

HEADLINE

Fall 2021

# Discoveries



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# HEADLINE Discoveries

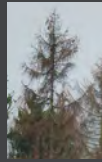
Fall 2021

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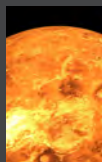
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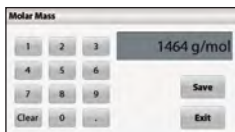
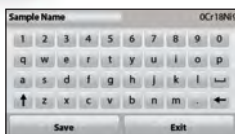
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# The Future of Respiratory Support May Be Through the Intestines

By Mike Howie



An uncommon fact about the everyday act of respiration is that, in some creatures, it can be done through their rear end.

Several aquatic organisms that live in low-oxygen environments evolved to breathe using organs other than their gills or lungs — namely, their intestines. This has been documented in sea cucumbers, loaches, and certain freshwater catfish. But scientists have debated whether mammals have similar abilities.

Now, researchers have demonstrated that rats, mice, and pigs can indeed “breathe” to some degree through their intestines. Their study, published May 14, 2021, in the journal *Med*, detailed how delivering oxygen gas or oxygenated liquid through the rectum saved two mammalian models from respiratory failure.

## Take a Deep Breath

The study began with mice. The researchers designed an intestinal gas ventilation system that could administer pure oxygen to the mice through their rectums. The system had a positive effect on 75% of the mice.

So the first test was a success — it showed that the system helped more oxygen reach the heart and provided rescue in the face of conditions that would normally spell peril. The problem, however, was that the system required abrasion of the intestinal mucosa, making it unlikely to be applicable to human patients, especially those who are severely ill.

Faced with this fact, the researchers developed a second system, one that uses oxygenated perfluorochemicals, which have already been shown to be safe in humans.

This new liquid-based ventilation system delivered similarly successful results when tested with mice and pigs exposed to low-oxygen conditions. Pigs connected to the system exhibited reversed skin pallor and coldness as well as increased oxygen levels without obvious side effects.

These successes prompted the researchers to ask a bigger question: could a version of these systems help manage respiratory failure in humans?

## New Potential for Respiratory Support

“Artificial respiratory support plays a vital role in the clinical management of respiratory failure due to severe illnesses such as pneumonia or acute respiratory distress syndrome,” said senior study author Takanori Takebe of the Tokyo Medical and Dental University and the Cincinnati Children’s Hospital Medical Center. “Although the side effects and safety need to be thoroughly evaluated in humans, our approach may offer a new paradigm to support critically ill patients with respiratory failure.”

The COVID-19 pandemic demonstrated at devastating scale just how critical respiratory care is. With hospitals around the world overwhelmed, the global supply of ventilators

and artificial lungs fell short, endangering patients. Had more options for respiratory support been available, the toll of the pandemic might have been lessened.

These new techniques for delivering oxygen to patients in need are still in their infancy, but Takebe is optimistic. “The level of arterial oxygenation provided by our ventilation system, if scaled for human application, is likely sufficient to treat patients with severe respiratory failure, potentially providing life-saving oxygenation.”

### DISCUSSION QUESTIONS

How will these systems need to be changed to be suitable for use with humans?

What other respiratory support techniques are available?

### VOCABULARY

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# Microfluidic Devices

## Mimic and Treat Cardiovascular Disease

By Anna C. Martinez



Cardiovascular disease, or CVD, is the leading cause of death for people in the United States. The most common causes of CVD are a lack of exercise, poor diet, high blood pressure, and high cholesterol. People with CVD are more susceptible to heart attacks, a phenomenon that occurs when the heart does not receive enough blood. One in five heart attacks are silent, meaning that the affected person may not realize that they are having a heart attack right away.<sup>1</sup>

Microfluidics is a developing field that involves moving fluids through minuscule devices. This fluid manipulation often emulates biological, chemical, and physical processes, such as the movement of blood through veins, arteries, and the heart.<sup>2</sup> Microfluidic devices can be used to mimic blood flow through the heart to help diagnose and treat CVD.

### Diagnosing CVD with Microfluidics

Biomarkers are medical signs that inform people what is happening inside the body.<sup>3</sup> Because cardiac troponin T (cTnT) and myoglobin (Myo) are antibodies that are typically found in cardiac muscle, they are often used as biomarkers for the heart. Abnormal amounts of these biomarkers in the heart are signs that someone may be developing CVD.

Microfluidic chips can measure cTnT and Myo levels in the blood using chemiluminescence and immunofluorescence.<sup>4</sup> These optical detection methods involve labeling cTnT and Myo with fluorescent markers and quantifying the biomarker levels as they circulate through the microfluidic chip. Abnormal biomarker levels, as indicated by the fluorescent marker counts, show a potential risk of CVD being present.

### Cardiovascular Microfluidic Models and CVD Treatments

The primary treatment for CVD is drug therapy. Microfluidic devices that emulate the cardiovascular system can be used to assess the efficacy of new drug treatments. These microfluidic devices mimic the blood flow and pressure that is typical in people with CVD.<sup>4</sup> By injecting drug treatments into circulation inside a cardiovascular-mimetic device, researchers can ascertain which treatment therapies are the most effective at treating CVD.

1. <https://www.cdc.gov/heartdisease/facts.htm>
2. <https://www.sciencedirect.com/science/article/pii/B978044453125450019X>
3. <https://www.niehs.nih.gov/health/topics/science/biomarkers/index.cfm>
4. <https://www.nature.com/articles/s41378-021-00245-2#Sec6>

### DISCUSSION QUESTIONS

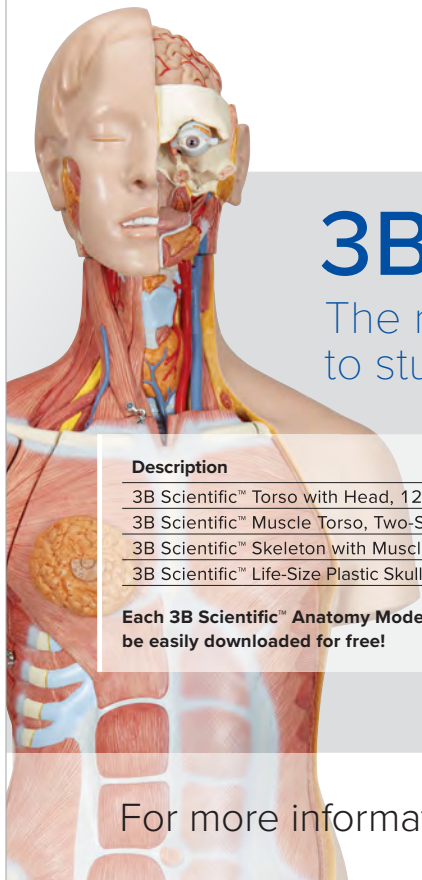
- Why is it important to eat a healthy diet and to exercise regularly?
- How do doctors and nurses use biomarkers to make sure you are healthy?
- Are there other ways that microfluidic devices can mimic a process that occurs inside the human body?

### VOCABULARY

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# Teens Win Awards for Drought-Fighting Technology

By Mark Miller

Two teen engineers have come up with award-winning technologies to help combat drought by determining how thirsty plants are and improving water management.

John Benedict Estrada, a sophomore at Clovis North High School in Fresno, California, developed a robotic arm that determines how thirsty plants are by measuring how they reflect light. He was awarded the \$50,000 Gordon E. Moore Award for Positive Outcomes for Future Generations.

Arya Tschand, a senior at High Technology High School in Lincroft, New Jersey, used a flying drone as part of his drought-busting solution. It measures a plant's thirst by the color of its leaves. He received the \$10,000 Craig R. Barrett Award for Innovation from ISEF.

## Detection by Reflection

Scientists can detect plant thirst or drought stress by measuring how dry the air is above a field or by taking the temperature of the plants themselves. John Estrada's robotic arm uses an infrared camera to directly measure how red, green, and blue light reflects off bell pepper plants. How plants reflect light changes as they become drier. We can't see these changes, but the infrared camera can.

The robotic arm is also able to measure soil moisture and temperature.

The data collected by these instruments is fed into artificial intelligence computer software that uses machine learning to predict which plants will require the most water.

## Drone vs Drought

As Arya Tschand's drone hovers over plants, it can measure how dry they are by the color of their leaves. Signals are then sent to an irrigation system on the ground that adjusts its output based on the color data. The system also includes a valve that connects to the irrigation pipes to optimize how much water is used.

Arya witnessed the effects of water shortages first hand. One feature of his system is that it does not require internet access, which can be scarce in developing areas where better water management may be needed most.

## Next Steps

The next steps for John Estrada's robotic reflection device are already in the works. "I am planning to do a field experiment," John told *Science News for Students*, "to collect field data and adapt my model to actual field conditions."

As for Arya Tschand's drone, he is also looking to scale. "I didn't have a field of crops to test my drone on, so I used some plants I had at home." According to *Science News for Students*, he is looking to broaden the scope of his system and has applied for a patent.

### DISCUSSION QUESTIONS

Talk about the effects of water shortages around the world. How big is the problem and which areas are affected most?

Discuss what computer models are and how they are used. What are some applications where creating simulations can help solve problems?

### VOCABULARY

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# Dead Trees

## Add to Mix of Greenhouse Gases

By Christina P. Hooton

Ghost forests, or forests of dead trees, form along coasts like eerie harbingers. These trees, once part of healthy woodland, are poisoned by saltwater as sea levels rise, a condition that is expected to increase as climate change advances. According to a new study published in *Biogeochemistry*, they're becoming a source of greenhouse gas emissions to watch.

### Haunted by Climate Change

"The emergence of ghost forests is one of the biggest changes happening in response to sea level rise," said Keryn Gedan, a coastal ecologist at George Washington University in Washington, DC. Gedan, who was not involved in the work, was quoted in the *Science News* article "'Tree farts' contribute about a fifth of greenhouse gases from ghost forests" by Maria Temming.

Gedan explained that eventually, these areas would become carbon "sinks," as wetlands store more carbon than forests. But in the short term, the dead trees stop absorbing carbon dioxide through photosynthesis and instead release greenhouse gases. Referred to as "tree farts," these gas emissions are created by microbes in the soil and trees, just

like the farts of people and animals, which are the result of microbes that live in the gut.

### Assessing the Damage

Equipped with portable gas analyzers, researchers measured carbon dioxide (CO<sub>2</sub>), methane, and nitrous oxide emissions from dead trees and soil in five ghost forests on the Albermarle-Pamlico Peninsula in North Carolina.

The soil in these areas gives off more greenhouse gases than trees, emitting an average of 416 milligrams of CO<sub>2</sub>, 5.9 milligrams of methane, and 0.1 milligrams of nitrous oxide per square meter of ground per hour. Dead trees emit 116 milligrams of CO<sub>2</sub>, 0.3 milligrams of methane, and 0.04 milligrams of nitrous oxide for the same amount of space and time. In comparison, a dairy cow can emit up to 27 grams of methane per hour.

Researchers noted that the dead trees increased greenhouse gas emissions of the overall ecosystem by about 25 percent. "Even though these standing dead trees are not emitting as much as the soils, they're still emitting something, and they definitely need

to be accounted for," said the study's lead author Melinda Martinez, a graduate student in forestry and environmental resources at North Carolina State University, in a university news release. "Even the smallest fart counts."

Studies like this one have the potential to help us see a more complete picture of climate change, giving us the data we need to understand its compounding effects.

### DISCUSSION QUESTIONS

Brainstorm sources of greenhouse gas emissions. Rank them on a scale of 1 to 10, 1 being the lowest emitters and 10 being the greatest. See if you can verify your hunches.

Talk about the relationship between greenhouse gas emissions, rising sea levels, and warmer weather. Explain how they all interact to further the effects of climate change.

### VOCABULARY

GREENHOUSE GAS   PHOTOSYNTHESIS  
ECOSYSTEM



# Antibiotics Might Help Scientists Treat Coral Disease

By Kylie Wolfe

Stricken with a tissue-eating disease, coral reefs off the coast of Florida are dying. Now, to help them recover, experts are searching for solutions. And they just might have found their answer in a common antibiotic.

During a recent study, researchers found that amoxicillin, often prescribed for ear and chest infections, stops the disease temporarily. Their findings were published in *Scientific Reports*.

## Trouble at Sea

Threats like warming waters, pollution, and overfishing are already stressing coral populations. Although they make up less than two percent of the ocean's floor, coral reefs are key to underwater ecosystems. Dozens of coral diseases plague them, but little is known about each illness.

Stony coral tissue loss disease (SCTLD), nicknamed skittle-D, was first discovered in 2014 near Miami and has since traveled to the Caribbean. What begins as a white lesion quickly spreads to surrounding tissue. The spots grow until the entire organism is overtaken and, unable to fight the infection, the coral dies days or weeks later.

Today, most of the Great Florida Reef is infected. That's 360 miles of coral. With an unknown cause and no cure, scientists began testing various treatments.

## Research and Recovery

Erin Schilling, a coral researcher at Florida Atlantic University, and her team started their study in April 2019. For 11 months, they monitored 95 lesions on coral colonies of *Colpophyllia natans*, *Dichocoenia stokesii*, *Meandrina meandrites*, *Montastraea cavernosa*, and *Pseudodiploria strigosa*.

On some, they applied a chlorinated epoxy and on others, an amoxicillin paste. To keep healthy and diseased coral tissue apart, they carved channels around the lesions and filled them with the appropriate treatment.

Of the lesions treated with epoxy, only 20 percent healed. Of those treated with amoxicillin, 95 percent healed. This occurred within three months of observation.

## Questions Left Unanswered

Because of the treatment's success, researchers speculate that SCTLD is a bacterial disease. If it's actually viral, the

tooth-paste-like cream is merely addressing symptoms and not the root cause. To combat the disease long-term would require a different treatment.

With results in hand, scientists now want to understand whether or not the coral will experience side effects, which species will respond positively, and how long the treatment will help.

Though the antibiotic doesn't stop new lesions from appearing, it helps heal existing ones. As scientists monitor the spread of SCTLD, there's hope that more answers lie ahead.

## DISCUSSION QUESTIONS

Why might an antibiotic traditionally given to humans also be a viable treatment for coral disease?

What other environmental concerns are affecting coral populations?

## VOCABULARY

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After 40 Years,  
**Still Waiting for  
an HIV Vaccine**

By Iva Fedorka

In 1981, researchers described a pneumonia caused by the *Pneumocystis carini* fungus in five gay men, two of which had already died. In the June 5, 1981 issue of the *CDC Morbidity and Mortality Weekly Report*, they described this infection that usually occurs only in people who are severely immunocompromised. Scientists would soon discover that the disease, which would later be known as AIDS, was affecting the men's immune systems.

Three years later, scientists identified HIV, the human immunodeficiency virus. In an April 1984 news conference, U.S. Secretary of Health and Human Services Margaret Heckler promised that a vaccine against HIV would be ready to test within two years.

Two years have turned into 40 — and counting.

## The HIV Pandemic

The HIV virus has caused huge losses. As of 2019, it has infected more than 75 million people worldwide and killed approximately 32.7 million. Advances in antiviral treatments have prevented even more infected people from transmitting or dying from HIV.

But an HIV infection never really ends. Its long-lasting effect is one reason why we still don't have an HIV vaccine. Other reasons include its many variants and its unusual ability to evade the body's immune system.

## HIV Research

Cost has also been an issue. Funding for HIV research has historically been distributed in five-year installments, which makes it difficult to efficiently allocate funds. However, HIV-funded research has contributed to the rapid development of other vaccines, including the COVID-19 vaccines.

The technology used in the Johnson & Johnson vaccine was first developed for HIV because it stimulates a strong immune response. Like previous HIV vaccine candidates, it uses altered common cold viruses as carriers to deliver instructions to cells to produce the viral proteins that trigger the immune system.

"The absence of a good HIV vaccine is not for lack of trying," said Mark Feinberg, a viral immunologist who is president and CEO of the International AIDS Vaccine Initiative in New York City. "The work that's gone into HIV vaccine development has been by far the most sophisticated and creative."

## HIV Complexity

The biology of the virus itself has been a factor, including the genetic diversity of HIV viruses found around the world. The virus replicates its genetic blueprint rapidly and creates tens of thousands of new copies a day in a single person. Since each copy has, on average, at least one mutation, a person's body may house multiple variants. Not all variants are transmissible, but some have a greater transmissibility.

The virus also deploys tactics to escape detection by the immune system. Mutations may occur in the parts of the virus targeted by the immune system and may escape detection that way. The virus can also cover parts of its surface in a layer of sugar molecules that obscure the prime antibody targets.

"The body recognizes these sugars as "self," said Barton Haynes, an immunologist at the Human Vaccine Institute at Duke University School of Medicine. "Basically, what the virus is saying to our immune system is 'Sure, you can make a protective immune response, go for it.'" But if the antibodies attack, they're seen as turncoats and are eliminated. That means the body can't fight the virus as effectively.

The lifelong nature of the infection is also significant. Many viruses disappear from the body after being defeated by the immune system. But HIV can insert genetic material into its host's DNA, which establishes a reservoir in immune T cells. Since T cells normally fight infections, the virus is less detectable by the immune system and safe from medicines.

## HIV Vaccine Candidates

Only a small number of clinical trials have been conducted to test potential HIV vaccines in people. Of the six completed trials, only one vaccine effectively prevented infection.

Named RV144, it required six shots per participant — four "prime" and two "boost" injections — and lowered the risk of infection by 31.2 percent for vaccinated vs. unvaccinated individuals.

The results from RV144, published in the *New England Journal of Medicine* in December 2009, suggested that antibodies were critical

for reducing the risk of infection. That changed views about the relative importance of T cells and antibodies for protection.

## Producing the Right Immune Response

Since some infected people naturally produce antibodies to multiple HIV variants, some vaccine developers still hope to make a vaccine that provides sterilizing immunity. By identifying neutralizing antibodies in HIV-infected people, they hope to better understand how the body created those immune proteins.

Other groups remain focused on infection-fighting T cells. As reported in *Science Immunology* (March 2021), researchers developed a vaccine to cause specialized T cells to kill any T cells infected with HIV.

If these vaccine candidates show promise, they will be moved into clinical trials and eventually the vaccines will go into people's arms. After nearly forty years of trying, scientists still see light at the end of the tunnel.

### DISCUSSION QUESTIONS

- What is the function of T cells?
- Is there more than one type of T cells?
- How is cellular immunity different from humoral or antibody-based immunity?

### VOCABULARY

- IMMUNITY
- IMMUNOSUPPRESSION
- VARIANT





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# Memory Research

## Reaffirms Common Study Strategy

By Gina Wynn

If you've ever tried to recall information for an important test, you know that some of your memories are more vivid than others. And if it's a mid-term or final exam — when months have passed since you first learned the information — the details that you remember are even foggier.

Researchers from the Universities of Glasgow and Birmingham in the United Kingdom set out to help us learn how to optimize our memories by uncovering what information in a memory is retained over time and which parts get lost. They published their results in the May 26, 2021, issue of *Nature Communications*.

### Get the Gist?

Scientists have been theorizing about how our memories work for years. The new study highlights the “gistification” of our memories, demonstrating that they become less vibrant and detailed over time, with only the central gist being preserved, according to a University of Birmingham news release.

The gist gets reinforced when we frequently recall our recent experiences — like when you quiz yourself prior to an exam using flash cards or other methods. This helps meaningful information stick longer, especially when followed by periods of rest and sleep.

### Memory Milestone

Until now, scientists have found it difficult to study memory in a laboratory setting to gain a better understanding of how memories differ from the original experiences and how they transform over time. But by developing a simple computerized task, the research team was able to gather the data they needed. The task measured how quickly people can recover certain characteristics of visual memories when asked to do so.

Participants were shown word–image pairs and asked to recollect different elements of the image as fast as possible when prompted by the word. The test was then repeated two days later. Researchers took note of their recollection of perceptual details about the image like whether it was colored or grayscale, and semantic elements about the image like whether an object was animate or inanimate. The pattern of reaction times indicated

that participants remembered meaningful, semantic elements more quickly than insignificant, perceptual ones.

### The Test of Time

The results also confirmed that with the passage of time and repeated remembering, bias toward more significant, semantic memories becomes stronger. In addition, when participants were tested after a two-day delay, their ability to recall semantic content of the images remained relatively constant, although their speed at recalling details of perceptual questions slowed.

This reaffirms what most students have already discerned: it gets more difficult to recall the details you need to know for an exam as time passes. But the findings also suggest that you can help solidify the information you want to retain by using common study techniques.

### Societal Benefits

In addition to reinforcing tried and true study habits, the research can benefit healthcare and law enforcement. It provides a tool for doctors

treating patients with post-traumatic stress disorder whose memories can be disabling. For officials who work with eyewitnesses, the findings can also help them understand how frequent interviews and repeatedly recollecting the same event may cause bias.

The research also teaches us that by frequently recalling and reminiscing about our most cherished memories, we can help keep them alive.

### DISCUSSION QUESTIONS

What are some strategies that can help you remember important information?

Test your memory by playing a game of Concentration or What's Missing?

### VOCABULARY

GIST

PERCEPTUAL

SEMANTIC



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# Two New Venus Missions

## Set to Study the Planet's Atmosphere and Topography

By Mike Howie

In early June of 2021, NASA administrator Bill Nelson announced that the agency will send two new robotic missions to Venus, the second planet from the Sun and one of Earth's nearest neighbors. Costing up to a combined \$1 billion, the missions will mark NASA's first visits to the planet in nearly 30 years and are expected to launch by the end of this decade.

"We hope these missions will further our understanding of how Earth evolved and why it's currently habitable when others in our solar system are not," Nelson said. "This is really exciting stuff."

### DAVINCI+

The first of the two missions has been dubbed DAVINCI+, which stands for Deep Atmosphere Venus Investigation of Noble gases, Chemistry, and Imaging Plus. While the name may be a mouthful, the mission is fairly straightforward: NASA will pack an array of instruments into an armored sphere and send it through the Venusian atmosphere, where it will collect data that will help us learn more about the planet.

Noble gases present in the atmosphere could be particularly illuminating. They could help scientists understand whether Venus began life with as much water as Earth and whether the planet still has water deep in its interior that could fuel plate tectonics.

DAVINCI+ will also search for sulfur and carbon near the planet surface, which could be evidence of recent volcanic activity, and park an orbiter around Venus to map the planet's geology. The mission will launch from NASA's Goddard Space Flight Center in Greenbelt, Maryland, and be led by Jim Garvin, the Center's chief scientist.

### VERITAS

The second of the new missions is named VERITAS, which stands for Venus Emissivity, Radio science, InSAR, Topography, and Spectroscopy. Another mouthful, to be sure, but equally simple in concept: it will use synthetic aperture radar to recreate the topography of Venus in the hope of finding active volcanoes or variants of tectonic plates.

While measurements of Venus have been taken before, the planet's thick clouds may have obscured some surface features. But with this high-resolution radar, scientists may find chasms that resemble Earth's midocean ridges or get a better look at oval-shaped features called coronae.

Suzanne Smrekar, the planetary scientist who will lead the mission from NASA's Jet Propulsion Laboratory in Pasadena, California, believes that Venus could be a good model

to help us learn about the beginning of plate tectonics here on Earth. Because its greenhouse-heated surface is cooling much slower than Earth's, it may just now be cracking into plates.

"We're ushering in a new decade of Venus to understand how an Earth-like planet can become a hothouse," said Thomas Zurbuchen, NASA's science chief. "Our goals are profound. It is not just understanding the evolution of planets and habitability in our own solar system, but extending beyond these boundaries to exoplanets."

### DISCUSSION QUESTIONS

How can studying planets like Venus and Mars help us learn more about Earth?

What other missions is NASA working on? How could they advance our understanding of the solar system?

### VOCABULARY

EMISSIVITY

EXOPLANET

NOBLE GAS

SPECTROSCOPY



# Unpacking an Elephant's Trunk:

## How It Uses Suction to Eat and Drink

By Gina Wynn



Elephant trunks are complex appendages that enable the enormous animals to taste, touch, smell, breathe, communicate, and even protect themselves. Engineers have taken note of the usefulness and versatility of the pachyderm's multi-functional proboscis and have even built robotic trunk replicas.

Engineers from the Georgia Tech College of Engineering, led by Andrew Schulz, are hoping to take this a step further. They recently investigated how elephants use their trunks to manipulate air, water, food, and other objects, aiming to find out whether trunk mechanics could inspire the development of better, more efficient air-wielding robots.

They published their findings in the June 2, 2021, issue of the *Journal of the Royal Society Interface*.

### Expanding Trunks

In collaboration with veterinarians at Zoo Atlanta and a 34-year-old female African elephant, the team conducted a variety of experiments, including ones that measure the speed of elephant suction and how much water a trunk could hold. They found that elephants can Hoover up three liters of water per second — 30 times faster than a human sneeze. Pachyderms can also hold up to 5.5 liters of water by dilating their nostrils to create more space in their trunks, kind of like an expanding suitcase.

### Finger Foods

The team also studied how elephants eat various foods. "An elephant eats about 400 pounds of food a day, but very little is known about how they use their trunks to pick up lightweight food and water," said Schulz, according to the Georgia Tech College of Engineering article "How an Elephant's Trunk Manipulates Air to Eat and Drink" by Jason Maderer.

They learned that for larger foods like rutabaga cubes, the elephant grabbed and collected them using the two finger-like ends of the trunk. For smaller cubes, the animal sucked them up, making a slurping sound, before transferring them to its mouth.

### Nature's Swiss Army Knife

The pachyderm also used suction to pick up a delicate tortilla chip. It either inhaled and used the end of its trunk to suck up the chip like a person might pick up a piece of paper with their mouth or applied suction from a distance like a vacuum cleaner to draw the chip toward its trunk.

"An elephant uses its trunk like a Swiss Army Knife," said David Hu, professor in Georgia Tech's George W. Woodruff School of Mechanical Engineering. "It can detect scents and grab things. Other times it blows objects away like a leaf blower or sniffs them in like a vacuum."

### Trunk Technology

These unique capabilities make the pachyderm proboscis the perfect model for robotic replicas. "By investigating the mechanics and physics behind trunk muscle movements, we can apply the physical mechanisms — combinations of suction and grasping — to find new ways to build robots," Schulz said.

He also hopes that the insights he and other researchers gain about elephants and their trunks will help better conserve the creatures in the wild. Because of poaching and loss of habitat, the African elephant is on the endangered species list.

#### DISCUSSION QUESTIONS

What different methods do you use for eating and drinking?

Why do you think elephants evolved with long trunks?

Why do you think African elephants are on the endangered species list?

#### VOCABULARY

PACHYDERM

PROBOSCIS

SUCTION

MANIPULATE



# Humans Have Impacted

# Most of the World's Ecosystems

By Kylie Wolfe

The Earth and its mix of species look different than they did hundreds of years ago. Some animals and plants have gone extinct, others are threatened. The land they once called home has either been cleared or polluted, a result of an overwhelming presence of people. Whether direct or indirect, our existence has influenced ecosystems around the world.

A new study published in *Frontiers in Forests and Global Change* found that only three percent of our globe has remained unchanged, what its authors refer to as an intact ecosystem. These results are making scientists take a closer look at the way human activity affects other species.

## Finding Balance

The team, led by Andrew Plumptre, a conservation biologist at the University of Cambridge, assessed 7,500 animal species and combined multiple data points to reach their conclusion. Surveying Earth's land-based ecosystems, they considered places where habitats and species had decreased or disappeared.

For the purposes of their study, an intact ecosystem was defined as an area presently consisting of the same species in the same amounts as it did in the year 1500. Of the three percent of ecosystem found intact, only eleven percent are within protected lands.

Some of these lands, like the Amazon Rainforest, remain biodiverse. Others, like the tundra of Greenland, are more limited. According to the study, these areas still thrive with the same levels and mix of species they've always had. A balance of predator and prey keeps the ecosystem in check.

## Important Considerations

In many cases, human intervention challenges an ecosystem's natural balance, but in some, it's proven the opposite. Just over 25 years ago, wolves were reintroduced to Yellowstone National Park. This helped strengthen other animal populations, including elk. While successful, this may not be the solution for every ecosystem.

As reported in *Science News for Students*, Jedediah Brodie, a conservation ecologist at the University of Montana in Missoula, thought the study authors put too confining of parameters in place for their survey. His analysis clarifies that the loss of a few species might not always throw an ecosystem out of balance.

"Many ecosystems around the world have lost one or two species but are still vibrant, diverse communities," said Brodie.

With a greater understanding of the issues at hand, scientists are left with an opportunity to protect and restore natural ecosystems, no small task.



## DISCUSSION QUESTIONS

Weigh the pros and cons of human intervention on an ecosystem. What are the potential risks and rewards?

How can we minimize our impact on the environment?

## VOCABULARY

BIODIVERSITY

ECOSYSTEM

ECOLOGICALLY INTACT



# Scratch That Itch:

## Wildfires Might Be the Cause

By Kevin Ritchart



Wildfires can have a devastating effect on both people and the environment, but a recent study has uncovered an unexpected consequence that's only skin deep.

A team of researchers from the University of California-San Francisco (UCSF) looked at visits to the university's dermatology clinic during an 18-week period in October 2018, which coincides with the start of the most destructive wildfire in the state's history. Known as the Camp Fire, this wildfire lasted 17 days and destroyed almost 19,000 buildings.

The team also reviewed data from the same time frame in 2015 and 2016 when there were no wildfires reported in the area. The findings were surprising.

"A very short-term exposure to air pollution causes an immediate signal in terms of skin response," said Dr. Maria Wei, a dermatologist at UCSF.

### Effect on Children

Wei and her team found that clinic visits increased in all age groups, but children were the most affected. While adult visits increased

by 15 percent, children's visits climbed by nearly 50 percent.

"When you're born, your skin isn't totally mature," Wei said. "So eczema is more common in children than adults."

The study, which was published in the April 2021 issue of *JAMA Dermatology*, found a link between fire-related pollution and oral eczema medications that were prescribed to adults. Oral medication is often used in severe cases where skin cream provides no relief.

### Where There's Smoke...

The UCSF study also examined the effects of smoke-related aerosols on the skin. Some chemicals that are released into the air can be directly toxic to cells. They can cause a type of cell damage known as oxidation. Other aerosols can trigger allergic reactions. A person's stress level can even play a role in skin reactions.

The UCSF study only looked for links between skin irritation during one wildfire and visits to a single hospital system, so it's possible that the findings don't apply to other fires or locations.

But it's smart to take precautions.

If wildfire smoke is polluting the air where you live, it's best to stay indoors when possible. If you must go outside, wear long sleeves and pants. Using a skin moisturizer regularly can help provide an extra layer of protection for your skin.

### DISCUSSION QUESTIONS

Aside from what was mentioned in the article, what other negative effects can wildfires have on people and the environment?

What are some precautions you can take to protect yourself and your family if there are wildfires near you?

### VOCABULARY

AEROSOL

DERMATOLOGIST

OXIDATION

CONSEQUENCE

ECZEMA





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