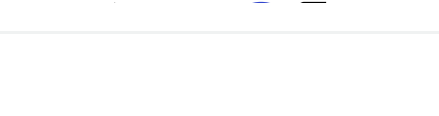


the microbiologist

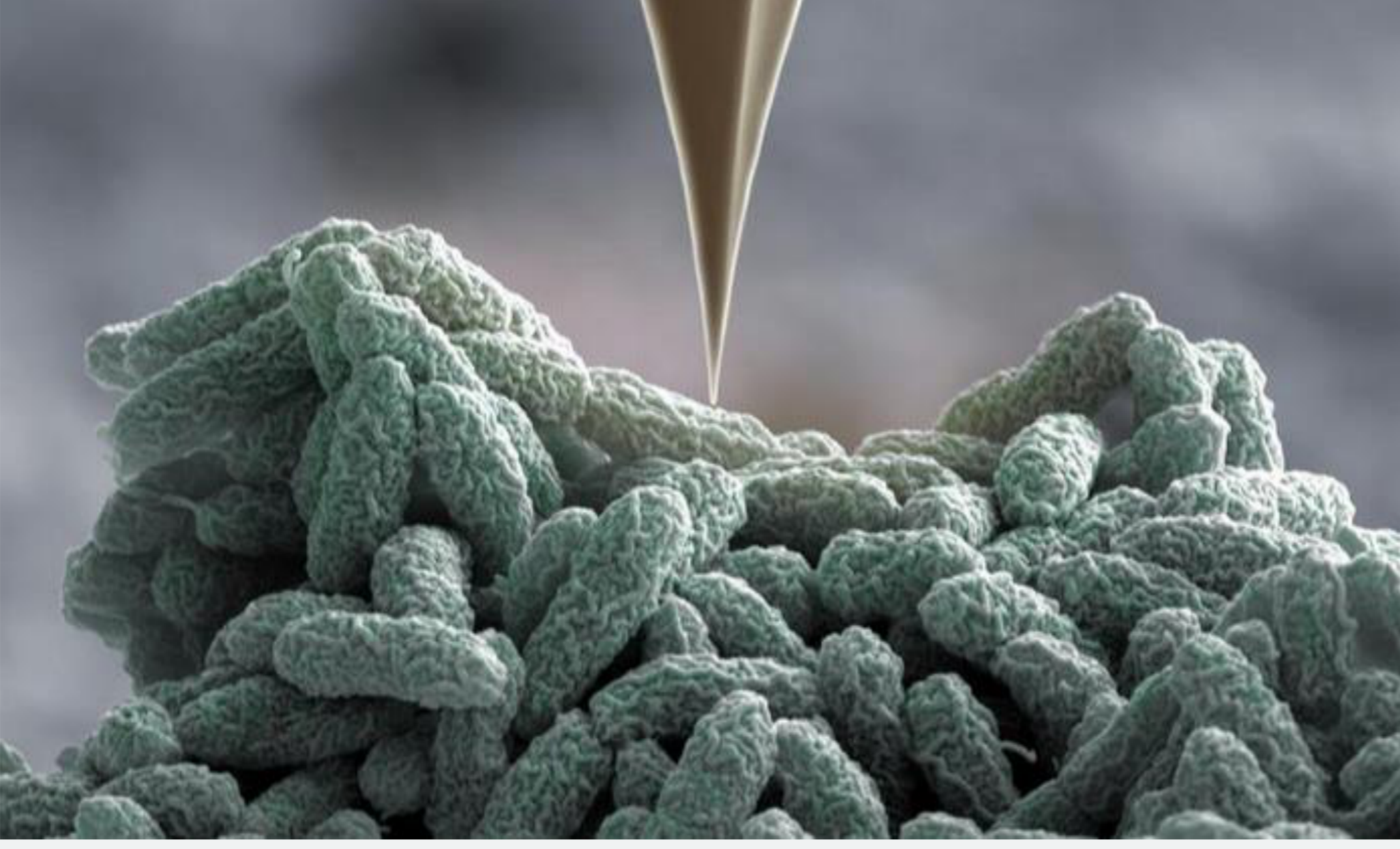
NEWS

Damaged but not defeated: Bacteria use nano-spearguns to retaliate against attacks

BY BASIL FOK | 6 MARCH 2025



Some bacteria deploy tiny spearguns to retaliate against rival attacks. Researchers at the University of Basel mimicked attacks by poking bacteria with an ultra-sharp tip. Using this approach, they have uncovered that bacteria assemble their nanoweapons in response to cell envelope damage and rapidly strike back with high precision.

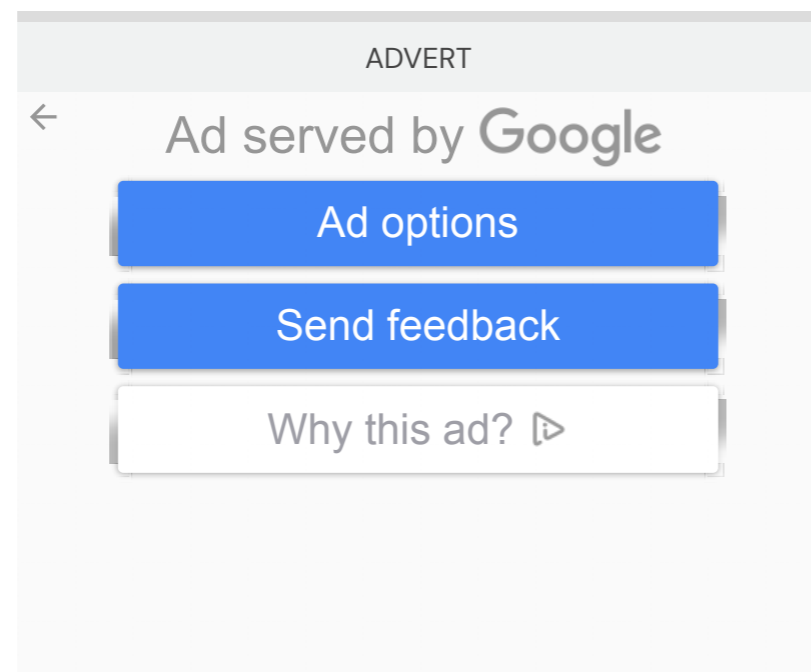


Source: University of Basel, Biozentrum/SNI Nano Imaging Lab
Pseudomonas bacteria deploy their nano-spearguns when damaged by a sharp tip (15,000 x magnification).

In the world of microbes, peaceful coexistence goes hand in hand with fierce competition for nutrients and space. Certain bacteria outcompete rivals and fend off attackers by injecting them with a lethal cocktail using tiny, nano-sized spearguns, known as type VI secretion systems (T6SS).

Bacteria respond to cell envelope damage

The research group led by Professor Marek Basler at the Biozentrum, University of Basel, has been studying the T6SS of different bacterial species for many years. "We knew that *Pseudomonas aeruginosa* uses its T6SS to fire back when attacked", explains Basler. "But we did not know what exactly triggers the assembly of the nano-speargun: the contact with neighbors, toxic molecules, or simply cell damage?"



READ MORE: [Pathogens deploy speargun nanomachine to spread unrecognized in the body](#)

READ MORE: [Scientists uncover mechanism that could weaken virulence of *Pseudomonas aeruginosa*](#)

In close collaboration with Roderick Lim, Argovia Professor for Nanobiology at the Biozentrum and the Swiss Nanoscience Institute (SNI), the researchers have now demonstrated: *Pseudomonas aeruginosa* responds to ruptures in the outer membrane – initiated by mechanical force, such as poking with a sharp tip. The study has been published in *Science Advances*.

Counterattack with a tiny 'needle'

Roderick Lim's lab has a long-standing expertise in atomic force microscopy (AFM) technology. "Using AFM, we have been able to mimic a bacterial T6SS attack", says Mitchell Bröderlin, PhD student at the SNI PhD School and first-author of the study. "With the needle-like, ultra-sharp AFM tip, we can touch the bacterial surface and, with gradually increasing the pressure, puncture the outer and the inner membrane in a controlled manner."

In combination with fluorescence microscopy, the researchers revealed that the bacteria respond to outer membrane damage. "Within ten seconds the bacteria assemble their T6SS, often repeatedly, at the site of damage and fire back with pinpoint accuracy," adds Basler. "Our work clearly shows that breaking the outer membrane is necessary and sufficient to trigger T6SS assembly."

New insights into bacterial defense mechanisms

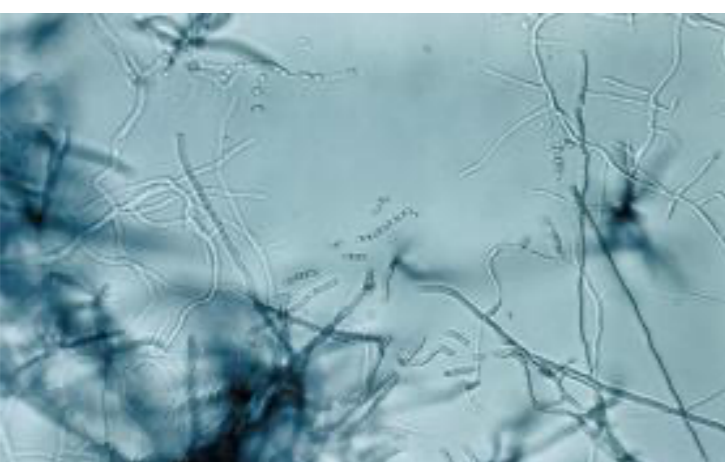
The biggest challenge for the researchers was the size and the shape of the bacteria. "So far, we have only used the AFM to study eukaryotic cells, including human cells," explains Lim. "But *Pseudomonas* bacteria are more than ten times smaller than human cells, so it was demanding to poke them at a specific site."

In the microbial ecosystem, survival is all about strategy, and *Pseudomonas aeruginosa* has certainly mastered the art of defense. "The targeted and swift retaliation against local attacks minimizes misfiring and optimizes the cost-benefit ratio", says Basler. This clever tactic gives *Pseudomonas* a survival advantage, enabling it to incapacitate attackers and thrive in diverse and often challenging environments.

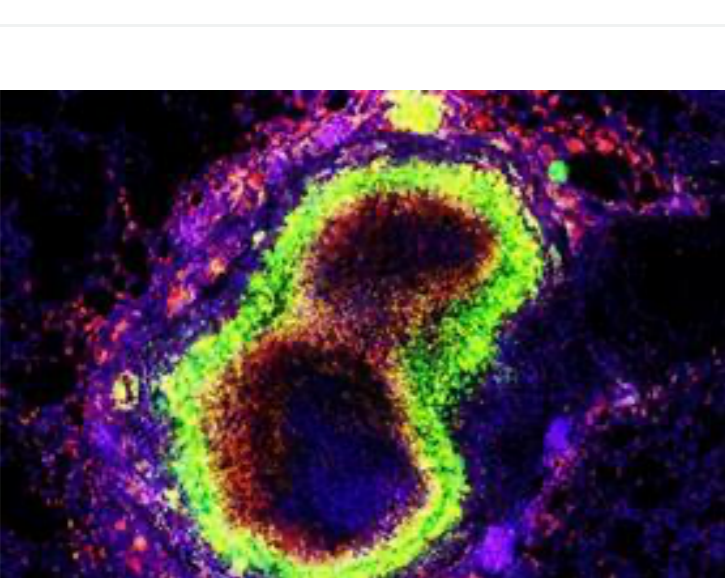
ATOMIC FORCE MICROSCOPY BACTERIA MAREK BASLER MICROBIOLOGICAL METHODS MITCHELL BRÜDERLIN NANO-SPEARGUN ONE HEALTH PSEUDOMONAS AERUGINOSA RESEARCH NEWS RODERICK LIM STRUCTURAL BIOLOGY SWISS NANOSCIENCE INSTITUTE TYPE VI SECRETION SYSTEMS UK & REST OF EUROPE UNIVERSITY OF BASEL



RELATED ARTICLES



News
Bacterial 'jumping genes' can target and control chromosome ends
6 MARCH 2025 20:01 | BY LINDA STEWART
Researchers have discovered a new mechanism that transposons, or "jumping genes" use to survive and propagate in bacteria with linear DNA, with applications in biotechnology and drug development.



News
TB vaccine candidate provides 'elite' protection
6 MARCH 2025 16:05 | BY BASIL FOK
A tuberculosis vaccine candidate under development shows complete protection and superior immune response in nonhuman primates compared to the existing BCG vaccine.



News
A 'Trojan Horse' approach to develop new antimalarial drugs
6 MARCH 2025 16:04 | BY BASIL FOK
Researchers have discovered a key process whereby malarial parasites take up a human blood cell enzyme, which could provide a new approach for antimalarial treatment.

LOAD MORE ARTICLES

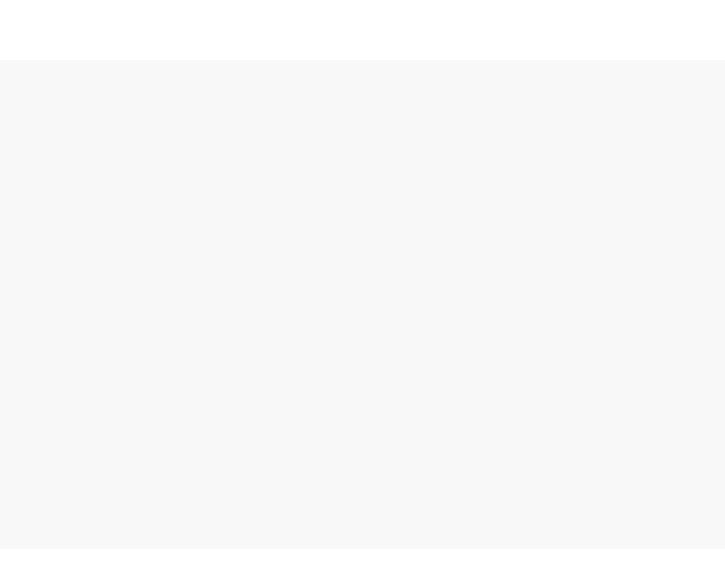
NO COMMENTS YET

Only registered users can comment on this article.
You're not signed in. [SIGN IN](#) [REGISTER](#)

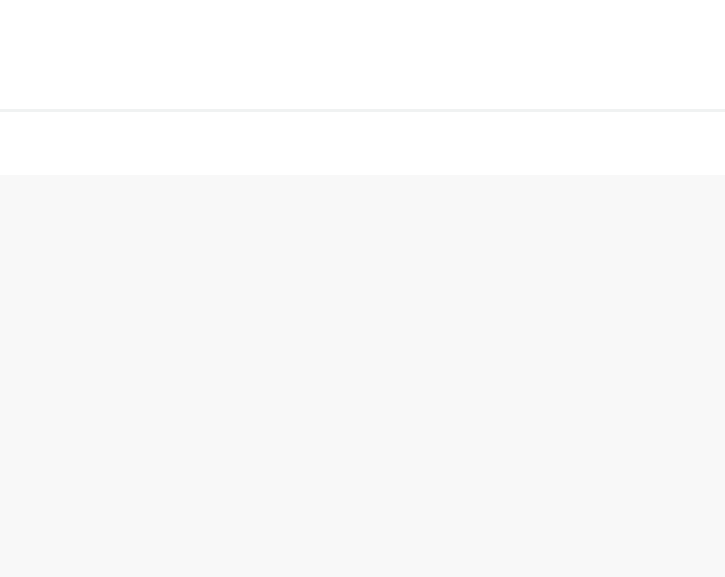
MORE FROM NEWS



News
Method detects signs of life in ancient rocks - such as Mars samples
6 MARCH 2025 16:03 | BY BASIL FOK
A new instrument was successfully developed to detect microbial lifeforms in ancient Earth rocks analogous to those found on Mars rocks, as a biohazard precaution measure when Mars rock samples are brought to Earth.



News
Packets of freeze-dried bacteria grow bio cement on demand
6 MARCH 2025 12:59 | BY LINDA STEWART
Researchers report a freeze-drying approach that preserves bio-cement-producing bacteria, potentially allowing construction workers to use powder out of a packet to quickly make tiles, repair oil wells or strengthen the ground for makeshift roads.



News
Research identifies key antibodies for development of broadly protective norovirus vaccine
6 MARCH 2025 12:48 | BY LINDA STEWART
A new study identifies powerful antibodies capable of neutralizing a wide range of norovirus strains. The finding could lead to the design of broadly effective norovirus vaccine, as well as the development of new therapeutic antibodies.

LOAD MORE ARTICLES

MOST POPULAR	LATEST
A cider a day keeps the UTIs away	The scent of infection: how smells can help us spot disease
Scientists probe honeybee antiviral defense mechanisms	Advancing microbial research in the North East Indian Himalaya: a pathway to sustainable hill agriculture
Promoting plant growth with the help of yeasts	Applied Microbiology International launches 2025 Grant Portfolio
Antimicrobials for an Antimicrobial Resistant World	The birds, the bees, and the bugs: how gut microbes impact sex hormones and reproductive health
Free-living amoebae and emerging public health challenges in a warming world	Probiotics in kombucha mimic fasting and reduce fat stores in worms