women in science. They see, through her example, that it's possible to balance a family and a career in science (see sidebar, right).

"She's very committed to her family without having it take away from her work—and vice-versa," says Megan Schrementi, who was a graduate student in DiPietro's lab for 4 years.

"As a woman in science who would like to have a family, that's something I look up to."

DiPietro has the same advice for any students trying to figure out who they want to be when they grow up.

"Follow your heart. Look for your passion and what interests you—don't let anyone talk you out of that," she says.

DiPietro has certainly taken her own advice.

"To have a job where you're paid to think about things and to learn all the time—I still feel like I have to pinch myself sometimes." ■

A Balancing Act

"My most interesting life experience has been raising twin sons while maintaining my scientific career," says Luisa DiPietro, a wound healing researcher at the University of Illinois at Chicago (see main story). Now 18, the boys were born a few months before DiPietro finished her Ph.D.



LUISA ANN DIPIETRO

▲ DiPietro's two sons graduated from high school this year.

"Only someone who loves science more than sleep would do such a thing!" she admits.

DiPietro vividly recalls some of the crazy things she's done to simultaneously nurture two growing boys and a blossoming career.

While home on bed rest during the last 7 weeks of her pregnancy, she analyzed the results of experiments.

In a hospital waiting room as one of her 18-month-old sons was having a peanut surgically removed from his lung, she put together a

scientific seminar. Watching her high school-age son at a swim meet, she read articles she was preparing to publish.

The unstructured nature of research helped a lot, she says.

"Even though scientists work a lot of hours, it tends to be pretty flexible. I could leave the lab and go to my son's school concert or water polo game," DiPietro says.

Researchers she has worked with over the years credit her talent, hard work, phenomenal organizational skills, and wise career choices.

"She has a stable family in a loving home and a wonderful research [program]," says Peter J. Polverini, dean of the University of Michigan School of Dentistry in Ann Arbor.

"I can't think of a better role model, male or female."—A.Z.M.

Social Studies



TOP: JOHN MCCORMICK
BOTTOM: STEPHEN EUBANK



BY EMILY CARLSON

Katie Holmes and Kevin Bacon? According to the popular trivia game, “Six Degrees of Kevin Bacon,” Holmes is tightly linked to the *Footloose* and *Beauty Shop* star. The game asks participants to connect Bacon to any other actor, resulting in a “degree of Bacon” score.

Holmes’ number is two: She starred in *Batman Begins* with Sarah Wateridge, who was in a movie with Bacon.

College students at the University of Virginia in Charlottesville developed a Web site, <http://oracleofbacon.org/>, to compute the Bacon degree of just about any Hollywood personality. Tom Cruise, for instance, is one degree. The average number is 2.96.

While the game and its results may seem like idle fun, they demonstrate an inherent feature not just of Tinseltown, but of communities in



general: We are linked to each other through intricate social networks.

More Than Friends

Stephen Eubank, a physicist at Virginia Tech University in Blacksburg, studies these complex networks. Right now, he's using the networks to understand how diseases, like a deadly flu, could spread through communities.

"Most people think of their social networks as their friends," says Eubank. "But our networks include all the people who help us accomplish what we need to do."

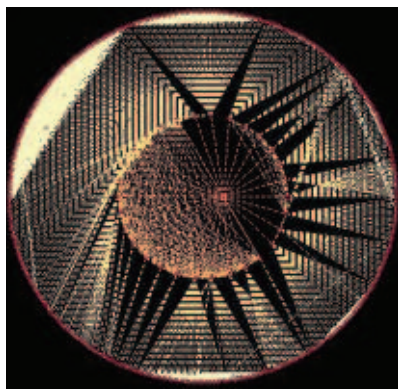
Your circle, for instance, could include clerks at the mall, ushers at movie theaters, students in your math class, and the person who delivers your latest online order.

Eubank uses public surveys, census reports, and transportation data to piece together the general schedules of thousands of people leading very different lives.

In one such scenario, for instance, he knows that a dad drops off his daughter at daycare at 7:30 a.m. and, after an evening meeting, picks the girl up at grandma's around 9 p.m. Or, that a retired electrician goes fishing with his buddies at 1 p.m. every Friday and then eats out with his wife.

With this information, Eubank begins to link an individual to personal contacts, those contacts to their contacts, and so on until he has mapped an entire community that represents how people move around and interact.

But as you can imagine, people interact in nearly infinite ways. Maybe lightning knocks out power at the daycare center, forcing the dad or his wife to change their



STEPHEN EUBANK

▲ What looks like a Native American dream catcher is really a network of social interactions within a community.

routine. Perhaps one of them stays home or all three go to a movie.

Maybe the same storm forces the fisherman to go to a matinee instead. Maybe they all end up at the same theater.

Twists and Turns

Plans change, leading us to different people and places all the time. Sometimes, external factors like weather or world events compel us to make certain choices. Other times, chance happenings shape our actions. Either way, how we move around and come together can vary the course of events.

Eubank's own course has involved many twists and turns.

"I thread my way through life," laughs Eubank.

The son of an Army officer who fought in World War II, Eubank graduated from Swarthmore College in Pennsylvania knowing he wanted to be a scientist, but that he didn't want to go back to school right away.

So he headed to Florida to hitch rides on sailboats. He crewed boats to Cape Cod and the Bahamas. He even bought his own boat, but he shipwrecked it on his first long cruise.

Better at science than captaining, Eubank left the sea for graduate

school in Austin, Texas, a city he likens to an island isolated from the world. He studied physics—and baked bread, made beer, and rode his bike.

"Graduate school was a great time in my life."

Eubank still visited the ocean, often when he went home to see his parents in South Carolina. On these sandy shores, he met his future wife, Helen.

"I thread my way through life."

Seemingly random, this first encounter actually was fated by their social network: His parents lived across the street from her grandparents!

The couple, married for 23 years, have two children, Jonathan, 15, and Elizabeth, 8.

Complexity Made Easy

Eubank is an expert on "complex systems." A complex system has several components that interact in more ways than you can count. Exactly how those components interact can change the behavior of the whole system.

Social networks are only one type of complex system. Another type is the earth's climate. Static components such as the lay of the land, and more dynamic ones like ocean currents, distribution of heat, rainfall, and greenhouse gases, can mix in different ways to cause floods, tornadoes, and even global warming.

If the components of a complex system can interact in any combination, how do you begin to calculate the temperature in the year 2150... or a country's response to a widespread outbreak of a contagious disease?

The answer is simple, says Eubank. "Math rules!"

Eubank and others studying complex systems primarily use statistics and advanced algebra to figure out the likely outcomes. The science may be ancient, but the tools are quite modern.

"It used to be that you could write down some equation on paper and come up with solutions," says Eubank, who still likes solving equations by hand.

"Math rules!"

Social networks are far too complex to work out on restaurant napkins, where Eubank often jots down ideas. They need to be sorted out through computer simulations, he says.

Eubank and computer scientists enter the interactions among components of a particular complex system into a software program. The program does the calculations to create a model of the entire system, say the transportation network of a large city. The model then can simulate probable outcomes—morning gridlock at a downtown intersection, for example—over a period of days, weeks, or months.

Since outcomes are also dependent on random interactions, Eubank and other modelers will simulate a single day 100 times to produce a collection of the possible outcomes. It's kind of like the movie *Groundhog Day*, where the main character wakes up over and over again to February 2, explains Eubank.

The simulations run on high-performance computers that generate massive amounts of calculations, which could show the number of tractor-trailers on an interstate at 4 p.m. or the alternate routes that a city's drivers take in response to an accident.

Statisticians study the data to make sure it all makes sense. If it doesn't, they'll figure out why. The answer can help Eubank retool the models to make them more accurate.

Simple Pleasures

Eubank's antidote to complex research is a simple lifestyle.

Just because his family recently bought its first DVD player, cell phone, and cable TV connection doesn't mean they actually use them! They only watch one show—on DVD. They all enjoy the simple pleasures music can bring: Jonathan plays piano and Elizabeth plays violin. Eubank strums his mandolin.

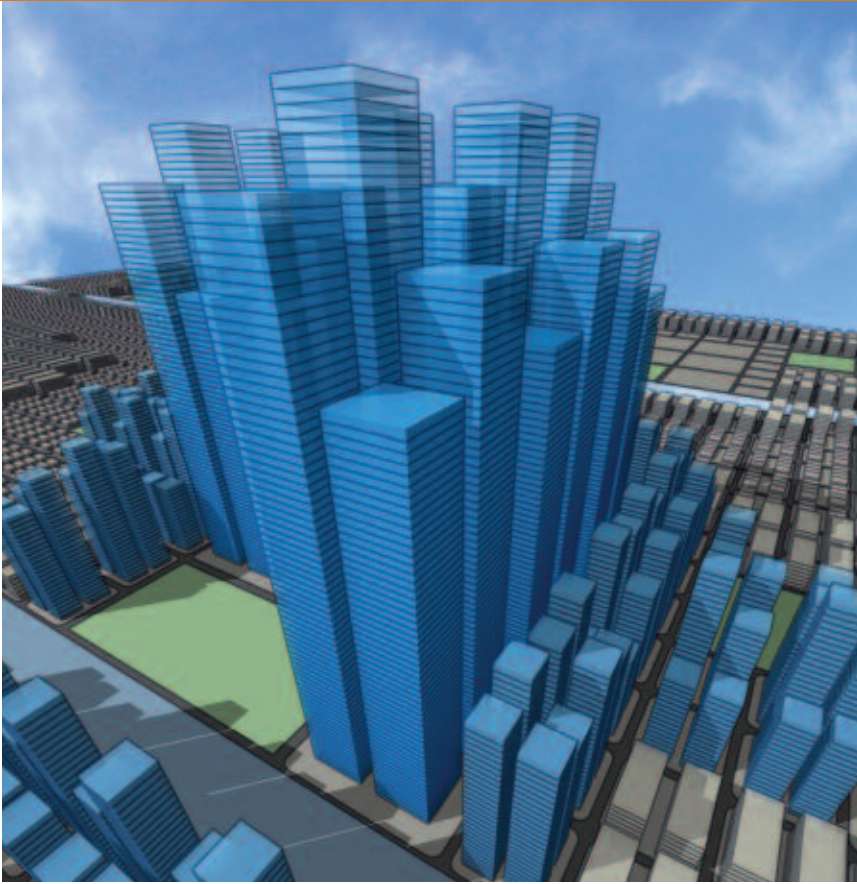
Or, they head for the hills to camp in their green 1984 Volkswagen van. Eubank says its main feature is a "pop-top," or expandable roof. The van has more problems than Eubank can fix, so he has focused his energy on figuring out how he can use Jonathan's new iPod to rock out the van. Expectedly, it has no radio.

Living in a town of 40,000 people tucked along the Blue Ridge Mountains, the family spends a lot of time outdoors. Eubank often starts the day by strolling the Virginia Tech campus with his dog Goldberry, a hefty retriever



▲ Components of complex systems like climate or traffic interact in many different ways. Computer simulations can model potential outcomes, such as traffic jams or storms.





▲ In Eubank's simulated version of Portland, Oregon, there are six or fewer degrees of separation between any two people.

named after a *Lord of the Rings* character.

If the weather's bad, like when a blanket of snow spreads across the campus, Eubank will stay home with Jonathan and Elizabeth. They spent the last snow days building a 4-foot-tall obstacle course through which balls drop, spin, and slide.

Although the family members spend time together disconnected from their own individual worlds, they're continuously touched by Eubank's social network.

A job studying the complex system of human language took them to Japan for 2 years. For nearly 15 years, they lived in the rocky desert of New Mexico, where Eubank studied complex systems at the Santa Fe Institute and started his own company to predict the ups and downs of financial markets.

Such adventures, too, have expanded the family network to include people like the Harry Potter

series author, J.K. Rowling. When the family traveled to England with Eubank for a business trip, a cab driver pointed out Rowling's house and said she knew the author.

At that very moment, Jonathan was sitting in the back reading the latest Potter adventure. Because the Eubanks met the taxi driver with connections to the creator of the fictional hero, they can now say they're "three degrees of Potter!"

Threading Science

Eubank, who hasn't taken biology since eighth grade, had never planned on studying the spread of infectious disease.

"When I was in school, the big advertisement for physics was that if you got a degree in it you could do just about anything," he says. Physics even taught him where to put the power in his swimming stroke. "I've learned how to apply my particular skills to solve any problem."

In New Mexico, Eubank also worked for the Los Alamos National Laboratory with a group developing the transportation analysis system TRANSIMS. The goal was to simulate the second-by-second movements of 1.6 million virtual people living in Portland, Oregon.

"My brother lives in Portland," said Eubank, the youngest of five children. "I tried to figure out who represented him in the simulated population." He admitted with some relief that synthetic people only *represent* real people and don't resemble individuals closely enough to identify them.

The model showed that there really are six or fewer degrees of separation between Portlanders. Transportation planners now use TRANSIMS to examine everything from traffic safety to energy consumption.

With many questions looming about the impact of biological warfare, the group used TRANSIMS as a foundation for modeling how diseases could move through communities and what interventions might slow or stop that spread. They started by unleashing virtual smallpox in the virtual Portland.

After the first simulated smallpox cases emerged—and spread quickly as people carried on with their daily activities—the researchers introduced various interventions, such as mass vaccination or quarantine, at different times. Patterns that emerged from the data showed that acting fast was the most crucial strategy for saving lives.

Eubank started attending scientific talks related to infectious disease spread. He met a new crowd of scientists, who encouraged him to get involved in a research project called Models of Infectious Disease Agent Study, or MIDAS, funded by the

National Institute of General Medical Sciences.

MIDAS researchers use different types of models to address a variety of questions about communicable diseases. But they've also teamed their expertise to focus on one in particular: pandemic flu.

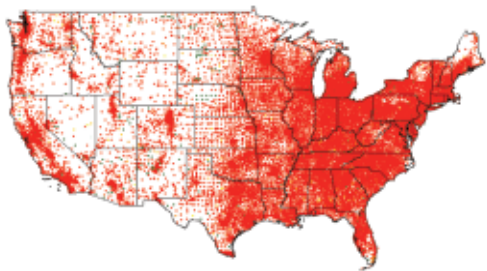
Cause for Concern

Beginning in December 2003, reports of a deadly flu in poultry emerged from several Asian countries. By early the next year, more than 100 million birds had died from the disease or were killed to control outbreaks. After a short lull, new cases appeared in European and African poultry, wild birds, and other animals like pigs. Some people caught it, too. As of May 2007, there have been more than 300 human cases and nearly 200 deaths.

Nearly all the evidence suggested that people caught the virus by directly handling sick birds.

But what if avian influenza started spreading easily between people? Health officials worried that if such a scenario ever occurred, millions of people worldwide would be at risk.

PROCEEDINGS OF THE NATIONAL ACADEMY OF SCIENCES



▲ This map of a simulated pandemic flu outbreak (red) shows how it could spread quickly across the nation without interventions like vaccination or quarantines.



▲ First released in 1989, *SimCity*™ is a simulation and city-building personal computer game.

So, Eubank and other MIDAS researchers got to work building models of pandemic flu. On top of the social network, they added whatever information they could gather about the avian influenza virus.

Using historical data, they estimated that a contagious person would infect at least one person in his or her social network—just enough to allow infection to spread. The researchers watched a simulated pandemic flu spread across countries and continents.

About 60 of Eubank's high-performance computers spent 10 hours modeling the spread of pandemic flu in Chicago. The simulated city, like the real one, has about 8.5 million people, and Eubank knew exactly when each person got sick and showed symptoms.

Preparedness Planning

The great thing about models, Eubank says, is that you can try out different scenarios not easily studied in real life.

“If the social network in the model is right, we can estimate pretty closely if a targeted intervention

like closing a particular school will slow down the spread of flu.”

The MIDAS researchers have used the pandemic flu models to answer questions—many times from policy-makers—about the potential effectiveness of different interventions and their timing of implementation. For instance, the models suggest that if people get vaccinated, the virus will spread more slowly. The results have helped shape national preparedness plans.

The next challenge is modeling how people will react during an outbreak. “A lot of models don't take into account people's behavior,” Eubank explains. “This makes determining the probability of outcomes harder.”

Whether someone gets a flu shot, for example, depends on a bunch of things: personal convenience, cost, risk, and whether the person has had one before.

To help figure out how to model human decisionmaking processes, Eubank has joined forces with an economist who studies game theory, a method for analyzing strategic behavior.



“We know what needs to go into the model, but not how to do it—that’s what makes it fun!” Eubank says.

He also has started working with an entomologist, a scientist who studies insects, to develop models of how diseases carried by organisms like mosquitoes are transmitted through social networks. These simulations could lead to practical measures for reducing the spread of dengue, malaria, and other diseases.

Real Life or Model?

As Eubank creates models in his Blacksburg office, a teenager in Fargo, North Dakota, may be building his own synthetic town. With the click of the mouse, he can build bridges, change tax rates, and zone buildings. His town may face disasters, like fires or monster attacks.

Actual computer games like *SimCity*™ let people simulate cause and effect.

Even though these games don’t begin to capture the complex dynamics at play in research models, Eubank says they offer a teaching tool that illustrates main concepts about social networks.

In fact, anyone can play Eubank’s videogame version of a MIDAS model at the Marian Koshland Science Museum in Washington, DC. With the push of a button, you can infect just a handful of virtual Chicagoans with measles or flu.

In seconds, the city map is covered in red, showing thousands of sick residents. Acting as the mayor of the city, you push another button that administers vaccines to as many people as possible very quickly.

You’ve prevented thousands from the virtual outbreak, and the map goes back to mostly green, representing healthy individuals.

And in the process, you’ve become two degrees of Eubank. ■

Spreading the Word

From horrific footage captured on cell phones to frantic messages from people under lockdown, the country learned of an unimaginable event unfolding on the ordinarily quiet campus of Virginia Tech University in Blacksburg.

In two separate attacks on April 16, 2007, a student opened fire on other students and faculty, brutally killing 32.

But many on campus didn’t know what was happening.

Stephen Eubank, a physicist at Virginia Tech, found out about the second attack during a conference call with colleagues at other campuses.

“Everyone said, ‘We saw the news and can’t believe it,’” he remembers. Eubank specializes in studying how future events might unfold.

“I want to develop models that help people prepare for and understand situations more quickly,” he says.

Right now, his research team focuses on understanding how infectious diseases can spread through cities and what interventions might slow or stop that spread. Understanding how communication spreads, he explains, is no different.



Information, much like a contagious infection, must be disseminated from person to person. Eubank has found that limiting social interactions can curb the number of people who get sick.

Could increasing social interactions speed the spread of news?

Studies at Virginia Tech are under way to examine how the campus responded to the events and to identify modes of communication, such as e-mail or phone trees, that circulate urgent news the fastest, farthest, and with the greatest impact.

Eubank, forever touched by the tragedy, may be among the researchers answering these questions.—E.C.



MICHAEL SWERDLOV LAB

▲ Researchers have linked DNA repair problems with Huntington's disease.

Overworked Gene Repair Kit Tied to Huntington's

Huntington's disease, or HD, is a neurological disorder that causes uncontrolled movements, clumsiness, and balance problems. As the disease worsens, HD can take away the ability to walk, talk, and swallow. There is no cure.

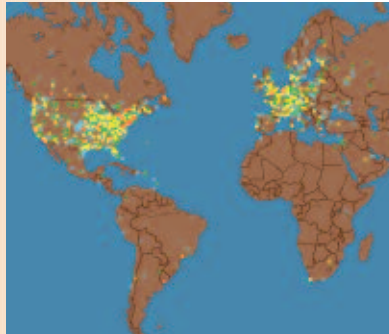
Although HD is an inherited disease involving a defective gene, symptoms usually don't appear until middle age. Researchers have been puzzled about why.

It's known that the disease gene contains an extra piece of DNA that gets copied over and over. For a while, the body's DNA repair machinery can trim the excess. But over time, the gene repair kit becomes overwhelmed, says pharmacologist **Cynthia McMurray** of the Mayo Clinic in Rochester, Minnesota.

McMurray did experiments with genetically altered mice that have the human version of the HD gene. Her results showed that in "middle-aged" mice, the DNA segments continued to grow in length and the mice's brain cells died.

When that happened, McMurray explains, faulty repair was worse than no repair at all. She is now looking for ways to either fix or eliminate the broken repair kit, which could ultimately prevent the onset of symptoms.

— *Alison Davis*



VIJAY PANDE

▲ Home computers all over the world contribute to science through Folding@Home.

Gamers for Science

Finally, you can tell your parents you're doing something worthwhile by racing virtual cars or fighting intergalactic battles on your video game console.

Scientists teamed with the Sony Corporation to install a program on every PlayStation®3 (PS3) that donates machine downtime to a research project called Folding@Home. The project harnesses the processing power of game consoles and computers to study proteins.

Proteins are chains of amino acids that fold into special shapes that allow them to do their jobs. Badly folded proteins can trigger diseases like Alzheimer's or cystic fibrosis.

Vijay Pande, a computational biologist at Stanford University in California, created Folding@Home to let idle home computers connected to the Internet help researchers solve huge scientific problems—like how proteins fold. Studying these processes requires enormous amounts of computing power.

Twenty times faster than the average computer, the PS3 also simulates protein folding twice as fast. When gamers connect their consoles to the Internet to play opponents, their machines get regular work assignments.

As of March 2007, more than 100,000 PS3 owners, including Pande himself, were playing for science. — *E.C.*



JEFFERY TITCOMB STUDIO

▲ Cutting-edge DNA technology has created super-strong sutures.

Bacteria Make Strong Stitches

Doctors use sutures to seal a wound caused by a serious cut or surgery. Stitches need to be strong enough to close a wound, but flexible enough to be tied easily. Absorbable sutures dissolve on their own, usually in a few weeks. These are ideal for many types of wounds.

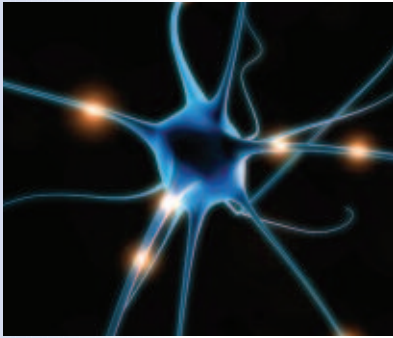
Typically, self-dissolving stitches are made of a synthetic fiber produced with standard chemical manufacturing methods. Unfortunately, these methods can be time-consuming and costly.

Now, scientists have discovered a new, relatively cheap way to manufacture sutures that are tougher and more flexible than current ones. Using recombinant DNA technology, or genetic engineering, chemist **David P. Martin** of the biotechnology company Tephra, Inc., in Cambridge, Massachusetts, created bacteria that produce a substance that can be converted to a self-dissolving, super-strong suture.

The U.S. Food and Drug Administration recently cleared the natural sutures, meaning they have passed safety tests and doctors can begin using them.

Tephra is looking for more ways to use genetic engineering to make new materials for use in medical devices such as surgical meshes. — *A.D.*





▲ In epilepsy, nerve cells fire uncontrollably.



▲ Scientists have found a new suspect in childhood asthma: bacteria.

Dandruff-Shampoo Ingredient May Calm Seizures

In a surprise discovery, scientists have found that zinc pyrithione, the active ingredient in dandruff shampoos, appears to do something else: quiet jumpy nerve cells that cause seizures in epilepsy and other neurological disorders.

Healthy nerve cells give off electrical pulses in response to two carefully timed chemical signals that start and stop the pulses. With seizures, potassium, the chemical “stop” signal, cannot flow into cells fast enough to shut off the pulse. The cells then “fire” uncontrollably.

Neuroscientist **Min Li** of the Johns Hopkins School of Medicine in Baltimore, Maryland, wasn’t looking for new cures for dandruff, the itchy, skin-flaking disorder of the scalp.

Rather, his research focuses on finding new treatments for epilepsy, a disorder caused by nerve cells that become overexcited.

Li’s team performed an exhaustive chemical search for substances that could let potassium into nerve cells.

After screening thousands of substances, one at a time, he discovered that zinc pyrithione allowed potassium to gush in and calm the nerve cells. — *A.D.*

Asthma Linked to Disappearing Stomach Bug

Trillions of bacteria live in our gastrointestinal tracts. They’re part of our health, helping to digest food, make vitamins, and run metabolism. Sometimes they even make us burp!

New research suggests they do something else really important: protect kids against getting asthma.

One of the most common stomach microbes, *Helicobacter pylori*, has lived in the stomachs of humans for millions of years. It’s best known for causing stomach cancer and ulcers. But due to better sanitation and more frequent use of antibiotics, fewer people in developed countries like the United States have this bacterium.

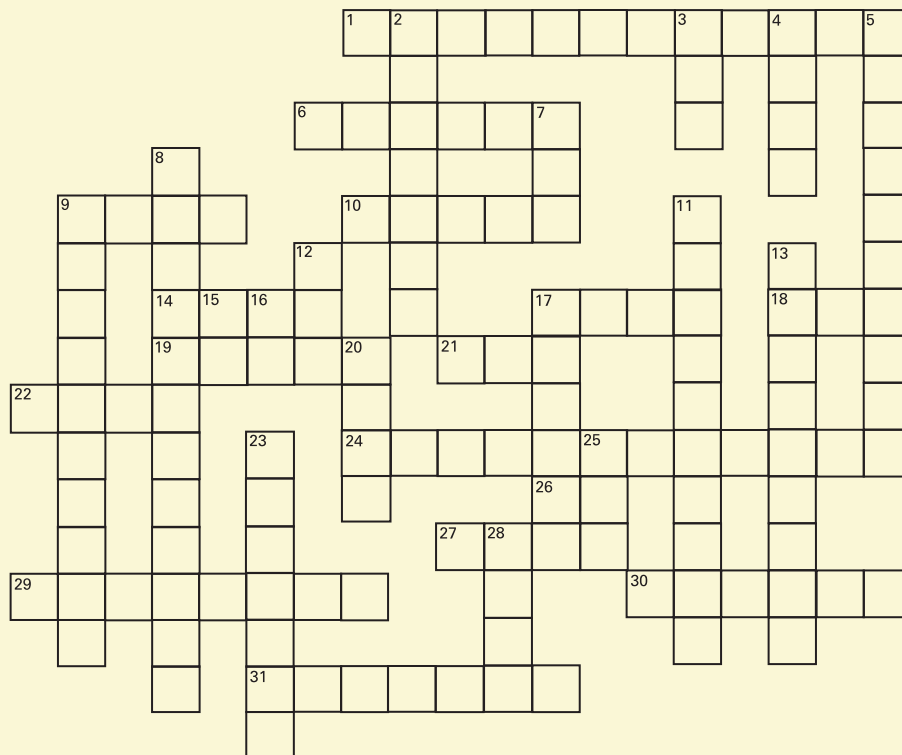
With *H. pylori* on the decline and other illnesses like asthma on the rise, microbiologist **Martin Blaser** of the New York University School of Medicine in New York City suspected a connection.

Blaser and his team compared the medical history and *H. pylori* status of more than 7,000 people. They found that people with the bacterium were less likely than those without it to develop asthma before their mid-teens.

The research raises questions about potential consequences of evicting this long-time microbial resident. — *E.C.*

These stories describe NIGMS-funded medical research projects. Although only the lead researchers are named, scientists work together in teams to carry out these studies.

The Last Word



ACROSS

1. blood vessel growth
6. stitch
9. not a one
10. injury
14. not closed
17. round Dutch cheese
18. cap
19. NIGMS-funded modeling project
21. influenza, for short
22. black and white sandwich cookie
24. body's start to healing a wound
26. not applic.
27. pen-stained
29. dentist-researcher Luisa Ann
30. four-legged trotters
31. epilepsy attack

Puzzle answers can be found at
<http://www.nigms.nih.gov/findings>

DOWN

2. interconnected people or things
3. Nat. Inst. of Health
4. wound's mark
5. distance between
7. final point
8. bug studier
9. first inflammation cell
11. model
12. gene storer
13. scientist who studies matter and energy
15. 3.14159265...
16. education, for short
17. physicist Stephen
20. body cover
23. tooth fixer
25. pre-June spring month
28. not far



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