HEALTH & SCIENCE

FOREMAN >>> HEALTHY GUMS CAN HELP WITH A HEALTHY BODY >>>PG 3D

POLAR BEAR ON PARADE

YOUNG CUB TO MAKE DEBUT AT BERLIN ZOO

>>>PG 2D

A SHOT IN THE ARM

HPV VACCINE MAY BE GOOD IDEA FOR MEN, TOO

>>>PG 6D

Bacteria thrive on 'film'

This slimy glue is everywhere – in your body, on your teeth – and hard to kill

BY CHRIS EMERY
[SUN REPORTER]

When he was studying for his doctorate in microbiology, Mark E. Shirtliff thought he knew a lot about bacteria.

Then things got scary.

He discovered that bacteria can band together into sheets — called biofilms. When they do, they alter their behavior. They build complex communities, establish lines of communication and coordinate their actions. Like ants, the microbes find power in numbers. And they're nasty.

"Infections that should respond to antibiotics don't," Shirtliff said. "They become 50 to 500 times more resistant."

With drugs often useless against biofilms in the human body, Shirtliff is trying to turn the tables on the slippery infections.

The assistant professor at the University of Maryland Dental School received $1.25 million this month from the National Institutes of Health for research into vaccines that might prevent the deadly films from forming in the first place.

Although the public rarely hears it in popular discussions of health issues, the term "biofilm" was coined in a 1978 *Scientific American* article by William Costerton, now of the University of Southern California Dental School. He used it to describe microbes that clump together on wet surfaces.

"It came up in dentistry first," Costerton said. "They called it plaque. I just proposed [that] the biofilm isn't just in the mouth, but everywhere."

In fact, biofilms *are* just about everywhere. They coat everything from Alpine river rocks to neglected teeth. Every year they cause billions of dollars of damage to ship hulls, oil pipelines and machinery by corroding metal surfaces and clogging up the works.

[Please see BIOFILM, 5D]

Mark E. Shirtliff holds a section of silicon tubing filled with bacteria. The University of Maryland Dental School assistant professor is studying ways to combat the complex communities of microbes known as biofilm that grow in the human body and elsewhere.
ALGERINA PERNA [SUN PHOTOGRAPHER]

Date palm gets new life after 2,000 years

Sapling grown from seed found by archaeologists

BY JOEL GREENBERG

JERUSALEM // In quarantine under protective netting, a palm sapling coaxed from a seed that's nearly 2,000 years old is growing in southern Israel.

Researchers nurturing the plant, nicknamed Methuselah after the biblical figure said to have lived 969 years, are worried about the seedling's exposure to modern pests.

"Things have changed in 2,000 years, and we have this plant that is frozen in time, like Rip Van Winkle," said Elaine Solowey, a horticulturist from the Arava Institute for Environmental Studies at Kibbutz Ketura in the southern Negev region.

"We have date trees across the road with modern diseases," Solowey said. "There's only one tree like this, and I feel very responsible for it."

The fledgling date palm was grown from a seed found by archaeologists at the desert fortress of Masada, where Jewish rebels took their own lives in A.D. 73 rather than submit to Roman forces that captured the stronghold after a long siege. Carbon dating has shown the seed to be from around the 1st century.

If the plant is female and continues to grow normally, researchers say, it could produce fruit in three to four years, replicating the ancient date of Judea, a valued export also known for its medicinal properties.

"Our ancestors were eating these kinds of dates," Solowey said. "That's kind of a thrill, to put yourself in the shoes of ancient people and know how they made their living and what they were eating."

The idea of germinating the ancient seed was conceived by Dr. Sarah Sallon, director of the Louis L. Borick Natural Medicine Research Center at Hadassah Medical Center in Jerusalem. The center focuses on the study of natural therapies such as Tibetan and Chinese medicine as well as medicinal plants indigenous to the Middle East.

Researchers study local species for their remedial properties and collect information on their traditional use. They also work to preserve such plants and reintroduce those that have become extinct in Israel.

The Judean date once grew in vast plantations stretching from the Sea of Galilee to the

[Please see PALM, 4D]

SCARRED BY THE PAST

The planet's recent run-ins with Mother Nature are nothing compared with what the Earth has been through over millions of years of history

BY ROBERT S. BOYD
[MCCLATCHY-TRIBUNE]

Tornadoes, hurricanes, blizzards, floods, wildfires, earthquakes, tsunamis: Mother Nature seems to have it in for our world these days.

In a way, though, we live in a relatively peaceful time. While it's no comfort to those hurting or grieving now, Earth saw far greater catastrophes in its long and troubled past.

The planet has been frozen, roasted, smothered, battered, shaken and half-drowned. Entire species have been obliterated. So far, fortunately, that doesn't include *Homo sapiens*, but we've had a close call.

And these are all natural calamities, not those caused by humans, such as war, terrorism or the Holocaust.

"The history of life may have been shaped by major catastrophes to a far greater extent than previously realized," Trevor Palmer, a biologist at Britain's Nottingham Trent University, wrote in his 2003 book, *Perilous Planet Earth*.

Some disasters struck in recent centuries and

[Please see EARTH, 3D]

The eruption of Mount St. Helens in 1980 was one of the most catastrophic and powerful natural events in recorded history. Many researchers say eruptions bigger than this would have been likely when the planet was in its infancy.
ROGER WERTH [ASSOCIATED PRESS]

FROM THE COVER

Combating bacteria bound by film

BIOFILM [From Page 1D]

These plaques often contain a variety of microorganisms, including bacteria, protozoa and algae suspended in slimy glue called polysaccharide that holds them together and binds them to surfaces. When enough of the organisms have collected, they undergo metabolic changes that make them better team players.

"We tend to think of them as primitive single-celled organisms," said Phil Stewart, the director of the Center for Biofilm Engineering at Montana State University. "But there is a lot of cooperation and coordination comparable to something more like an ant colony. It allows them to accomplish more than they could on their own."

Particularly vexing is the ability of virulent bacterial infections to resist attack after forming a biofilm. "We could pump bleach into your system," Shirtliff said, "and it probably wouldn't do anything."

"BIOFILM ISN'T JUST IN THE MOUTH, BUT EVERYWHERE."
MARK E. SHIRTLIFF
UM DENTAL SCHOOL

That's saying something. Chlorine bleach is the microbiologist's ultimate weapon — it's used to disinfect the labs that house the world's most dangerous germs.

Like soldiers hiding in a castle, the bacteria inside the film are protected from drugs design to kill them. The cells are also starved for nutrients. This makes them grow and divide slowly — providing even more drug resistance, since antibiotics often target fast-growing cells.

The stress also puts biofilm bacteria on the defensive, causing them to release caustic acids and proteins. "They start freaking out," Shirtliff said. "They turn on stress response genes that make them attack the antibiotic."

Compounding the problem, the stress response tricks the natural immune system into using the wrong attack plan. When the macrophages and other white blood cells that form the body's police force arrive on the scene, they're ambushed and destroyed by the biofilm's arsenal of proteins and acids.

Biofilm infections often return because antibiotics kill only the free-floating — or planktonic — bacteria. When a patient stops taking the drug, new free-roaming bacteria emerge from the biofilm and the infection spreads again.

Scientists estimate that 65 percent to 80 percent of chronic infections in industrialized nations linger on because of biofilm formation. Biofilms appear in patients with cystic fibrosis, gum disease and chronic inner ear, urinary tract and bone infections.

Medical devices such dental implants, catheters, artificial joints and heart valves are vulnerable to biofilm formation.

Central venous catheters, a type inserted into most intensive-care patients in hospitals, are a common source of bacterial biofilms. About 80,000 of ICU patients contract bacterial infections from the catheters each year — and about 35 percent of those die from the infection, according to the Centers for Disease Control and Prevention.

When biofilms grow on bone and metal after joint replacement surgery, the only option may be to start again from scratch.

"The only way you can get it out of there is by carving it out," Shirtliff said. "If an artificial knee gets infected, you're going to have to take that knee out and put another one in."

In his research, Shirtliff has focused on one particularly bad actor that has gotten a lot of press lately: methicillin-resistant staphylococcus aureus (MRSA). The antibiotic-resistant bacteria kill about 90,000 people in the United States every year, according to the CDC.

Mark E. Shirtliff walks in his lab at the University of Maryland Dental School. He recently received $1.25 million to research vaccines to prevent the formation of biofilms.
PHOTOS BY ALGERINA PERNA [SUN PHOTOGRAPHER]

Because MRSA infections are difficult or impossible to eradicate once a biofilm is fully formed, Shirtliff is searching for a way prevent the films from growing.

The trick, he believes, is to hone in on the odd behavior of the biofilm bacteria. He has identified proteins the bacteria produce in abundance as they form a film and hopes to develop antibodies that will target those proteins.

Like an army attacking a half-built fortress, the antibodies would attack the immature biofilm and destroy it before its defenses are fully formed.

"The antibodies come in and deactivate the proteins and can destroy the biofilm," he said. "The immune cells could also come in safely then and attack as well."

To test his theories, Shirtliff grows MRSA biofilms in silicon tubing in his lab at the dental school and looks for protein targets.

Anti-biofilm vaccines he has developed have proven effective for treating rabbits with MRSA bone infections. He hopes to move on to clinical trials in humans within four years, he said.

He said a vaccine might be the best way to combat MRSA because the bacteria are so widespread. "Here in the United States," he said, "it's hard to cork that bottle."

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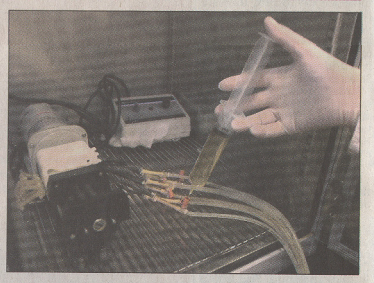

Bacteria culture media is injected into silicon tubing connected to a bioreactor system, which pumps liquid into the tubing. The bacteria that adhere to the tubing are then studied.