

# Bulletin Board

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### ASIA PACIFIC

#### China moves to regulate all synthetic cannabinoids

2021-05-11

China will become the world's first country to regulate all synthetic cannabinoid substances, in a bid to get ahead of new variations whose chemical properties are not yet subject to regulation, the country's drugs control office said on Tuesday.

Synthetic cannabinoids are lab-made drugs originally designed to produce similar effects to cannabis, but which are often far stronger and carry a greater health risk, Deng Ming, deputy director of China's National Narcotics Control Commission, said at a briefing.

By the end of 2020, 1047 variations had appeared worldwide, Deng said. Some of the drugs in China were being produced domestically, though some were also being smuggled from abroad, he added.

Abuse of the drug has been particularly prevalent in China's western Xinjiang region, where police have seized 16 kilos of the drug and arrested 390 suspects since 2018, Yu Haibin, another official, said.

Read More

Reuters, 11 May 2021

<https://www.reuters.com/world/china/china-moves-regulate-all-synthetic-cannabinoids-2021-05-11/>

#### Darwin rural aquifers vastly over-allocated with water licences declined

2021-05-13

Ken Jones' plans to develop his 300-hectare block in Darwin's rural area into a vegetable farm have been dashed after his application to secure water from an aquifer under his land was denied.

He had hoped to employ up to 50 people during the peak harvest time and deliver fresh food to markets across Australia.

But 12 months after applying for a licence to extract groundwater to irrigate his future crops, he was told the aquifer under his land was over-allocated.

**Some of the drugs in China were being produced domestically, though some were also being smuggled from abroad, he added.**

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It was a rare decision by Top End water management after long stretches of little or no water resource regulation.

The area is home to almost a quarter of Australia's mango crop as well as watermelon farms, Asian vegetable farms and Australia's biggest barramundi farm.

So what do decisions like this mean for the future of agricultural development in the region?

Read More

ABC Rural, 13 May 2021

<https://www.abc.net.au/news/rural/2021-05-13/darwin-rural-water-aquifer-agricultural-development/100116664>

#### Govt. reviews blanket ban on chemical fertiliser

2021-05-09

Regulations relaxed for shipment finalised before May 5; import licences for some products

The Finance Ministry has issued a gazette that, without completely banning the import of all agrochemicals, allows for some items to be brought in after May 6 this year subject to special import licence regulations.

The gazette also effectively permits any shipments of agrochemicals that were seaborne on or before May 5 to arrive, be cleared and distributed. In the chemical fertiliser, pesticide and other agrochemical sectors, sources expressed confusion at the development this week as they had been told a total ban would be imposed with immediate effect.

"We are waiting till Monday to clarify this with the Controller General of Imports and Exports and relevant authorities," one private sector source said. "The directions are not clear cut."

Gazette 2226/48 of May 6, signed by Mahinda Rajapaksa in his capacity as Finance Minister, is available on the website of the Department of Imports and Exports Control but is yet to be released via the Government Printer. It says the regulations shall only be applicable to the importation of goods which have a date of bill of lading or airway bill on or after May 6, 2021.

Meanwhile, the Department issued operating instructions to commercial banks stating, among other things, that: "Commercial banks shall not

**"The directions are not clear cut."**



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proceed with any payment in respect of the importation of items shipped on or after May 6, 2021, mentioned under regulation No 3 of Gazette Extraordinary No 2226/48 of May 6, 2021, without a valid Import Control Licence (ICL)".

"Sri Lanka Customs shall not release the items which shipped on or after May 6, 2021, specified under regulation No 3 of the Gazette Extraordinary 2226/48 of May 6, 2021, without a valid Import Control Licence (ICL)," the letter, addressed to the Chief Executive Officers of commercial banks, states.

"There is no impediment to the clearing of any shipments from the port if they were seaborne before 6th May," Imports and Exports Controller General T V D Damayanthi S Karunaratne, said. "Anything after May 6 must have a valid import licence."

[Read More](#)

Sunday Times, 9 May 2021

<http://www.sundaytimes.lk/210509/news/govt-reviews-blanket-ban-on-chemical-fertiliser-443063.html>

## AMERICA

### Wisconsin's attorney general calls for federal regulation of 'forever chemicals'

2021-05-11

Wisconsin Attorney General Josh Kaul and other state law enforcement officials are calling on the U.S. Environmental Protection Agency to expand monitoring and testing of drinking water for toxic "forever chemicals."

Kaul, a Democrat, and attorneys general from 17 states and the District of Columbia, submitted **comments** Monday asking the agency to regulate PFAS as a class, something the chemical industry has staunchly opposed.

The comments, submitted in support of the EPA's plan to require public water systems to test for 29 unregulated PFAS compounds, say the agency should also require monitoring and validate a method for measuring total PFAS, lower minimum reporting levels and advance environmental justice with PFAS monitoring.

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Despite studies showing PFAS exposure negatively affects human health, there are no national drinking water standards or requirements that public water systems test for the compounds.

"Millions of people across the United States are exposed to PFAS-contaminated drinking water and widespread releases of PFAS into the environment," the attorneys general wrote. "The states have limited resources to comprehensively assess and address PFAS. Therefore, it is crucial for EPA to broadly regulate PFAS ... to protect public health and the environment."

PFAS are a group of thousands of largely unregulated synthetic compounds that do not break down naturally and have been shown to increase the risk of cancer and other ailments.

[Read More](#)

Wisconsin State Journal, 11 May 2021

[https://madison.com/wsj/news/local/environment/wisconsins-attorney-general-calls-for-federal-regulation-of-forever-chemicals/article\\_b6ac4fbc-1b59-5124-9049-374350c223b8.html](https://madison.com/wsj/news/local/environment/wisconsins-attorney-general-calls-for-federal-regulation-of-forever-chemicals/article_b6ac4fbc-1b59-5124-9049-374350c223b8.html)

### EPA launches new paperless communication application for TSCA data in CDX

2021-05-11

The U.S. Environmental Protection Agency (EPA) **announced** on May 11, 2021, that it has launched a new application in the Central Data Exchange (CDX), EPA's electronic reporting site, that will allow users to submit electronically certain communications under the Toxic Substances Control Act (TSCA). According to EPA, the new application provides users with a faster, secure, and more convenient way to comply with TSCA reporting requirements and is "expected to be used for hundreds of individual communications every year."

EPA states that the application is located within the Chemical Safety and Pesticide Programs (CSPP) data flow and supports numerous types of communications, including General Confidential Correspondence, Requests for Chemical Information, Pre-manufacture Notice (PMN) Corrections for Submissions made Prior to 2016, and Copy of Record Requests. Previously, these types of communications were required to be sent to EPA in hard copy. EPA will continue to accept paper documents,

**According to EPA, the new application provides users with a faster, secure, and more convenient way to comply with TSCA reporting requirements...**



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MAY. 21, 2021

but recommends submitting TSCA communications electronically when possible “since paper communications could take longer to process.”

[Read More](#)

TSCAblog, 11 May 2021

<http://www.tscablog.com/entry/epa-launches-new-paperless-communication-application-for-tsca-data-in-cdx>

### PFAS – Regulation is upon us

2021-05-12

#### Recent Regulatory Steps

On January 14, 2021, on the eve of President Biden’s inauguration, EPA issued an [advance notice of proposed rulemaking](#), seeking comment on whether PFOA and PFOS should be regulated under the Comprehensive Environmental Response, Compensation and Liability Act (“CERCLA”) and the Resource Conservation and Recovery Act (“RCRA”). This will likely lead to the designation of PFOA and PFOS as “Hazardous Substances” under CERCLA and RCRA. Such a designation will likely lead to EPA and the state agencies taking more aggressive action to investigate and identify new sites where PFAS may be a concern and also to review the status of existing sites where PFAS may be a concern that was not addressed in previous investigations or response actions and to potentially pursue response actions at such sites. At this moment though there is only the [interim policy](#) that EPA provided to assist in addressing PFOA and PFOS groundwater contamination. The comment period on this advance notice just closed and we anticipate a proposed rulemaking in the near future.

Next, EPA reissued the [final regulatory determinations](#) for PFOA and PFOS under the Safe Drinking Water Act (SDWA), which was published in the Federal Register on March 3, 2021. This determination will begin the process to label both PFOA and PFOS as hazardous substances under the SDWA and will allow EPA to set Maximum Contaminant Levels (“MCL”) for both compounds. This process usually takes approximately two years and will allow EPA to eventually propose a national drinking water standard for both PFOA and PFOS. This will also allow EPA to require cleanup of some PFOA and PFOS where it is found in potential drinking water sources. The current suggested maximum concentration is 70 parts per trillion (ppt) for both compounds based on EPA guidance.

Lastly, on March 11, 2021, EPA published the proposed [fifth Unregulated Contaminant Monitoring Rule](#), which requires data to be collected

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regarding the presence of 29 PFAS compounds in drinking water. The proposal seeks 12 months of data collected by various public water systems from January 2023 and December 2025. EPA will be holding two virtual stakeholder meetings on April 6, 2021 and April 7, 2021, and the comment period will be open for 60 days.

In addition to the regulatory steps that EPA has taken, Michael Regan’s recent confirmation as Administrator of the EPA is likely to further accelerate PFAS regulations. A former secretary of the North Carolina Department of Environmental Quality (NC DEQ), Regan is no stranger to PFAS. Regan was the secretary of the NC DEQ when it sued Chemours for allegedly discharging PFAS into the Cape Fear River in eastern North Carolina. Regan’s prior experiences with PFAS, coupled with the Biden Administration’s commitment to prioritizing PFAS, will likely result in new regulations sooner rather than later

[Read More](#)

Mondaq, 12 May 2021

<https://www.mondaq.com/unitedstates/water/1067640/pfas-regulation-is-upon-us>

### New York will hold public meeting on toxic chemicals in children’s products law

2021-05-12

The New York State Department of Environmental Conservation (NYSDEC) will hold a **virtual public meeting** on **May 26, 2021, at 1:00 p.m. (EDT)**. NYSDEC will present topics for discussion related to implementation of the recently enacted law, which created ingredient disclosure requirements for children’s products. **Title 9 of Article 37 of the Environmental Conservation Law** (ECL) establishes an ingredient disclosure program and prohibits certain chemicals in children’s products. ECL Article 37 instructs NYSDEC to promulgate lists of chemicals of concern and high-priority chemicals **by March 1, 2022**. It also prohibits the sale of children’s products containing benzene, asbestos, or tris(1,3-dichloro-2-propyl) phosphate effective **January 1, 2023**. NYSDEC states that it is in the process of developing a rule to implement portions of the law. NYSDEC expects the rule to address the specific product categories that are covered, what chemicals and supporting information must be disclosed, details on how to obtain a waiver from reporting or the sales prohibition, and the fees associated with reporting and applying for a waiver. NYSDEC

**Title 9 of Article 37 of the Environmental Conservation Law (ECL) establishes an ingredient disclosure program and prohibits certain chemicals in children’s products.**



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notes that it will hold a formal public comment period on the proposed rule at a later date. Stakeholders must **register** to attend the virtual public meeting.

### [Read More](#)

TSCA, 12 May 2021

<http://www.tscablog.com/entry/new-york-will-hold-public-meeting-on-toxic-chemicals-in-childrens-products>

### TRI reporting requirements to expand

2021-05-11

On April 29, 2021, the EPA announced it will be expanding Toxics Release Inventory (TRI) reporting requirements to include additional chemicals and facilities and provide more tools for communities to increase access to environmental information.

“Every person in the United States has a right to know about what chemicals are released into their communities,” said EPA Administrator Michael S. Regan in an Agency press release. “By requiring new and more data on chemical releases from facilities, EPA and its partners will be better equipped to protect the health of every individual, including people of color and low-income communities that are often located near these facilities but have been left out of the conversation for too long.”

TRI reporting is required under Section 313 of the Emergency Planning and Community Right-to-Know Act (EPCRA).

### Expanded TRI Reporting Requirements

The EPA is adding TRI reporting requirements for ethylene oxide (EtO) to include certain contract sterilization facilities that use EtO to sterilize medical equipment but are not currently required to report this information.

“Many of these contract sterilization facilities are located near areas with Environmental Justice (EJ) concerns,” according to the EPA press release. “Workers in facilities that use EtO and communities – including historically underserved communities – living adjacent to these facilities are at the highest risks from exposure to EtO. Making more information available about releases of EtO will assist the agency in identifying and responding to any human health and environmental threats they cause.”

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### [Read More](#)

EHS Daily Advisor, 11 May 2021

<https://ehsdailyadvisor.blr.com/2021/05/tri-reporting-requirements-to-expand/>

## EUROPE

### EFSA panel concludes that titanium dioxide cannot be considered safe as a food additive

2021-05-10

On May 6, 2021, the European Food Safety Association (EFSA) announced that E171 is no longer considered safe when used as a food additive. The European Commission (EC) asked EFSA to update its safety assessment of the food additive titanium dioxide (E171). EFSA states: “Taking into account all available scientific studies and data, the Panel [on Food Additives and Flavorings] concluded that titanium dioxide can no longer be considered safe as a food additive. A critical element in reaching this conclusion is that we could not exclude genotoxicity concerns after consumption of titanium dioxide particles. After oral ingestion, the absorption of titanium dioxide particles is low, however they can accumulate in the body.” According to EFSA, the Panel applied for the first time the 2018 EFSA Scientific Committee guidance on nanotechnology to the safety assessment of food additives. EFSA states that “[t]itanium dioxide E 171 contains at most 50% of particles in the nano range (i.e. less than 100 nanometres) to which consumers may be exposed.” EFSA notes that its evaluation is related to the risks of titanium dioxide used as a food additive, not to other uses. EFSA has not banned E171. Any legislative or regulation decisions on the authorizations of food additives are the responsibility of the EC and member states, who will now “reflect on EFSA’s scientific advice and decide upon any appropriate regulatory measures or advice for consumers.”

### [Read More](#)

Nano and Other Emerging Technologies Blog, 10 May 2021

<https://nanotech.lawbc.com/2021/05/efsa-panel-concludes-that-titanium-dioxide-cannot-be-considered-safe-as-a-food-additive>

**EFSA states: “Taking into account all available scientific studies and data, the Panel [on Food Additives and Flavorings] concluded that titanium dioxide can no longer be considered safe as a food additive. [”]**



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### EU U-turns on 'unsafe' common food additive linked with cancer risk

2021-05-06

**The European Food Safety Agency (EFSA) has deemed titanium dioxide, a widely used food additive, to be unsafe in its latest study, contradicting an earlier conclusion and paving the way for an EU-wide ban after a decade of debate.**

In a new opinion, published on Thursday (6 May), EFSA found that concern for genotoxicity "could not be ruled out" and, consequently, a "safe level for daily intake of the food additive could not be established".

Genotoxicity refers to the ability of a chemical substance to damage DNA, the genetic material of cells, which may then lead to carcinogenic effects.

After evaluating new evidence, EFSA's experts therefore no longer consider titanium dioxide safe when used as a food additive.

Titanium dioxide (known as E171) is a common food additive which is used as a white food colourant. It has no nutritional or functional benefits in food.

E171 is composed of a mix of titanium dioxide particles which, due to their extremely small size, are classified as nanoparticles. The concern is that these nanoparticles may be able to infiltrate the natural protective barriers of the human body and pass into the body.

The main food categories where E171 can be found include baked goods, soups, broths and sauces, although its use is also widespread in hundreds of everyday products such as toothpaste, cosmetics and sunscreen.

Titanium dioxide is also widely used in the pharmaceutical sector, including packaging, coatings of pills, formulations and pigments.

[Read More](#)

EURATIV, 6 May 2021

<https://www.euractiv.com/section/agriculture-food/news/eu-u-turns-on-unsafe-common-food-additive-linked-with-cancer-risk>

**Genotoxicity refers to the ability of a chemical substance to damage DNA, the genetic material of cells, which may then lead to carcinogenic effects.**

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### EU aims to halve premature deaths from air pollution by 2030 – Lithuanian commissioner

2021-05-12

The European Commission aims to reduce premature deaths associated with air pollution by halve by 2030, European Commissioner for Environment, Oceans and Fisheries Virginijus Sinkevicius said on Wednesday.

Earlier on Wednesday, the Commission unveiled a zero-pollution plan that also calls for reducing waste, plastic litter at sea by half and microplastics released into the environment by 30 percent, and for improving soil quality by reducing nutrient losses and chemical pesticides' use by half.

Other targets include a 25 percent reduction in EU ecosystems where air pollution threatens biodiversity, a 30 percent reduction in the share of people chronically disturbed by transport noise, and a 50 percent reduction in residual municipal waste.

"The plan sets out 33 actions. The key principle of the action plan is pollution prevention, so we will transfer its provisions to other policy areas, such as agriculture, industry, buildings, energy or transport," Sinkevicius told BNS.

The plan provides for aligning the air quality standards to the World Health Organization's recommendations and reviewing the existing legislation. Member states will be encouraged to implement "national air pollution control programs and emission reduction commitments", according to the commissioner.

"For its part, the Commission will update the rules on tires, road vehicles, aircraft and railways. One of the ways to address both air and noise pollution problems is through the new Euro 7 standard for road vehicles, on which my team and that of [Internal Market] Commissioner Thierry Breton are working now," Sinkevicius said.

"We will also review the Urban Waste Water Treatment Directive to reduce microplastic pollution," he added.

Among other things, a key role in reducing urban pollution is played by public transport which has to be not only convenient and easily accessible, but also environmentally friendly, according to Sinkevicius.

Member states will have access to money from the Recovery and Resilience Fund to deal with pollution issues. For its part, the Commission



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## Regulatory Update

MAY. 21, 2021

aims to implement the actions set out in the plan by 2024, the commissioner said.

Countries will face sanctions if they fail to comply with the new rules, he added.

[Read More](#)

The Baltic Times, 12 May 2021

[https://www.baltictimes.com/eu\\_aims\\_to\\_halve\\_premature\\_deaths\\_from\\_air\\_pollution\\_by\\_2030\\_lithuanian\\_commissioner](https://www.baltictimes.com/eu_aims_to_halve_premature_deaths_from_air_pollution_by_2030_lithuanian_commissioner)

## INTERNATIONAL

### IAEA releases two new e-learning courses on radiation protection of workers

2021-05-11

More than 300 users worldwide have already signed up to two new e-learning courses on radiation protection of workers, recently launched by the IAEA: Occupational Radiation Protection based on General Safety Guide No. GSG-7 and Management and Control of Naturally Occurring Radioactive Material (NORM). The material focuses on how to further strengthen worker protection and occupational exposure control, and provides guidance on monitoring and recording methodologies.

“The courses contain practical examples drawn from occupational radiation protection related requirements of IAEA General Safety Requirements GSR Part 3 and are tailored to the needs of employers, licensees and registrants; management bodies and their specialist advisers and health and safety committees concerned with the radiation protection of workers,” said Burcin Okyar, IAEA Radiation Safety Specialist and the Technical Officer responsible for the development of courses.

The course on occupational radiation protection, based on GSG-7, aims to increase understanding of the occupational exposure control requirements contained in No. GSR Part 3 and how these safety standards fit within the IAEA Safety Standards hierarchy. The course on Naturally Occurring Radioactive Material (NORM) is based on IAEA General Safety Guide (No. GSG-7) and supports participants in fulfilling the requirements of GSR Part 3 regarding worker protection in industrial processes and operations, said Okyar.

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Developed under the IAEA Technical Cooperation Project Enhancing National Capabilities on Occupational Radiation Protection in Compliance with Requirements of the New International Basic Safety Standards, these courses promote a uniform approach to the control, monitoring and recording of occupational exposure and provide guidance on practical aspects of management, planning and conduct of occupational radiation protection.

“The courses are free for participants and designed to harmonize capabilities for occupational exposure monitoring, improve the implementation of a radiation protection programme and safety culture in activities and end-user facilities in participating Member States,” said Marina Binti Mishar, Section Head of the Technical Cooperation Division for Asia and the Pacific.

“The examples and visuals taken from various working environments combined with a high level of interactivity included in these courses maximise the learning experience,” added Okyar, highlighting that “to check and assess understanding, each course module includes a brief assessment at the end.”

[Read More](#)

IAEA, 11 May 2021

<https://www.iaea.org/newscenter/news/iaea-releases-two-new-e-learning-courses-on-radiation-protection-of-workers>

**The material focuses on how to further strengthen worker protection and occupational exposure control, and provides guidance on monitoring and recording methodologies.**



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## REACH Update

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### What might UK Reach look like?

2021-05-10

As the UK's legal system finds its feet post-Brexit, stakeholders have mixed feelings about the changes it could bring

Four months into the UK being fully divorced from the EU, the chemical industry has had its first taste of operating under a separate legal system for chemicals. But rather than get their teeth into a fully thought-out version of the country's own Reach (registration, evaluation, authorisation and restriction of chemicals) legislation, companies are facing a law that is just beginning to evolve.

Initially a direct copy of its EU counterpart, the practicalities and consequences of implementing UK Reach (the law's official name, despite applying only in England, Scotland and Wales) are playing out gradually. The last few months were defined by companies grandfathering their EU chemical registrations to the UK system. If done by the 30 April deadline, this guaranteed continued access to the British market.

The process went relatively smoothly, according to County Durham-based chemical manufacturer Thomas Swan, whose in-house regulatory experts prepared early. 'In 2018, we started surveying all our suppliers to make sure they were aware of the potential new UK registration requirements,' says regulatory affairs manager, John Mackenzie. By the time UK Reach came into force, the company was certain that its supply chain was solid. Thomas Swan has so far grandfathered 24 EU substance registrations to the UK system, 'without any major issues'.

London-based consultancy firm ERM sees smaller companies, who don't usually have a regulatory expert, struggling more. The grandfathering deadline might well have passed by many businesses, says consultant Louise Boardall: 'A lot of small companies will have been caught out which is quite sad because they face difficult times now.'

#### Read More

Royal Society of Chemistry, 10 May 2021

<https://www.chemistryworld.com/news/what-might-uk-reach-look-like/>

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## REACH Update

MAY. 21, 2021

### Is your company size declared correctly?

2021-05-10

If you are a micro, small or medium-sized company, you should check that the company size you claimed when registering your substances is correct. You should also ensure that you have uploaded the required supporting documents in REACH-IT.

Helsinki, 10 May 2021 – If you notice that you have claimed your enterprise size incorrectly, you should inform ECHA by emailing to: [sme-verification@echa.europa.eu](mailto:sme-verification@echa.europa.eu) by 31 May 2021.

By declaring and correcting your company size before ECHA begins verifying it, you will benefit from a full administrative charge waiver and only have to pay the difference to the applicable registration fee.

If ECHA learns only after the verification process has started that you have claimed an incorrect size, you will have to pay the balance of the accurate fee and an administrative charge of up to EUR 19 900.

Help on how to determine and declare the correct size of your enterprise is available on ECHA's website.

It is important to regularly check your REACH-IT accounts for any messages and tasks from ECHA. Keep your registrations and your contact details up to date and react to ECHA's requests.

#### Read More

ECHA, 10 May 2021

<https://echa.europa.eu/-/is-your-company-size-declared-correctl-1>

**The last few months were defined by companies grandfathering their EU chemical registrations to the UK system.**



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## Janet's Corner

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## Fiction

2021-05-21



<https://parade.com/1193513/marlynliles/science-jokes/>

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## Hazard Alert

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## Malathion

2021-05-21

Malathion is an organophosphate parasympathomimetic that binds irreversibly to cholinesterase and has the molecular formula  $C_{10}H_{19}O_6PS_2$ . [1] It is a colourless liquid in pure form and a brownish-yellow liquid with a garlic smell when part of a technical grade solution. It is manufactured and does not occur naturally in the environment. [2] Malathion is an insecticide of relatively low human toxicity. In Australia and New Zealand it is known as maldison. [1]

## USES [3]

Malathion is a pesticide that is used to kill insects on agricultural crops, on stored products, on golf courses, in home gardens, and in outdoor sites where trees and shrubs are grown at home; it is also used to kill mosquitoes and Mediterranean fruit flies (medflies) in large outdoor areas. Additionally, malathion is used to kill fleas on pets and to treat head lice on humans. It is usually sprayed on crops or sprayed from an airplane over wide land areas, especially in the states of California and Florida.

## IN THE ENVIRONMENT [3]

Once malathion is introduced into the environment, usually from spraying on crops or in wide urban/residential areas, droplets of malathion in the air fall on soil, plants, water, or man-made surfaces. While most of the malathion will stay in the areas where it is applied, some can move to areas away from where it was applied by rain, fog, and wind. Malathion stays in the environment from a few days to several months, but is usually broken down within a few weeks. It is broken down to other chemical compounds by water, sunlight, and bacteria found in soil and water. Malathion does not tend to stick to the soil and is rapidly broken down by bacteria; thus, it is unlikely that malathion will reach groundwater in significant amounts. In water, malathion breaks down quickly by the action of the water and the bacteria in the water. In air, malathion is broken down by reacting with other chemicals formed naturally in the air by sunlight, to form a more toxic product called malaoxon. If malathion is present on dry soil or on man-made surfaces such as sidewalks, pavements, or playground equipment, it usually does not break down as fast as it would in moist soil.

**Malathion is an organophosphate parasympathomimetic that binds irreversibly to cholinesterase and has the molecular formula  $C_{10}H_{19}O_6PS_2$ .**



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### SOURCES & ROUTES OF EXPOSURE [2]

#### Sources of Exposure

##### General Populations

- The general population is not likely to be exposed to high levels of malathion.
- Exposure to malathion predominantly occurs through ingestion of contaminated food or water.
- People living near areas where malathion is sprayed have a greater risk of being exposed through dermal contact with contaminated plants and soils, inhalation of mist formed during application, and ingestion of residues in food or water.

##### Occupational Populations

- Workers involved in the production, formulation, handling, and application of malathion are likely to have the highest levels of exposure.
- Farm workers who enter treated fields prior to the passage of the appropriate restricted entry intervals may also be exposed to high levels of malathion.

#### Routes of Exposure

The following are the routes of exposure for malathion:

- Inhalation – Minor route of exposure for the general population.
- Oral – Predominant route of exposure for the general population through ingestion of contaminated food or water.
- Dermal – Minor route of exposure for the general population. Predominant route of occupational exposure.

### HEALTH EFFECTS [3]

Malathion interferes with the normal function of the nervous system. Because the nervous system controls many other organs, malathion indirectly can affect many additional organs and functions. Exposure to high amounts of malathion in the air, water, or food may cause difficulty breathing, chest tightness, vomiting, cramps, diarrhoea, watery eyes, blurred vision, salivation, sweating, headaches, dizziness, loss of consciousness, and death. If persons who are exposed accidentally or intentionally to high amounts of malathion are rapidly given appropriate treatment, there may be no long-term harmful effects. If people are

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exposed to levels of malathion below those that affect the function of the nervous system, few or no health problems seem to occur. This has been shown in studies with volunteers who inhaled or swallowed small known amounts of malathion. There is no evidence that malathion affects the ability of humans to reproduce. There is also no conclusive proof that malathion causes cancer in humans, although some studies have found increased incidence of some cancers in people who are regularly exposed to pesticides, such as farmers and pesticide applicators. The International Agency for Research on Cancer (IARC) has determined that malathion is unclassifiable as to carcinogenicity to humans.

### SAFETY [4]

#### First Aid Measures

- Inhalation: Remove source of contamination or move victim to fresh air. Keep affected person warm and at rest. Supply oxygen if necessary. Treat symptomatically and supportively. Seek medical advice immediately.
- Skin contact: Remove contaminated clothing, shoes and leather goods. Gently wipe off excess chemical. Wash skin gently and thoroughly with water and non-abrasive soap. Seek medical advice if necessary. Persons who become sensitised may require specialised medical management with anti-inflammatory agents.
- Eye contact: Immediately flush eyes with gently flowing cold water or saline solution for 20 minutes, holding the eyelid(s) open. Seek medical attention immediately.
- Ingestion: Have victim rinse mouth thoroughly with water. Do not induce vomiting, due to the aromatic solvent. Seek medical advice immediately.
- Advice to physician: Atropine must be administered as early as possible and could save lives, if given in time and in an adequate dosage.

#### Exposure Controls & Personal Protection

##### Engineering controls

- It is essential to provide adequate ventilation.
- Ensure that control systems are properly designed and maintained.
- Comply with occupational safety, environmental, fire and other applicable regulations.



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### Personal Protective Equipment

If engineering controls and work practices are not effective in controlling exposure to this material, then wear suitable personal equipment including approved respiratory protection.

- Respirator: An approved full-face respirator suitable for protection from dusts or mists of pesticides is required. Limitations of respirator use specified by the approving agency and the manufacturer must be observed.
- Clothing: Employee must wear appropriate protective (impervious) clothing and equipment to prevent skin contact with the substance.
- Gloves: Employee must wear appropriate chemical resistant protective gloves to prevent contact with this substance.
- Eye protection: Employee must wear splash-proof safety goggles and face shield to prevent contact with this substance.
- Emergency eye wash: Where there is any possibility that an employee's eyes may be exposed to this substance, the employer should provide an eye wash fountain or appropriate alternative within the immediate work area for emergency use.

### REGULATION [3,5]

#### United States

OSHA: The Occupational Safety & Health Administration has set the following Permissible Exposure Limit (PEL) for malathion:

- General Industry: 29 CFR 1910.1000 Z-1 Table -- 15 mg/m<sup>3</sup> TWA; Skin
- Construction Industry: 29 CFR 1926.55 Appendix A -- 15 mg/m<sup>3</sup> TWA; Skin
- Maritime: 29 CFR 1915.1000 Table Z-Shipyards -- 15 mg/m<sup>3</sup> TWA; Skin

ACGIH: The American Conference of Governmental Industrial Hygienists has set a Threshold Limit Value (TLV) for malathion of 1 mg/m<sup>3</sup> TWA - Inhalable fraction, Vapour and aerosol; Skin; Appendix A4 - Not Classifiable as a Human Carcinogen; BEI - Appendix A: Carcinogens

NIOSH: The National Institute for Occupational Safety and Health has set a Recommended Exposure Limit (REL) for malathion of 10 mg/m<sup>3</sup> TWA; Skin

EPA: The Environmental Protection Agency states that the following levels of malathion in drinking water are not expected to cause effects that are harmful to health:

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- 0.2 milligrams per litre (mg/L) for 1 day, 10 days, or longer-term exposure for children, and
- 0.1 mg/L for lifetime exposure of adults.

EPA also has set maximum levels of malathion residues in meat and dairy products, vegetables, fruits, tree nuts, cereal grains, and grass forage, fodder, and hay. EPA requires notification to the Agency of spills or accidental releases of 100 pounds or more of malathion to the environment.

### Australia

Safe Work Australia: Safe Work Australia has established a Time Weighted Average Concentration (TWA) for malathion of 10 mg/m<sup>3</sup> for a 40-hour workweek.

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**SARS-CoV-2 gets a STING from diaminobenzimidazoles**

2021-05-19

Two research teams have published back-to-back papers in *Science Immunology* suggesting that a class of chemical compounds, diaminobenzimidazoles (diABZIs), treated SARS-CoV-2 infection and prevented severe disease in mice and in vitro human cells. Both studies support the use of diABZIs as promising COVID-19 therapies to mobilize defense and block viral replication once it enters the body. The authors say that diABZIs offer several advantages over similar drugs, including cost, enhanced stability, room temperature storage, and potential for efficacy even at low dose treatments.

Together with his colleagues, Minghua Li, PhD, a post-doc in Sara Cherry's lab in the department of pathology and laboratory medicine at the University of Pennsylvania, demonstrated in human respiratory cell culture experiments that SARS-CoV-2 "hides" from the immune system. More specifically, the virus evades the activation of interferons (IFN), inflammatory proteins that inhibit viral replication. These findings are published in the paper, "Pharmacological activation of STING blocks SARS-CoV-2 infection."

By evading IFN activation, SARS-CoV-2 delayed the response of bystander immune cells, leading the authors to hypothesize that targeting immune pathways involved in IFN activation could help control SARS-CoV-2 infection. They screened a panel of 75 microbial ligands to search for potent antiviral innate immune players, finding that molecules that activate STING—a key stimulator of IFN genes—were strongly antiviral.

They tested one type of diABZI, a potent STING activator, in in vitro human cell experiments and two different mouse models of SARS-CoV-2 infection. Across models and experiments, the molecule potently inhibited SARS-CoV-2 infection—including those caused by diverse strains and variants—by transiently stimulating IFN signaling. RNA sequencing of immune cells in mouse lungs also revealed rapid activation of IFN signaling pathways after a single intranasal administration of diABZI. The researchers also discovered striking overlap between orthologs of genes induced by diABZI in human respiratory epithelial cells and mouse lungs, suggesting promise for the drug's clinical translation from mouse to human.

In the second paper, Fiachra Humphries, PhD, a post-doc in the lab of Kate Fitzgerald in the program in innate immunity, department of medicine, University of Massachusetts Medical School, in collaboration with GlaxoSmithKline, tested a variation of the same compound, called

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diABZI-4, in a transgenic mouse model of SARS-CoV-2 infection. The molecule was highly effective in limiting viral replication in lung epithelial cells, the primary targets of the virus.

This work is published in the paper, "A novel diamidobenzimidazole STING agonist protects against SARS-CoV-2 infection."

STING activation was rapid and short lived, but enough to inhibit viral replication by inducing transient production of inflammatory molecules and lung immune cell activation. Administration of diABZI-4 intranasally before and after virus infection protected mice from severe respiratory disease.

In future work, researchers from both groups seek to determine the appropriate dose and delivery method for diABZIs in humans, and whether the lung-targeted therapy could also be used to treat other respiratory pathogens, such as influenza.

genengnews.com, 19 May 2021

<https://www.genengnews.com>

**Twenty firms produce 55% of the world's plastic waste, report reveals**

2021-05-18

Twenty companies are responsible for producing more than half of all the single-use plastic waste in the world, fuelling the climate crisis and creating an environmental catastrophe, new research reveals.

Among the global businesses responsible for 55% of the world's plastic packaging waste are both state-owned and multinational corporations, including oil and gas giants and chemical companies, according to a comprehensive new analysis.

The Plastic Waste Makers index reveals for the first time the companies who produce the polymers that become throwaway plastic items, from face masks to plastic bags and bottles, which at the end of their short life pollute the oceans or are burned or thrown into landfill.

It also reveals Australia leads a list of countries for generating the most single-use plastic waste on a per capita basis, ahead of the United States, South Korea and Britain.

**Both studies support the use of diABZIs as promising COVID-19 therapies to mobilize defense and block viral replication once it enters the body.**

**It also reveals Australia leads a list of countries for generating the most single-use plastic waste on a per capita basis, ahead of the United States, South Korea and Britain.**



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ExxonMobil is the greatest single-use plastic waste polluter in the world, contributing 5.9m tonnes to the global waste mountain, concludes the analysis by the Minderoo Foundation of Australia with partners including Wood Mackenzie, the London School of Economics and Stockholm Environment Institute. The largest chemicals company in the world, Dow, which is based in the US, created 5.5m tonnes of plastic waste, while China's oil and gas enterprise, Sinopec, created 5.3m tonnes.

Eleven of the companies are based in Asia, four in Europe, three in North America, one in Latin America, and one in the Middle East. Their plastic production is funded by leading banks, chief among which are Barclays, HSBC, Bank of America, Citigroup and JPMorgan Chase.

The enormous plastic waste footprint of the top 20 global companies amounts to more than half of the 130m metric tonnes of single-use plastic thrown away in 2019, the analysis says.

Single-use plastics are made almost exclusively from fossil fuels, driving the climate crisis, and because they are some of the hardest items to recycle, they end up creating global waste mountains. Just 10%-15% of single-use plastic is recycled globally each year.

The analysis provides an unprecedented glimpse into the small number of petrochemicals companies, and their financial backers, which generate almost all single-use plastic waste across the world.

Al Gore, the environmentalist and former US vice-president, said the groundbreaking analysis exposed how fossil fuel companies were rushing to switch to plastic production as two of their main markets – transport and electricity generation – were being decarbonised.

"Since most plastic is made from oil and gas – especially fracked gas – the production and consumption of plastic are becoming a significant driver of the climate crisis," said Gore.

"Moreover, the plastic waste that results – particularly from single-use plastics – is piling up in landfills, along roadsides, and in rivers that carry vast amounts into the ocean."

The plastic waste crisis grows every year. In the next five years, global capacity to produce virgin polymers for single-use plastics could grow by more than 30%.

By 2050 plastic is expected to account for 5%-10% of greenhouse gas emissions.

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"An environmental catastrophe beckons: much of the resulting single-use plastic waste will end up as pollution in developing countries with poor waste management systems," the report's authors said. "The projected rate of growth in the supply of these virgin polymers ... will likely keep new, circular models of production and reuse 'out of the money' without regulatory stimulus."

The report said the plastics industry across the world had been allowed to operate with minimal regulation and limited transparency for decades. "These companies are the source of the single-use plastic crisis: their production of new 'virgin' polymers from oil, gas and coal feedstocks perpetuates the take-make-waste dynamic of the plastics economy."

The report said this undermines the shift to a circular economy, including the production of recycled polymers from plastic waste, reusing plastic and using substitute materials. Just 2% of single-use plastic was made from recycled polymers in 2019.

"Plastic pollution is one of the greatest and most critical threats facing our planet," said Dr Andrew Forrest AO, chairman of the Minderoo Foundation. "The current outlook is set to get worse and we simply cannot allow these producers of fossil fuel-derived plastics to continue as they have done without check. With our oceans choking and plastic impacting our health, we need to see firm intervention from producers, governments and the world of finance to break the cycle of inaction."

[theguardian.com](https://www.theguardian.com), 18

<https://www.theguardian.com>

### Woman gets 6 doses of COVID-19 vaccine at once

2021-05-12

A woman in Italy accidentally received six doses of the Pfizer-BioNTech COVID-19 vaccine all at once, according to news reports.

The 23-year-old woman did not experience any serious side effects from the vaccine overdose, CBS News reported.

The accident happened Sunday (May 9) at the Noa Hospital in Tuscany, Italy, according to CBS News. The nurse administering the vaccine mistakenly injected the woman with an entire vial of the Pfizer-BioNTech vaccine, which contains six doses.

**The nurse administering the vaccine mistakenly injected the woman with an entire vial of the Pfizer-BioNTech vaccine, which contains six doses.**



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The error happened because the nurse thought that the vial she was injecting had already undergone a necessary dilution step — before the vaccine can be administered, each of the six doses is taken out of the original vial and put into a new vial, where the dose is diluted, CBS News reported.

“She thought that the dilution had taken place,” Dr. Tommaso Bellandi, director of patient security for the northwest Tuscany health authority, told CBS News. “They are both transparent liquids of the same density. Unfortunately, this contributed to the error.”

The nurse quickly realized her mistake, and the patient was monitored for 24 hours at the hospital. She was given fluids and fever-reducing medications as a preventive measure, according to CBS News.

The only side effect the woman experienced was pain at the injection site, and she was released from the hospital Monday (May 10), officials said.

The hospital has launched an investigation into the error.

Several other cases of COVID-19 vaccine overdoses have made headlines in recent months, including the case of a 91-year-old man in Ohio who went into shock after he received two COVID-19 vaccine doses in one day, Live Science previously reported.

### PLAY SOUND

And in April, 77 inmates at the Iowa State Penitentiary in Fort Madison each received up to six times the normal dose of the Pfizer-BioNTech vaccine due to human error, according to the Des Moines Register. None of the inmates required hospitalization after the vaccine overdose, but some experienced sore arms, body aches and fevers, the Register reported. The two nurses who were administering the vaccine at the prison have been placed on leave during an investigation into the incident, officials said.

Originally published on Live Science.

[livescience.com](https://www.livescience.com), 12 May 2021

<https://www.livescience.com>

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### Australian woman's shock after 'waking up with Irish accent'

2021-05-15

A woman from Queensland is documenting her journey on TikTok after she said she woke up with an Irish accent following surgery on her tonsils at the end of April.

Angela Yen, 27, told Storyful she had a tonsillectomy on April 19 and was shocked 10 days later when she found herself speaking in an Irish accent.

“I’ve never been to Ireland. I grew up in Australia and had an Aussie accent for the last 20 years since I moved here when I was eight years old,” she said.

Dr Karl Kruszelnicki, a science communicator, said in a TikTok video Yen may have foreign accent syndrome, a rare speech disorder that causes the person with it to sound like they are speaking with an accent from another country.

“I woke up this morning. I didn’t do anything different. I had breakfast,” Ms Yen says in a TikTok video.

“I took a shower, and I usually sing when I’m showering and listening to songs. And all of a sudden, I was talking in an Irish accent.

“And I thought initially that that was just something I was just hearing, that this can’t be real. And now, I can’t shake it.

“I just did a job interview in an Irish accent when I’ve never been to Ireland.”

In her most recent update, Yen hit back at a skeptical commenter, documenting the amount she could end up spending in medical bills while trying to get her Australian accent back.

Ms Yen said she had a neurologist appointment in early June, which would cost \$460 “with maybe about \$100 and something back from Medicare”.

“And I do have top private health insurance, but even for that, I had to pay an out-of-pocket for my anaesthetist and also my ear, nose, and throat specialist for my tonsillectomy,” she said.

“Speech therapy sessions, I’m told that I need a couple regular ones, and I don’t even know how much each session costs.”



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Ms Yen said one of her doctors told her she might need to go to acting school to relearn her Australian accent “and that’s very expensive”.

[au.news.yahoo.com](https://www.au.news.yahoo.com), 15 May 2021

<https://www.au.news.yahoo.com>

### The holy grail is here: a stable, solid-state, lithium-metal battery

2021-05-17

Lithium-ion batteries are the backbone of most of today’s electronic devices, including electric vehicles. But for all of their game-changing benefits, the batteries still have an inherent flaw: dendrites. These thin, snaking, tree-like pieces of lithium form sharp points and end up piercing the battery, causing short circuits and other problems. This ultimately shortens the lifespan of lithium-ion batteries, and leaves major room for improvement.

Scientists have focused, then, on studying lithium dendrite formation to see how they can make better, longer-lasting batteries for electric vehicles. Now, Harvard University researchers say they have the answer: a lithium-metal battery made of a solid-state metal material rather than lithium-ion, eliminating the pesky dendrites and offering more structural stability than a battery consisting of liquid or graphite materials.

Think of the new battery like a BLT: “Our multilayer design has the structure of a less-stable electrolyte sandwiched between more-stable solid electrolytes, which prevents any lithium dendrite growth,” the scientists say in their new study, which appears in *Nature*.

Making the battery out of mostly solid materials helps prevent dendrite formation in more than one way. Mechanically, it’s far easier to crack a thin shell of metal or ceramic than to penetrate a solid battery anode, for example. But this design goes a step further, chemically accounting for any cracks with “dynamically generated decompositions” that fill and stop potential dendrites, the scientists say.

What changes if we switch from lithium-ion batteries to lithium-metal ones? Well, lithium-metal batteries are lighter, more powerful, and longer-lasting ... in a perfect world. Unfortunately, when scientists have experimented with lithium-metal batteries in the past, they’ve been extremely unstable and often exploded. That’s why scientists have

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long clamored to stabilize the lithium-metal battery and bring a viable commercial version to the marketplace.

Reducing or eliminating dendrite formation is critical to any of these designs, because removing the most volatile portion of the battery’s life greatly reduces any adverse outcomes. The Harvard scientists tested their battery over 10,000 charge cycles—competitive with the lifetime of a conventional fossil fuel car and a huge step forward. They found their design still held 82 percent of its charge after 10,000 cycles.

From Harvard’s press release:

“This battery technology could increase the lifetime of electric vehicles to that of the gasoline cars—10 to 15 years—without the need to replace the battery. With its high current density, the battery could pave the way for electric vehicles that can fully charge within 10 to 20 minutes.”

What does this all mean for the future of batteries and electric vehicles? If the design works as planned, it could singlehandedly open the door for lithium-metal batteries in the marketplace. For electric vehicles, the cost of batteries alone is thousands of dollars, and reducing the failure rate, as well as the weight of the batteries, could create a huge savings.

“A lithium-metal battery is considered the holy grail for battery chemistry because of its high capacity and energy density,” Harvard’s Xin Lee told the *Independent*. “This proof-of-concept design shows that lithium-metal solid-state batteries could be competitive with commercial lithium-ion batteries.”

[popularmechanics.com](https://www.popularmechanics.com), 17 May 2021

<https://www.popularmechanics.com>

### The 5 mass extinction events that shaped that history of Earth—and the 6th that’s happening now

2021-05-18

For the last 10,000 years, Earth has been in the midst of yet another extinction event that is rapidly removing animals from our planet.

Scientists define a mass extinction as around three-quarters of all species dying out over a short geological time, which is anything less than 2.8 million years, according to *The Conversation*. Right now, humans find themselves at the beginning of the latest mass extinction, which is moving much faster than any of the others. Since 1970, the populations

**From greenhouse gas emissions and ozone depletion to deforestation, plastic pile-up and the illegal animal trade, humans have actively stripped the world of some species and threatened many more.**



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of vertebrate species have declined by an average of 68%, and currently more than 35,000 species are considered to be threatened with extinction, according to the International Union for Conservation of Nature (IUCN). During the 20th century alone, as many as 543 land vertebrates became extinct, according to a research article in the journal PNAS.

Are humans to blame?

Ever since the beginning of the pollutant-pumping industrial revolution in 1760, humans have been the main contributor to Earth's current environmental crisis. From greenhouse gas emissions and ozone depletion to deforestation, plastic pile-up and the illegal animal trade, humans have actively stripped the world of some species and threatened many more.

There are those who argue that climate change and the extinction of animal species are a natural part of life, and in some ways that's true. After all, the first five mass extinctions occurred without the presence of humans. However, the difference is the speed at which these mass extinctions happen.

Fossil records don't just tell us what creatures existed before us, but also how long a species can naturally survive before becoming extinct without human interference. This is referred to as the background rate, and it is equal to around one species extinction per 1 million species per year. Currently, because of human activity, the actual background rate is tens of thousands of times higher, meaning species are becoming extinct much faster than they should be. Studies have found that some species lost from Earth would have continued to survive for 800 to 10,000 years without the interference of human activities, according to a study published in the journal Science Advances. **PLAY SOUND**

Pandemic perspective

Never before has the world been able — if not forced — to take a step back from normal life and give nature the breathing room it needs. 2020's lockdowns have led to a 17% global decrease in carbon emissions and a 20% fall in nitrogen oxide levels, according to NASA. Waterways cleared up, and animals were seen venturing into cities and towns around the world. While it seems like a wonderful revival for the planet, it's a temporary one as human civilization returns to normal and extinctions return to their previous rate.

Ecotourism is an industry that fuels conservation efforts worldwide, but it's been on the verge of collapse since global travel restrictions were

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imposed. Without the income from tourists, conservationists are having trouble protecting vulnerable species from poaching, which during the pandemic has been on the rise, The New York Times reported. Rhinos in Botswana, wild cats in South America and tigers in India have all been targeted over the last year.

The 5 mass extinctions

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Ordovician-Silurian extinction: ~ 440 million years ago

Species made extinct: 85%

The first mass extinction on Earth occurred in a period when organisms such as corals and shelled brachiopods filled the world's shallow waters but hadn't yet ventured onto land. Life itself was beginning to spread and diversify, having first emerged around 3.7 billion years ago. But about 440 million years ago, a climatic shift caused sea temperatures to change, and the majority of life in the ocean died.

At the end of the Ordovician period, a rapid onset of mass glaciation covered the southern supercontinent, Gondwana. Glaciation on this scale locked away high percentages of the world's water and dramatically lowered global sea levels, which stripped away vital habitats from many species, destroying food chains and decreasing reproductive success, according to a study published in the journal Oceanology.

It is not known exactly what triggered these events. One theory is that the cooling process may have been caused by the formation of the North American Appalachian Mountains, according to Ohio State news. Large-scale erosion of these mountainous silicate rocks is associated with the removal of the greenhouse gas carbon dioxide from the atmosphere.

Not all scientists agree with this, however. Alternative theories suggest that toxic metal may have dissolved into ocean waters during a period of oxygen depletion, wiping out marine life, according to National Geographic. Other scientists suggest that a gamma-ray burst from a supernova ripped an enormous hole in the ozone layer, allowing deadly ultraviolet radiation to kill life below, according to APS News, and another theory suggests that volcanism was the cause, according to a study published in the journal Geology.

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Late Devonian extinction: ~ 365 million years ago



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Species made extinct: 75%

Often referred to as the “age of fish,” the Devonian period saw the rise and fall of many prehistoric marine species. Although by this time animals had begun to evolve on land, the majority of life swam through the oceans. That was until vascular plants, such as trees and flowers, likely caused a second mass extinction, according to a 1995 study published in the journal *GSA Today*.

As plants evolved roots, they inadvertently transformed the land they lived on, turning rock and rubble into soil, according to the BBC. This nutrient-rich soil then ran into the world’s oceans, causing algae to bloom on an enormous scale. These blooms essentially created giant “dead zones,” which are areas where algae strips oxygen from the water, suffocating marine life and wreaking havoc on marine food chains. Species that were unable to adapt to the decreased oxygen levels and lack of food died.

This theory, however, is debated, and some scientists believe that volcanic eruptions were responsible for the decrease in oxygen levels in the ocean, according to a study in the journal *Geology*.

One sea monster that was wiped from the world’s oceans was a 33-foot-long (10 meters) armored fish called *Dunkleosteus*. A fearsome predator, this giant fish had a helmet of bone plates that covered its entire head and created a fang-like cusp on its jaw.

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Permian-Triassic extinction: ~ 253 million years ago

Species made extinct: 96% marine life; 70% terrestrial life

This extinction event, often referred to as the “Great Dying,” is the largest to ever hit Earth. It wiped out some 90% of all the planet’s species and decimated the reptiles, insects and amphibians that roamed on land. What caused this catastrophic event was a period of rampant volcanism, *Live Science* previously reported. At the end of the Permian period, the part of the world we now call Siberia erupted in explosive volcanoes. This released a large amount of carbon dioxide into the atmosphere, causing a greenhouse effect that heated up the planet. As a result, weather patterns shifted, sea levels rose and acid rain beat down on the land.

In the ocean, the increased levels of carbon dioxide dissolved into the water, poisoning marine life and depriving them of oxygen-rich water, according to the Sam Noble Museum in Oklahoma. At the time, the world

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consisted of one supercontinent called Pangaea, which some scientists believe contributed to a lack of movement in the world’s oceans, creating a global pool of stagnant water that only perpetuated carbon dioxide accumulation. Rising sea temperatures also reduced oxygen levels in the water, *Live Science* previously reported.

Corals were a group of marine life forms that were among the worst affected — it took 14 million years for the ocean reefs to rebuild to their former glory.

Death by volcano

How massive eruptions caused the biggest mass extinction on Earth

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Triassic-Jurassic extinction: ~ 201 million years ago

Species made extinct: 80%

The Triassic period erupted in new and diverse life, and dinosaurs began to populate the world. Unfortunately, numerous volcanoes also erupted at that time. Although it remains unclear exactly why this fourth mass extinction occurred, scientists think that massive volcanic activity occurred in an area of the world now covered by the Atlantic Ocean, according to *MIT News*. Similar to the Permian extinction, volcanoes released enormous amounts of carbon dioxide, driving climate change and devastating life on Earth. Global temperatures increased, ice melted, and sea levels rose and acidified. As a result, many marine and land species became extinct; these included large prehistoric crocodiles and some flying pterosaurs.

There are alternative theories explaining this mass extinction, which suggest that rising carbon dioxide levels released trapped methane from permafrost, which would have resulted in a similar series of events, according to *Discover magazine*.

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K-Pg extinction: ~ 66 million years ago

Species made extinct: 75%

The most famous of all the mass extinction events is the Cretaceous-Paleogene extinction — better known as the day the dinosaurs died. The event is sometimes also known as the K-T extinction, and geologists call it the “K-Pg extinction because the letter “C” is shorthand for a previous



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geological period called the Cambrian. The “K” is from the German word “Kreide,” which means “Cretaceous.”

Crash-landing into what is today Yucatán, Mexico, an asteroid over 8 miles (13 kilometers) wide plunged into Earth at around 45,000 mph (72,000 km/h). This punched a hole 110 miles (180 km) wide and 12 miles (19 km) deep, called the Chicxulub crater. The impact would have scorched all the land around it within 900 miles (1,450 km) and ended the 180 million-year reign of the dinosaurs on Earth.

What followed the impact were months of blackened skies caused by debris and dust being hurled into the atmosphere, Live Science previously reported. This prevented plants from absorbing sunlight, and they died out en masse and broke down the dinosaurs’ food chains. It also caused global temperatures to plummet, plunging the world into an extended cold winter. Scientists estimate that most extinctions on Earth at the time would have occurred in just months after the impact. However, many species that could fly, burrow or dive to the depths of the oceans survived. For example, the only true descendants of the dinosaurs living today are modern-day birds — more than 10,000 species are thought to have descended from impact survivors.

## Deep impact

How an asteroid brought about the end of the world for the dinosaurs

## Turning back the clock

Humans might be the driving force behind this accelerated extinction event, but we are also the answer to stopping it. The world is awash with scientists, conservationists and environmentalists working in the laboratory, in conservation areas and in political battlegrounds to protect endangered species.

From tackling global pollution emissions in the 2016 Paris Agreement to the U.K.’s Global Resource Initiative that combats deforestation, legislation will always be at the forefront of the fight against mass extinction. In particular, one of the biggest direct threats to endangered life is the illegal animal trade.

In the wake of the current pandemic, wildlife markets have been thrust into the spotlight as not only being environmentally irresponsible, but potentially dangerous to human health through zoonotic diseases —

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those that jump from animals to humans — such as COVID-19. These markets, trading live exotic animals or products derived from them, are found throughout the world. For example, bear farms in Asia cage 20,000 Asiatic black bears for their bile, resulting in the decline of the wild population, according to Animals Asia.

Lawmakers are tackling these kinds of markets with growing success. In Vietnam, for example, Prime Minister Nguyen Xuân Phúc signed a new directive that bans wildlife imports and closes illegal wildlife markets, according to a report in The Guardian.

## New eyes in the sky

One of the best ways to help prevent species from becoming extinct is to monitor their populations and identify any problems before it’s too late to help. Currently camera traps and surveys conducted on foot or from aircraft are the main method of data collection. However, recent research has used a combination of satellite imagery and artificial intelligence to observe animals from space. Using high-resolution aerial photographs of Africa’s grasslands, researchers created an algorithm to sweep over thousands of miles and count every elephant pictured in the blink of an eye.

The technology, however, is still in its infancy and is limited to areas where large animals, such as elephants, aren’t obscured by forest habitats. “The main question here would be the size of the animals and their habitats. We can’t see through clouds, obviously, but also we can’t see through forested areas. Therefore we can’t look for animals that are in dense forest,” Olga Isupova, a computer scientist at the University of Bath and creator of the elephant-tracking AI, told How It Works magazine, a sister publication to Live Science. “If they’re in open areas, then it’s just a question of their size.”

Nevertheless, it has huge potential to advance our ability to monitor species. “We are currently looking at how we can improve the algorithm itself to look specifically for smaller objects. We could also look for those animals who appear in herds,” Isupova said. “For example, with penguin colonies, the model can detect the whole colony and then have an additional algorithm that approximates the count based on the size of the colony. Also, you can look for the footprints of the animals. The animal itself can be quite small, but if there are many of them and they leave lots of footprints after them, we can also try to track that.”

## Saved by cloning



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Another potential solution to combat extinction could be to clone species. In February 2021, scientists revealed they had successfully cloned a black-footed ferret from an animal that had died more than 30 years ago. Native to North America, these small mammals were thought to be extinct until a small colony was found in the early 1980s, which were entered into a breeding program and reintroduced around the United States.

Due to inbreeding, the population of around 650 ferrets is at risk of extinction once again. This inspired researchers to create a genetic copy from the preserved cell of a wild female, named Willa, who died in the 1980s. The process of cloning was similar to that used to clone Dolly the sheep back in the early 1990s. Scientists hope that after time spent in captivity, cloned members of the species can successfully re-enter the wild, offering a new conservation tool to protect endangered species.

It is legal, scientific and technological advances such as these that will help to conserve Earth's wildlife and hopefully slow down the sixth mass extinction.

[livescience.com](https://www.livescience.com), 18 May 2021

<https://www.livescience.com>

### Study finds alarming levels of 'forever chemicals' in US mothers' breast milk

2021-05-13

A new study that checked American women's breast milk for PFAS contamination detected the toxic chemical in all 50 samples tested, and at levels nearly 2,000 times higher than the level some public health advocates advise is safe for drinking water.

The findings "are cause for concern" and highlight a potential threat to newborns' health, the study's authors say.

"The study shows that PFAS contamination of breast milk is likely universal in the US, and that these harmful chemicals are contaminating what should be nature's perfect food," said Erika Schreder, a co-author and science director with Toxic Free Future, a Seattle-based non-profit that pushes industry to find alternatives to the chemicals.

PFAS, or per and polyfluoroalkyl substances, are a class of about 9,000 compounds that are used to make products like food packaging, clothing and carpeting water and stain resistant. They are called "forever chemicals"

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because they do not naturally break down and have been found to accumulate in humans.

They are linked to cancer, birth defects, liver disease, thyroid disease, plummeting sperm counts and a range of other serious health problems.

The peer-reviewed study, published on Thursday in the Environmental Science and Technology journal, found PFAS at levels in milk ranging from 50 parts per trillion (ppt) to more than 1,850ppt.

There are no standards for PFAS in breast milk, but the public health advocacy organization Environmental Working Group puts its advisory target for drinking water at 1ppt, and the federal Agency for Toxic Substances and Disease Registry, within the Department of Health and Human Services, recommends as little as 14ppt in children's drinking water.

Though researchers are concerned by the findings, newborns are difficult to study so there has not been a thorough analysis of how PFAS affect them, said Sheela Sathyanarayana, a co-author of the study and pediatrician with the University of Washington.

But she added that studies of older children and adults have linked the chemicals to hormonal disruptions and suggests PFAS harm the immune system, which could be especially problematic for infants because breast milk bolsters their immune system.

Though the study checked a relatively small sample size, the contamination cut across socioeconomic and geographic groupings, which is "what makes the issue so difficult on an individual level", Sathyanarayana said.

"What it speaks to is that the chemicals are so ubiquitous that we can't really predict who will have the highest exposures," she added.

The study also runs counter to a chemical industry claim that its newer generation of PFAS that are still in use do not accumulate in humans. It found more than 12 kinds of compounds in about half of the samples, and 16 compounds overall, including several that are currently in use.

Evidence also suggests that the problem is getting worse. The study is the first in the US since 2005 to check breast milk samples, and shows an increase in the newer generation of PFAS, while older compounds that were phased out by industry are still present, and some at high levels.



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The study also analyzed breast milk data from around the world and found PFAS detection frequency is increasing.

Among steps that the authors recommend pregnant women and mothers take to protect themselves are avoiding greaseproof carryout food packaging, stain guards like ScotchGard, waterproof clothing that uses PFAS, and cooking products with Teflon or similar non-stick properties, though manufacturers often do not disclose the chemicals' use.

Moreover, the compounds' ubiquity makes them all but impossible to avoid, and Schreder said that the best solution is a virtual ban of the entire chemical class, including those that industry claims do not accumulate as much in humans.

"The study provides more evidence that the PFAS that companies are currently using and putting into products are behaving like the ones they phased out, and they're also getting into breast milk and exposing children at a very vulnerable phase of development," she said.

[theguardian.com](https://www.theguardian.com), 13 May 2021

<https://www.theguardian.com>

### Morphing noodles start flat but bend into curly pasta shapes as they're cooked

2021-05-11

This pasta is no limp noodle.

When imprinted with carefully designed arrangements of grooves, flat pasta morphs as it cooks, forming tubes, spirals and other shapes traditional for the starchy sustenance. The technique could allow for pasta that takes up less space, Lining Yao and colleagues report May 5 in *Science Advances*.

Pasta aficionados "are very picky about the shapes of pasta and how they pair with different sauces," says Yao, who studies the design of smart materials at Carnegie Mellon University in Pittsburgh. But those shapes come at a cost of excess packaging and inefficient shipping: For some varieties of curly pasta, more than 60 percent of the packaging space is used to hold air, the researchers calculated.

Yao and colleagues stamped a series of grooves onto one side of each noodle. As the pasta absorbed water during cooking, the liquid couldn't penetrate as fully on the grooved side, causing it to swell less than the

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smooth side of the pasta. That asymmetric swelling bent the previously flat noodle into a curve. By changing the arrangement of the grooves, the researchers controlled the final shape. Computer simulations of swelling pasta replicated the shapes seen in the experiments.

Flat pasta (top) with the right pattern of grooves imprinted on it curls into traditional pasta shapes when boiled. Computer simulations of the pasta (bottom) show the same behavior.

The technique isn't limited to pasta: Another series of experiments, performed with silicone rubber in a solvent, produced similar results. But whereas the pasta held its curved shape, the silicone rubber eventually absorbed enough solvent to flatten out again. The gluey nature of cooked pasta helps lock in the twists by fusing neighboring grooves together, the researchers determined. Removing the silicone from the solvent caused the silicone to bend in the opposite direction. This reversible bending process could be harnessed for other purposes, such as a grabber for robot hands, Yao says.

The pasta makes particularly good camping food, Yao says. A member of her team brought it along on a recent hiking trip. The pasta slips easily into a cramped pack but cooks into a satisfying shape.

[sciencenews.org](https://www.sciencenews.org), 11 May 2021

<https://www.sciencenews.org>

### The main ingredient in RoundUp doesn't just kill plants. It harms beetles, too.

2021-05-13

Across the world, insects are in decline. Ubiquitous species, like the rust-patched bumblebee and monarch butterfly, are now rarities, and studies in Europe have found catastrophic crashes in the total number of flying bugs.

There are overlapping causes of the decline, from habitat loss to electric light. Agricultural chemicals are almost certainly key, like the neonicotinoid pesticides involved in the catastrophic collapse of monarch populations. But it's not just pesticides: new research implicates glyphosate, one of the world's most common herbicides, as part of the problem, though in an unexpected way.

**In the well-studied sawtooth grain beetle, high doses of glyphosate, better known by its US brand name, RoundUp, disrupts a crucial relationship with symbiotic bacteria, weakening the beetles' exoskeletons.**



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In the well-studied sawtooth grain beetle, high doses of glyphosate, better known by its US brand name, RoundUp, disrupts a crucial relationship with symbiotic bacteria, weakening the beetles' exoskeletons.

Glyphosate is generally thought to kill only plants because it targets a specific molecular pathway, called the shikimate pathway, that doesn't exist in animals. (Some studies have linked the chemical to human cancer, although other peer-reviewed research—funded in part by Monsanto—hasn't found a link.)

But sawtooth grain beetles rely on a symbiotic relationship with a particular type of (unnamed) bacteria to build their shells. That bacteria in turn uses the shikimate pathway to manufacture the raw building blocks the beetles need.

In fact, that's one of the only things it does. According to Engl, the bacterium appears to have taken shelter inside the beetles for so long that it has shed much of its genome, leaving it "fully dependent on the host."

"They were under selective pressure to just perform this unique function," explains Tobias Engl, who studies insect symbiosis at the Max Planck Institute for Chemical Ecology and is a lead author on the study. "Now they live only to synthesize aromatic amino acids."

The beetles depend on the bacteria for those amino acids—particularly one called tyrosine—during their metamorphosis from larva into adulthood. During that period, they need tyrosine to harden their extra-hard exoskeleton, or cuticle. That puts them in a bind: while they metamorphose, they can't eat. But they also can't store enough tyrosine to tide them over, because the chemical is toxic in high concentrations.

"They need another way to cope," Engl says. "Either by creating nontoxic storage conditions, or having a partner that delivers the components just when they're needed"—the bacteria.

Glyphosate appears to kill off those partners. After exposure to the chemical, the beetles make softer, weaker shells. It doesn't kill them outright, but it leaves them more vulnerable. "They are doing way worse," Engl says. "Their cuticle is thinner, and this is creating a higher risk of desiccation and higher mortality."

The researchers exposed beetles to high levels of glyphosate, comparable to the moment a field is sprayed with the chemical. Engl says more research will be needed to show how beetles are affected by lower, persistent levels. But before the study, it wasn't clear that the beetles

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would even pass environmental glyphosate along to their internal bacterial partners.

The sawtoothed grain beetle is a crop pest, but Engl says it's a model for all kinds of other beetles, which constitute about a quarter of all known animal species. "[The beetle] is generally used by us to understand the associations between insects, their microbial partners, and their ecological importance, so it's a proxy for many insects," Engl says.

Previous research has found similar symbiotic relationships in other beetle species as well as in ants, which have the same hard cuticles. That research hasn't investigated glyphosate specifically, but the chemical has been found to disrupt symbiosis in tsetse flies, and to disturb the gut biome of honeybees.

"They are part of the natural diversity of insects out there. If [other insects] are susceptible to the same things, then it's a concerning thought given the widespread use of glyphosate," says Engl.

popsci.com, 13 May 2021

<https://www.popsci.com>

### Rarely seen supersized moth with 10-inch wingspan found at Australian school

2021-05-18

A gigantic moth that is almost never seen by humans was recently found on a building site at a school in Australia. The colossal insect is so heavy that it can't fly, and reaches its full size just a few days before mating. And then it dies.

Giant wood moths (*Endoxyla cinereus*) are the largest species of moth in the world. When fully grown, the females, which are around twice the size of the males, can weigh up to 1 ounce (30 grams) and reach a wingspan of 10 inches (25 centimeters), according to the Australian Museum. They live in forests across Australia and New Zealand.

Builders working at Mount Cotton State School discovered the female giant wood moth on the construction site of a new school building near the edge of a rainforest. After photographing their impressive find, the builders placed the moth back in the wild.

PLAY SOUND

**The colossal insect is so heavy that it can't fly, and reaches its full size just a few days before mating.**



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Meagan Steward, the school's principal, described it as "an amazing find," but also said "they were not surprised" because they often have a wide range of animal visitors, including wallabies, koalas, ducks, snakes, tree frogs, possums and turtles, according to a statement from the school.

The larvae of these supersized insects, known commonly as witchetty grubs, burrow inside eucalyptus trees before reemerging around a year later as caterpillars that then use silky threads to lower themselves to the ground, where they feed on the tree's roots. The caterpillars then undergo a staggering metamorphosis and emerge in their gigantic final form, according to the Australian

After emerging, the smaller males are able to fly short distances and search out females to mate with on the ground. If reproduction is successful, the female will lay around 20,000 tiny eggs that will hatch to become witchetty grubs. However, the massive moths are rarely seen by people because they quickly die after the energetically expensive reproduction process, according to the Australian Museum.

The school was closed when the moth was discovered, so students were not able to see the giant insect firsthand. However, photographs of the moth inspired a creative writing session that resulted in a story of a "giant moth invasion" that included their teacher "Mrs Wilson getting eaten," according to the school's statement.

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[livescience.com](https://www.livescience.com), 18 May 2021

<https://www.livescience.com>

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### More accurate clocks may add more disorder to the universe

2021-05-18

What's the price of an accurate clock? Entropy, a new study has revealed.

Entropy — or disorder — is created every time a clock ticks. Now scientists working with a tiny clock have proven a simple relationship: The more accurate a clock runs, the more entropy it generates.

"If you want your clock to be more accurate, you've got to pay for it," study co-author Natalia Ares, a physicist at the University of Oxford, told Live Science. "Every time we measure time, we are increasing the universe's entropy."

As we go forward in time, the second law of thermodynamics states that the entropy of a system must increase. Known as the "arrow of time," entropy is one of the few quantities in physics that sets time to go in a particular direction — from the past, where entropy was low, to the future, where it will be high.

This tendency for disorder to grow in the universe explains many things, such as why it's easier to mix ingredients together than separate them out, or why headphone wires get so intricately tangled together in pants pockets. It's also through this growing disorder that entropy is wedded so intimately to our sense of time. A famous scene in Kurt Vonnegut's novel "Slaughterhouse-Five" demonstrates how differently entropy makes one direction of time look to the other by playing World War II in reverse: Bullets are sucked from wounded men; fires are shrunk, gathered into bombs, stacked in neat rows, and separated into composite minerals; and the reversed arrow of time undoes the disorder and devastation of war.

PLAY SOUND

This intimate connection between time and entropy has fascinated scientists for decades. Machines, such as clocks, also produce entropy in the form of heat dissipated to their surroundings. Physicists have been able to prove that a tiny quantum clock — a type of atomic clock that uses laser-cooled atoms that jump at highly regular intervals — creates more disorder the more accurately it measures time. But until now, it has been very difficult to prove that larger, more mechanically complex clocks create more entropy the more accurate they get, even if the idea sounds good in theory.

**"Every time we measure time, we are increasing the universe's entropy."**



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“Clocks are in some way like little steam engines — you need to put work into them to measure time,” Ares said, where the “work is the energy transfer needed to make mechanical devices like clocks run. “In order to get that regular tick, tick, tick, you have to get the machine going. That means you need to invest in entropy production.”

To test this idea, the researchers built a simplified clock made up of a 50-nanometer-thick, 1.5-millimeter-long membrane stretched between two tiny posts that they vibrated with pulses of electricity. By counting every flex up and down as a tick, the team showed that more powerful electrical signals made the clock tick more regularly and accurately, but at the cost of adding more heat — and therefore more entropy — to the system.

Seeing this relationship between entropy and accuracy play out in a device much larger than a quantum clock has given the researchers confidence that their findings could be universal. Perhaps if clocks didn’t produce any entropy, they’d be just as likely to run backwards as they do forwards, and the more entropy they generate the more they’re protected from stutters and backwards fluctuations.

“We don’t know for certain yet, but what we’ve found — for both our clock and for quantum clocks — is that there’s a proportional relationship between accuracy and entropy,” Ares said. “It might not always be a linear relationship for other clocks, but it does look like the accuracy is bounded by the laws of thermodynamics.”

Asides from being useful for designing clocks and other devices in the future, the researchers view their findings as laying the groundwork for further exploration of how the large scale laws of thermodynamics apply to tiny nanosized devices. .

“We now have so much control over these tiny devices, and are able to measure them with so much precision, that we’re rediscovering thermodynamics at a completely new scale.” Ares said. “It’s like the Industrial Revolution at the nanoscale.”

The researchers published their findings May 6 in the journal *Physical Review X*.

Originally published on Live Science.

[livescience.com](https://www.livescience.com), 18 May 2021

<https://www.livescience.com>

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### No shared language? No problem! People across cultures understand clues from ‘vocal charades’

2021-05-14

One of the hardest questions for evolutionary linguists is why humans speak at all. When people don’t share a language, they quickly resort to using their hands, rather than their voices: It’s easier to mime “drink” than it is to make a noise that sounds like drinking. Those gestures, over time, can easily blossom into full-fledged sign languages. “If gesture is good enough for language,” says Aleksandra Ćwiek, a linguistics Ph.D. student at the Leibniz-Centre General Linguistics, “why the hell do we talk?”

In a new study, Ćwiek and her colleagues help answer that question: People from very different cultures can understand nonlinguistic vocal clues better than expected by chance, they find. Speakers of 28 languages could all successfully guess meanings in a charadeslike game where other people expressed words like “water” using vocal sounds—but no language.

The study bolsters a growing argument that vocal sounds, like gestures, can be “iconic”—mimicking some part of the idea they’re trying to convey—says Gareth Roberts, an evolutionary linguist at the University of Pennsylvania who wasn’t involved in the new work. For example, whereas a gesture for “eat” might mimic chewing food, a vocalization could mimic the noises of chewing itself—and unlike the word “eat,” both convey something about the act of eating. Smaller studies have shown similar effects, but “the true contribution of this [new] study lies in its scale,” Roberts says.

For their “vocal charades” experiment, researchers used recordings from a previous study, in which mostly English speakers came up with vocalizations for 30 words, including actions like “cut,” nouns like “child,” and more abstract ideas like “this” and “that.” They invented their sounds without using actual words or other linguistic conventions (such as saying “num num” to mean “eat”).

For some words, for example, “sleep,” the strategy was obvious—make a snoring sound. But for others, the best tactic wasn’t at all clear. For “fruit,” some people made a thumping noise, like a dropped apple hitting the ground. Others went for a crunching, slurping noise. And for an abstract word such as “good,” people often made a noise that changed in pitch from low to high; for “bad,” many made a pitch that went from high to low.

**“If gesture is good enough for language,” says Aleksandra Ćwiek, a linguistics Ph.D. student at the Leibniz-Centre General Linguistics, “why the hell do we talk?”**



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Then, Ćwiek and her colleagues asked a different group of 843 people to match the recorded sounds to their correct meanings. They tested speakers of 25 languages, including some that are closely related to English—like German and Swedish—and some that aren't, like Chinese and Armenian.

They found that participants could guess general meanings surprisingly well. Each correct meaning was presented along with five incorrect options, so guessing at random would give participants a 17% chance of being right. But on average, people across all languages guessed correctly 65% of the time, they report this week in *Scientific Reports*. That's enough to show participants often understood the clues, researchers say.

Some words were easier than others: Participants nearly always correctly guessed the sound for "sleep." But guesses for the more abstract "that" and "gather" scraped in only just above chance. English speakers were correct 74% of the time, suggesting a shared culture helps, says senior author Marcus Perlman, a linguist at the University of Birmingham. But the lowest score, for Thai speakers, was 52%—still far above chance.

To cast the cultural net even wider, the researchers also tested participants in communities that seldom use written language. This included speakers of three additional languages in Vanuatu, French Guiana, and Brazil. Rather than asking people to choose the written word that matched the clue they heard, they were asked to choose pictures, limiting the test to concepts that could be shown in a photograph.

Again, people were surprisingly good at the task. Participants were correct at least 34% of the time (compared with 8% if they'd been right by chance), with Daakie speakers from Vanuatu getting nearly half the answers right. "It's cool to think that we ... can communicate meaning just with the sound of our voice," Perlman says. "People don't just make meaningless sounds."

It's a neat study, says Limor Raviv, an evolutionary linguist at the Dutch-speaking Free University of Brussels who wasn't involved with the work. Although it's simple, it challenges an old and central idea in linguistics: that there's no relationship between the sounds that make up a word and the meaning of that word. For instance, there's nothing about the word "cat" that is obviously connected to the animal. But this study adds to a growing pile of evidence that iconicity in speech isn't limited to just the rare case of onomatopoeia, like "meow."

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If vocalization, like gesture, can convey meaning without being part of a language, it could have played a role in the emergence of early linguistic systems, Perlman says. The finding makes it possible for linguists to start to explore how vocalization and gesture might have worked in tandem in the evolution of language, Raviv says, rather than arguing about which came first: "It makes the mystery of the shift from gesture to spoken language obsolete."

sciencemag.org, 14 May 2021

<https://www.sciencemag.org>

### It's on our plates and in our poo, but are microplastics a health risk?

2021-05-16

As much as the idea might be unpalatable, all of our diets are now likely to include tiny servings of plastic.

The places where microplastics and plastic fibres have been found is beginning to read like a supermarket shopping list.

Studies have found microplastics – that is, pieces or fibres smaller than 5mm – in foods including tea, salt, seaweed, milk, seafood, honey, sugar, beer, vegetables and soft drinks. Tap water contains plastic. Bottled water contains even more.

Across our terrestrial and marine environments, microplastics have been found in most places where scientists have looked, including some of the most remote spots on Earth, threatening and, in some cases killing, wildlife.

But when it comes to the effect of omnipresent plastic on human health, what's the risk?

"Nobody really knows the answer," says Prof Mark Taylor of Macquarie University in Sydney and an expert on environmental contamination. "But the absence of evidence is not evidence of absence."

Rice riddled with microplastics

This week, a study of rice bought from supermarkets and a bulk-food store in Queensland became the latest to deliver a warning.

**The places where microplastics and plastic fibres have been found is beginning to read like a supermarket shopping list.**



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Researchers found plastic in every sample, whether the rice was grown in Thailand, India, Pakistan or Australia and whether the rice was packaged in plastic or paper.

Washing the rice reduced the amount of plastic likely to be ingested. But the study used special filtered water for rinsing. Most households only have access to tap water (which contains microplastics).

Precooked rice – the kind that comes in microwaveable sachets – had the most plastic. But the amounts are tiny.

The study says a 100g serve of rice typically contains 3.7mg of microplastics if it's unwashed, 2.8mg if it's washed or 13.3mg for instant rice (in the microwaveable pouches). A single grain of rice weighs roughly 30mg.

Dr Jake O'Brien, a lead author of the study from the Queensland Alliance for Environmental Health Sciences, says the higher levels of plastic in precooked samples was more likely down to the extra processing it goes through before it's packaged, rather than the plastic packaging itself.

According to the study, there are multiple opportunities for rice to pick up plastics, from the soils to the machines used to pick, store, move and process the rice, to the packaging and handling.

For an average Australian's rice consumption, this would equal about 1g a year of plastic.

O'Brien has also been finding levels of microplastics in prawns, oysters and sardines. He also took part in a study that found microplastics in the solid sludge left over at sewage works.

That sludge – known as biosolids – is widely used as a fertiliser and soil improver on agricultural land. Some scientists have asked if this process means agricultural soils are an unforeseen dump for domestic microplastics.

Our exposure to tiny pieces of plastic isn't limited to what we drink or eat. A team from Macquarie University in Sydney took samples of airborne dust from homes and in a study released earlier this month found about 40% of it was plastic.

Microplastic is clearly making its way into our bodies because it has been found in human poo.

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Scientists in Italy developed a plastic-free protocol in a hospital delivery room, and then examined placentas. They found microplastics there too.

Taylor, who carried out the dust study, says it would be "overreach" to say there are demonstrable effects on our health from ingesting microplastics, but he stresses this doesn't mean future studies won't find problems.

"It would be prudent and smart for people to reduce plastics in their home where that's possible. Do we really need all those plastic food containers?"

'It is the dose that makes the poison'

Prof Ian Musgrave, a toxicologist at the University of Adelaide, says knowing if microplastics are harmful to humans is hard to untangle when we are exposed to so many other substances.

"It is enormously difficult because we live in an environment with lots of other things," he says. "We have a saying though, that it is the dose that makes the poison."

"While we are consuming things that have tiny amounts of microplastics, we don't absorb them. But because we can't demonstrate damage, that's not a reason to be casual."

There are multiple studies showing microplastics are being ingested by marine animals, including seabirds and fish, but isolating the impact they have against all the other pollution and pressure they are exposed to is difficult.

Likewise, there are emerging studies reporting the effects of microplastics on laboratory mice, with some scientists suggesting if the dose is high enough, they can affect reproduction.

A 2019 study from German scientists examined 34 household plastic products – from shower slippers and fruit trays to yoghurt cups and scouring pads.

Many contained compounds that were toxic, but Musgrave says the products were soaked for an hour in an alcohol solution. That process doesn't happen in the human body.

But he says dusty environments in general can be harmful, and fibres – whether from a plastic source or otherwise – can also cause respiratory problems.



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He says plastics are having a major effect on marine environments and he is also concerned about the human health effects from particles of rubber and microplastics that come from tyre wear on roads.

“Tyre microplastics are very nasty,” he says.

A statement from Food Standards Australia New Zealand, a government body that sets standards and regulates food safety, said there was ongoing interest among scientists and the community about the potential health effects from microplastics in food.

“The scientific evidence on potential exposure and health risks continues to evolve, however, our current view is that plastic contamination of the food chain is unlikely to result in any immediate health risks to consumers.”

[theguardian.com](https://www.theguardian.com), 16 May 2021

<https://www.theguardian.com>

### Alcohol made from radioactive Chernobyl apples seized by Ukraine government

2021-05-12

In 2019, a group of scientists and distillers decided to create a bold new type of booze: Atomik, an artisanal alcoholic spirit made from ingredients grown in the Chernobyl nuclear power plant’s still-radioactive exclusion zone. (The booze itself was not radioactive after the distilling process, Live Science previously reported).

Now, the first batch of Atomik is finally complete — and all 1,500 bottles of it have been seized by Ukrainian Secret Services agents for unknown reasons, according to a statement from Atomik’s manufacturer, The Chernobyl Spirit Company.

“It seems that they are accusing us of using forged Ukrainian excise stamps, but this doesn’t make sense since the bottles are for the U.K. market and are clearly labelled with valid U.K. excise stamps,” Jim Smith, founder of the company and a professor at the University of Portsmouth in the U.K., said in the statement.

Elina Smirnova, a lawyer representing the company, added that the seizure was a “clear violation” of Ukrainian law. If Atomik does make its way onto shelves, it will be the first consumer product from the Chernobyl region since the infamous 1986 meltdown, the company said.

**If Atomik does make its way onto shelves, it will be the first consumer product from the Chernobyl region since the infamous 1986 meltdown, the company said.**

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Soon after the nuclear disaster, officials deemed the Chernobyl exclusion zone — the 1,000-square-mile (2,600 square kilometers) area surrounding the damaged power plant — uninhabitable by humans for 24,000 years. However, plants and animals are now thriving in the region — and so is tourism. According to local tourism officials, Chernobyl sees upwards of 60,000 visitors a year, with visits spiking after the May 2019 debut of HBO’s “Chernobyl” miniseries.

Atomik is made from apples grown in Ukraine’s Narodychi District, which sits on the edge of the exclusion zone and was heavily polluted by fallout from the meltdown. This region still has a population of nearly 10,000 people, according to Ukraine’s State Statistics Service, and must abide by stringent agricultural restrictions.

With Atomik, Smith and his colleagues hope to prove that some products made near the exclusion zone can be safe for consumption, according to the company’s website. Several years ago, the Atomik team tested rye crops from the exclusion zone for radiation, and found that the grains were indeed contaminated. However, Smith said, all traces of radiation were removed during the distillation process, making Atomik no more dangerous than other commercially available spirits.

Since then, the founders have changed their recipe from a rye-based booze to an apple-based one — but, according to Smith, the distillation process still renders the final product completely radiation-free. If Atomik makes it to liquor shops, 75% of the company’s profits will be used “to help bring jobs and investment to the Chernobyl affected areas of Ukraine and to further support the community,” according to the company’s statement.

In the meantime, would you care to try a bottle of wine exposed to cosmic radiation aboard a space station for 14 months? It’ll only cost you \$1 million.

Originally published on Live Science.

[livescience.com](https://www.livescience.com), 12 May 2021

<https://www.livescience.com>

### Scientists say this E. coli won’t make you sick and could be good for the planet

2021-05-12

Plastic has been discovered at the bottom of the ocean, at the top of the Himalayas, embedded in Arctic sea ice and swirling in the air around us.

**The material, which they call “aquaplastic,” is derived from Escherichia coli, or E. coli.**



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It is an environmental crisis that has spurred the creation of a number of plastic substitutes, many made from plants and advertised as compostable or biodegradable, though studies have shown some versions may not be either.

Now a team of scientists says it has created a possible alternative using a bacteria better known for turning stomachs. The material, which they call "aquaplastic," is derived from *Escherichia coli*, or *E. coli*.

The bacteria lives in the gut but when ingested through contaminated food or water can land someone in the emergency room.

Using genetically engineered *E. coli*, scientists from Northeastern University, Harvard, Johns Hopkins and elsewhere say they turned *E. coli* into a plastic that can be made into plastic film or bendable three-dimensional molds for cones, bowls, tubes or other structures. The plastic substitute almost completely dissolves in 45 days, according to a study published last month in *Nature Chemical Biology*.

They fed the *E. coli* a nutrient-rich material that enabled it to produce two types of "aquagels," flexible material they used to make different forms of aquaplastics.

"The original idea came from wanting to build materials the way biology does," said Neel Joshi, one of the study's authors and a professor of chemistry and chemical engineering at Northeastern.

It is like when a seed grows into a tree, he said. It absorbs "nutrients and water from its surroundings, and its genetic instructions allow it to produce a tree in the end."

"Even after the tree is built," he said, "the cells that built it remain active inside the tree and can provide some responsiveness to the environment and maintain the material over time, and we wanted to see if we could do a similar thing with engineered cells."

A house made from 3D aquaplastic derived from *Escherichia coli*. (Laura Castanon)

The science behind these aquagels is part of a new field called "engineered living materials," in which living materials are used to produce new substances. These materials develop some of the properties of the life it imitates and can then be used to create drugs, fuels and other products.

Joshi said *E. coli* is "one of the most engineerable organisms" and already has the tools needed to produce a new plastic.

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"Biological systems already know how to convert greenhouse gases, like CO<sub>2</sub>, into useful materials that ultimately will degrade back into CO<sub>2</sub>," he said.

Aquaplastic is still being studied and is not ready for broad distribution, Joshi acknowledged. The shift to a commercial product "is a bit unclear right now," he said, adding that it may depend on securing more funding.

"We make stuff one flask at a time, and we dry the plastic on little molds that we fabricate ourselves," he said. "Making huge roll-to-roll things is the other end of production that we need to hook up with."

But Joshi said it is still a potentially better alternative to plastic, which requires the extraction of fossil fuels. According to a report by the Center for International Environmental Law, 8.3 billion metric tons of virgin plastic had been produced by the end of 2015, and about two-thirds of it remains in the environment, since plastic does not biodegrade or could take tens or hundreds of years to do so.

And it comes at a time when the demand for plastic is growing, nearly doubling since 2000 as new applications are discovered, more products are individually packaged, and oil and natural gas, which are used to make plastic, are getting cheaper, according to the International Energy Agency. It is expected to double again by 2040, according to the World Economic Forum.

Jeffrey S. Moore, a professor of chemistry at the University of Illinois who was not affiliated with the study, said that there are some big barriers to making aquaplastic scalable and competitive with traditional plastic.

It is currently not water-resistant, for example. Customers expect plastic packages to offer protection for their food or other sterile objects, Moore said. At least in this iteration, Moore said, aquaplastic still has a long way to go.

"The investment and potential and the energy cost to get us there to grow things on the timeline and scale of manufacturing that we're used to seems to be a big hurdle," Moore said.

But, Moore said, he is excited about the potential: "I like the idea that biology has pervaded the planet for the last 3 billion years, and so why



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not find a solution wrapped up in biology to the synthetic problems we've created?"

washingtonpost.com, 12 May 2021

<https://www.washingtonpost.com>

### There's a neurological reason you say 'um' when you think of a word

2021-05-19

Eishi Asano's latest work sheds light on those seemingly pesky words that litter our speech: uhs and ums.

As a neurologist at Wayne State University, Asano works on mapping human abilities to brain regions. One such important ability is the ability to use language. Neuroscientists have discovered that, like many little cogs in a wheel, a wide network of brain regions all work together to produce language. Certainly, the ability to communicate with others affects all aspects of life. Thus, protecting these brain regions during brain surgery is of high priority.

Asano has an opportunity few have: to study the brain in action. During a pre-surgical procedure called an electrocorticography (ECoG), an incision is made in a research participant's skull, and electrodes are placed directly on the exposed surface of their brain. He then presents them with photographs of complex scenes and asks them to describe it.

"This one has some, uh, hippos, who are swimming in the, uh, swamp, during the summer," a research participant in his study might say.

When they ran this study, Asano and his team were originally interested in deciphering which regions of the brain were responsible for describing what was in the picture (hippo), what they were doing (swimming), where (swamp) and when (summer). But, as his team rummaged through transcripts, what transpired between these words – the uhs – caught their attention.

Referred to as a "disfluencies" by linguists, uhs and ums are often viewed as disruptions to the flow of speech. They are littered across our speech in all contexts, whether in presentations to a large audience, or in conversations with your closest pal. Estimates vary, but one research group found that such disfluencies pop up every 4.6 seconds, on average. They are equally short and overrepresented in all languages: French speakers say euh, Mandarin speakers say 呃, and ASL signers sometimes wiggle their fingers.

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But while uhs and ums may seem like accidental nonsense words, disfluencies can actually provide us a rare window onto what's going on in the brain as we speak. For example, psycholinguists (scientists who study the psychology of language) argue that disfluencies can actually convey meaning. When researchers scoured through a corpus of transcribed speech, they found that a large proportion of disfluencies arose in specific locations: before difficult-to-pronounce and difficult-to-name words, or before words that haven't been recently discussed. In short, when we need some time to think of the next word, we make use of uhs and ums.

Asano's recent work, published in *Scientific Reports*, shows an example of this. Asano and his team inspected the brain activity of three adolescents that performed the scene-describing task depicted above. While three participants is a smaller sample size than is typical in neuroscience research, the technique used in this study, ECoG, provides more reliable data compared to other neuroscience methods. The fact that electrodes are placed directly on the cerebral cortex makes this technique less susceptible to "noise" in the data, such as from accidental movements by participants.

The three research participants varied in how disfluent they were, with one participant producing seven times more uhs and ums than another. Findings about brain activity, nonetheless, were consistent. "[When the participants] produced the disfluency, extensive areas of the association cortex showed activation," Asano says.

The association cortex is a group of areas on the surface (cortex) of the brain, which has previously been linked with language tasks that require relatively high amounts of linguistic effort. For example, these regions are highly engaged when producing words that have competing meanings. When producing the word "orange," our brains have to suppress the sense of the word that conveys a fruit if we are thinking about the color.

These findings reiterate the idea that uhs and ums, in and of themselves, are not causing speech to be disfluent. Rather, they are behavioral markers that speakers are working hard to find the next word, Asano says. When a speech task is more difficult, the association cortex works harder. And when the association cortex works hard, we sometimes produce disfluencies to fill the space.

Every person's brain is wired slightly differently, so having precise knowledge of the brain regions responsible for speaking, listening, and yes, even for being disfluent, is important for neurosurgeons who have to make important decisions for their patients.



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"I remove brain regions that generate seizure activity for epileptic patients," Asano explains. "But, if you remove the wrong areas, then functionally important areas will be damaged." Indeed, there is some evidence that when parts of the association cortex sustain damage, patients may experience difficulty organizing their speech.

So, while they moonlight as mere speech errors, uhs and ums can actually give us insight into the brain. A healthy number of disfluencies in our speech let neuroscientists, and other listeners, know that we're experiencing a difficult speech moment — which is a perfectly acceptable sentiment to convey in many contexts. To err is human, after all.

massivesci.com, 19 May 2021

<https://www.massivesci.com>

### Pigs can breathe through their butts. Can humans?

2021-05-15

Mice, rats and pigs all share a secret superpower: They can all use their intestines to breathe, and scientists discovered this by pumping oxygen up the animals' butts.

Why run such experiments, you ask? The research team wanted to find a potential alternative to mechanical ventilation, a medical treatment where a machine pushes air into a patient's lungs through the windpipe. Ventilators deliver oxygen to the lungs and help remove carbon dioxide from the blood, but the machines aren't always available.

Early in the COVID-19 pandemic, for example, hospitals faced a severe shortage of ventilators, The New York Times reported. Although doctors can also use a technique called extracorporeal membrane oxygenation (ECMO), where blood is pumped out of the body and reoxygenated with a machine, the procedure carries inherent risks, such as bleeding and blood clots; and it's often less readily available than ventilators, according to Mayo Clinic.

PLAY SOUND

In search of another solution, the study authors drew inspiration from aquatic animals like sea cucumbers and freshwater fish called loaches (*Misgurnus anguillicandatus*), which use their intestines for respiration. It was unclear whether mammals have similar capabilities, although some scientists attempted to answer that question in the 1950s and 1960s.

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"We initially looked at a mouse model system to see if we could deliver oxygen gas intra-anusly," said senior author Dr. Takanori Takebe, a professor at the Tokyo Medical and Dental University and a director at the Center for Stem Cell and Organoid Research and Medicine at Cincinnati Children's Hospital Medical Center.

"Every time we performed experiments, we were quite surprised," Takebe told Live Science.

Without intestinal ventilation, mice placed in a low-oxygen environment survived for only about 11 minutes; with ventilation into their anuses, 75% survived for 50 minutes, thanks to an infusion of oxygen that reached their hearts. The team then tried using oxygenated liquid, rather than gas, in mice, rats and pigs, and they found similarly promising results. The team noted that more work still needs to be done to see if the approach is safe and effective in humans, according to a paper on their findings published May 14 in the journal *Med*.

"The pandemic has highlighted the need to expand options for ventilation and oxygenation in critical illness, and this niche will persist even as the pandemic subsides," as there will be times when mechanical ventilation is unavailable or inadequate on its own, Dr. Caleb Kelly, a clinical fellow and physician-scientist at Yale School of Medicine, wrote in a commentary of the study. If, after further evaluation, intestinal ventilation eventually becomes common practice in intensive care units, this new study "will be marked by historians as a key scientific contribution," he wrote.

That said, a research group in Russia has already explored the idea of using intestinal ventilation in human patients and first conducted a clinical trial of the method in 2014, as described in the *European Journal of Anaesthesiology*. The same group, led by Dr. Vadim Mazurok, a professor and head of the anaesthesiology and intensive care department at the Almazov National Medical Research Centre, has also patented methods and equipment for delivering oxygen gas into the intestines. Takebe and his team will likely focus on using oxygenated liquid in human patients in their future clinical trials, but this previous work by Mazurok and his colleagues sets a precedent for the approach.

Getting familiar with loach, mouse and pig guts

Before starting their experiments in rodents, Takebe and his colleagues got very familiar with loach guts. The fish take in oxygen mostly through their gills, but occasionally, when exposed to low-oxygen conditions, loaches instead use a portion of their intestines for gas exchange, Takebe said. In



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fact, in response to the lack of oxygen, the structure of gut tissues near the anus changes such that the density of nearby blood vessels increases and secretion of fluids related to digestion decreases.

These subtle changes allow loaches to “suck up the oxygen more efficiently,” Takebe said. In addition, the outermost lining of the loach gut — the epithelium — is very thin, meaning oxygen can easily permeate the tissue to reach the blood vessels beneath, he added. To simulate this structure in their mouse models, the team thinned out the gut epithelium of the rodents using chemicals and various mechanical procedures.

They then placed the mice under extremely low-oxygen conditions and used a tube to pump oxygen gas up the animals’ bums and into their large intestines.

Compared with mice whose gut epithelium had not been thinned, the mice with thin epitheliums survived significantly longer in the experiment — with most surviving 50 minutes as compared with about 18 minutes. Again, mice not given any oxygen only survived for about 11 minutes. In addition to surviving longer, the group with thinned-out gut linings showed signs that they were no longer starved for oxygen; they stopped gasping for air or showing signs of cardiac arrest, and the oxygen pressure in their major blood vessels improved.

Although this initial experiment suggested that oxygen could pass through the intestine and into circulation, thinning out the gut epithelium would likely not be feasible in human patients, Takebe said.

Particularly in critically ill patients, “I think additional damage to the gut would be really dangerous, for the treatment perspective,” Takebe said. But “over the course of the experiments, we realized that even the intact gut has some, not really efficient, but some capacity to exchange the gas,” he noted, meaning there may be a way to introduce oxygen through the gut without first thinning out the tissues.

So in another experiment, rather than using oxygen gas, the team tried perfluorodecalin (PFD), a liquid fluorocarbon that can be infused with a large amount of oxygen. The liquid is already used in people, such as for use in the lungs of infants with severe respiratory distress, the authors noted in their report.

The liquid also acts as a surfactant — a substance that reduces surface tension; since a surfactant lines the air sacs of the lungs and helps boost

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gas exchange in the organ, PFD may fulfill a similar purpose in the intestines, Takebe said.

Much like in the oxygen-gas experiments, the oxygenated PFD rescued mice from the effects of being placed in a low-oxygen chamber, enabling the rodents to meander about their cage more than mice not given the treatment. After just one injection of 0.03 ounces (1 milliliter) of the liquid, the rodents’ improvements persisted for about 60 minutes.

“We are not quite sure why this improvement is persisting much longer than the original expectations,” Takebe noted, as the authors expected the effects to wear off in just a couple minutes. “But the observation is really reproducible and very robust.”

The team then moved on to a pig model of respiratory failure, where they placed pigs on ventilators and only provided a low level of oxygen and then injected PFD into the pigs’ posteriors with a long tube. Compared with pigs not given the PFD treatment, pigs given PFD improved in terms of the oxygen saturation of their blood, and the color and warmth returned to their skin. A 13.5 oz (400 ml) infusion sustained these improvements for about 18 to 19 minutes, and the team found that they could give additional doses to the pigs without noticeable side effects.

The team also tested the safety of repeat dosing in rats and found that, while their oxygen levels rose, the animals showed no notable side effects, markers of organ damage or stray PFD lingering in their cells.

Following this success in animal models, Takebe said that his team hopes to start a clinical trial of the treatment in humans sometime next year. They would likely start by testing the safety of the approach in healthy volunteers and beginning to work out what dose levels would be reasonable, he said. However, to make the jump from animals to human patients, the team will need to address a number of critical questions.

For instance, the treatment could potentially stimulate the vagus nerve — a long nerve that connects the gut and brain — so trial organizers should likely be on the lookout for side effects like falling blood pressure or fainting, Takebe noted. Also, the lower gut contains relatively little oxygen compared with other organs in the body, he added. The community of bacteria and viruses that live in the gut are adapted to these low-oxygen conditions, and a sudden infusion of oxygen might disrupt those microbes, he said.



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“The consequence of reversing this so-called ‘physiologic hypoxia’ is unknown,” Kelly noted in his commentary, echoing Takebe’s sentiments. In humans, it will be important to determine how many doses of oxygenated liquid could be safely administered into the gut without causing unintended changes to the intestinal environment, he wrote.

In addition, the animal models in the study don’t fully reflect what critically ill patients experience during respiratory failure, a condition that often coincides with infection, inflammation and low blood flow, Kelly noted. So there may be additional factors to consider in critically ill patients that weren’t relevant in rodents and pigs. And depending on a given patient’s condition, they may need a higher or lower dose of PFD — all of these fine details will need to be carefully assessed in future trials, Takebe said.

Editor’s note: This story was updated on May 19 to note the previous work of Dr. Vadim Mazurok and his colleagues, who have patented methods of intestinal ventilation in human patients. The original story was published on May 14.

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[livescience.com](https://www.livescience.com), 15 May 2021

<https://www.livescience.com>

### Small bribes may help people build healthy handwashing habits

2021-05-12

Good habits are hard to adopt. But a little bribery can go a long way.

That’s the finding from an experiment in India that used rewards to get villagers hooked on routine handwashing. While tying rewards to desired behaviors has long been a staple of habit formation, handwashing has proven difficult to stick.

The rewards worked. “If you bribe kids, handwashing rates shoot up,” says developmental economist Reshmaan Hussam of Harvard Business School. And even just making handwashing a pleasant, easy activity improved health: Children in households with thoughtfully designed soap dispensers experienced fewer illnesses than children in households without those tools, Hussam and colleagues report in a paper to appear in *American Economic Journal: Applied Economics*.

**“If you bribe kids, handwashing rates shoot up,” says developmental economist Reshmaan Hussam of Harvard Business School.**

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Significantly, good habits lingered even after researchers stopped giving out rewards. “The fact that they found persistence suggests to me that participants did form habits,” says Jen Labrecque, a social psychologist at Oklahoma State University in Stillwater who was not involved with the research.

The study involved 2,943 households in 105 villages in the state of West Bengal between August 2015 and March 2017. All participants had access to soap and water. Nearly 80 percent said they knew soap killed germs, but initially only 14 percent reported using soap before eating.

To objectively assess habits, Hussam’s team devised a way to monitor handwashing in the absence of observers — whose presence typically makes people behave better. In collaboration with the MIT Media Lab, the team built a soap dispenser with a hidden sensor that recorded whenever somebody used it.

They then educated families on how to build good handwashing habits, such as establishing a trigger (dinner time) and a routine (handwashing right before meals). They also made the handwashing experience as simple and enjoyable as possible, such as by using scented soap and mounting the sensors where children could easily reach them. Researchers visited households every two weeks to collect data on children’s health and refill the dispensers.

Hussam’s team divided households into multiple groups. Some households received only a dispenser. Others received automated reports on their daily handwashing performance, a social incentive to gently prod routine activity. Still others got tickets each time somebody pressed the dispenser around dinner time — these tickets could be traded for toothbrushes, backpacks and other useful items. A control group received no dispensers.

In households that got no incentives, the team found that people used soap at dinnertime 36 percent of the time, one to four months after receiving a dispenser. Those who got automated reports used soap 45 percent of the time. And those earning tickets used soap 62 percent of the time.

Once rewards and feedback ceased, soap use abruptly plummeted. With little to lose, the researchers kept the sensors on. As months progressed, handwashing rates among households that had received incentives ticked slightly upward. Nine months after incentives ceased, households that



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had received tickets washed their hands 16 percentage points more than households that received dispensers only.

The team suspects that the return of cold and flu season reminded parents to use soap. Perhaps “when parents see that kids are sniffling or sneezing, that’s when they’re triggered to use the device,” Hussam speculates. Often, “habits are tied to specific cues.”

This study shows the value of spending a limited pool of money up front versus spreading it more evenly across time, as is common in public health campaigns, says medical epidemiologist Stephen Luby of Stanford University. “I do see the value of front-loading habit adoption.”

Even children living in households with just a dispenser and no rewards had better health than children in households without a dispenser. Eight months after incentives ceased, children with soap dispensers in their households experienced 38 percent fewer days with diarrhea and 16 percent fewer days with respiratory infections than children without dispensers. Access to a well-designed dispenser also tracked to healthier height and weight for children.

For product designers hoping to steer people toward good habits, a valuable lesson emerges: “Think carefully about human-centered design,” Hussam says.

[sciencenews.org](https://www.sciencenews.org), 12 May 2021

<https://www.sciencenews.org>

### Forget throat swabs: Dutch company claims its breathalyzer can help sniff out COVID-19

2021-05-17

People seeking to get tested for COVID-19 by Amsterdam’s Public Health Service (GGD) in February were pioneers: They were the first in the world to be tested using a “breathalyzer” that can sniff out the disease based on a mix of chemical components exhaled by the patient.

The approach promises to be faster and less unpleasant than a nose or throat swab, and cheaper. But soon after its premiere, 25 people who tested negative turned out to have COVID-19 after all, and Amsterdam halted its use. The Dutch government has decided the device itself was innocent, however, and has not withdrawn its authorization. A commercial testing company is now deploying it widely—for example to screen

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workers at the Eurovision Song Contest, which begins tomorrow in Rotterdam.

SpiroNose isn’t meant to definitively diagnose infection; instead it aims to rule it out in as many cases as possible. For the remainder, the test yields an “inconclusive,” and those people receive a polymerase chain reaction (PCR) or antigen test. “What we want is to exclude as many people as possible who might be infected with the coronavirus, to reduce the testing burden and increase the willingness to test,” says Rianne de Vries, chief operating officer of Breathomix, the Dutch company that makes the device.

Exhaled breath tests have proved hard to deliver. A long-sought breath test for lung cancer still doesn’t exist, for example. Yet researchers in several countries are at work on breath tests for COVID-19. They rely on a variety of technologies, including mass spectrometry and gas chromatography, but some of the most promising ones—in terms of affordability and ease of use—are based on nanomaterial-based sensors. Some sense viral particles, but most focus on compounds produced by the human body. SpiroNose contains seven metal oxide semiconductor sensors that detect thousands of volatile organic compounds in exhaled air; the idea is that the mix changes when someone has a COVID-19 infection. The biological processes responsible for the changes aren’t understood, says Paul Skipp, a proteomics researcher at the University of Southampton. “In principle, you’re purely measuring a correlation. It’s a black box,” he says.

But it works, according to a preprint published in February by researchers at Leiden University Medical Center in collaboration with company scientists. Using the breath profiles from 904 participants, 35 of whom were PCR positive for SAR-CoV-2, the team built an algorithm to predict infection based on the breath profile. In a validation study in another 904 people, the SpiroNose picked out all 33 PCR-positive subjects. The researchers then ran replication studies in populations with more viral transmission and among asymptomatic people who had been in contact with an infected individual. All but 20% of uninfected people tested negative. The device missed one positive case in each replication study. Those cases had a low viral load, meaning they were probably not contagious.

“That’s really, really good,” Skipp says. “The sensitivity is as good as any test that is out there, and of course it is much more rapid.” Patrick Bossuyt, a



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test evaluation researcher at Amsterdam University Medical Center who was not involved in the study, calls the results “quite stunning.”

Based on the studies, the Dutch Inspectorate for Health and Youth Care granted Breathomix a temporary exemption from the authorization procedures required for marketing a test in the European Economic Area. The Dutch government bought hundreds of SpiroNoses, to be deployed throughout the country, and health minister Huguette de Jonge launched the rollout by undergoing a test himself.

But GGD hit the brakes after the 25 PCR-confirmed COVID-19 cases in people who had a negative breath test. (One patient, sports law professor Marjan Olfers, tweeted that she was admitted to a hospital with COVID-19 within days after her test.) Urgent consultation between the Dutch health ministry, the health inspectorate, GGD, and Breathomix brought clarification a week later. The SpiroNose itself had not failed, the parties concluded. Most of the discrepancies were caused by user errors, which GGD blamed on a lack of clear instructions and assistance from the company; for the remainder, the interval between the SpiroNose test and the PCR test was long enough—two or more days—that people could have become positive after their breath test.

The health inspectorate agreed there were no fundamental issues, and De Vries says the company and GGD are working to improve the testing process. “We all learned a lot from the issue,” she says, although she’s frustrated about the negative publicity the pause generated. GGD has yet to resume breath testing, however; a spokesperson declined to explain the reasons but said, “We need to complete an additional validation first.”

In the meantime, a large commercial testing provider in the Netherlands, Lead Healthcare, has teamed up with Breathomix. It carried out a pilot screening at a port company in Rotterdam and is also using SpiroNose to screen workers preparing Eurovision. During the festival itself, it may test as many as 3500 employees per day. By now, Lead Healthcare has carried out more than 30,000 tests; de Vries says the false negative rate is about 0.1%.

Kevin Lamote, a respiratory diagnostics researcher at the University of Antwerp, says he hopes the field can eventually move away from the black-box method. Ideally, researchers will find the components in exhaled air that are truly characteristic of a disease and develop more specific sensors for them, comparable to an alcohol test, he says. “We try to achieve

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this by studying breath samples using sensors in parallel with mass spectrometry analyses,” Lamote says.

sciencemag.org, 17 May 2021

<https://www.sciencemag.org>

### Rivers might not be as resilient to drought as once thought

2021-05-13

Rivers ravaged by a lengthy drought may not be able to recover, even after the rains return. Seven years after the Millennium drought baked southeastern Australia, a large fraction of the region’s rivers still show no signs of returning to their predrought water flow, researchers report in the May 14 Science.

There’s “an implicit assumption that no matter how big a disturbance is, the water will always come back — it’s just a matter of how long it takes,” says Tim Peterson, a hydrologist at Monash University in Melbourne, Australia. “I’ve never been satisfied with that.”

The years-long drought in southeastern Australia, which began sometime between 1997 and 2001 and lasted until 2010, offered a natural experiment to test this assumption, he says. “It wasn’t the most severe drought” the region has ever experienced, but it was the longest period of low rainfall in the region since about 1900.

Peterson and colleagues analyzed annual and seasonal streamflow rates in 161 river basins in the region from before, during and after the drought. By 2017, they found, 37 percent of those river basins still weren’t seeing the amount of water flow that they had predrought. Furthermore, of those low-flow rivers, the vast majority — 80 percent — also show no signs that they might recover in the future, the team found.

Many of southeastern Australia’s rivers had bounced back from previous droughts, including a severe but brief episode in 1983. But even heavy rains in 2010, marking the end of the Millennium drought, weren’t enough to return these basins to their earlier state. That suggests that there is, after all, a limit to rivers’ resilience.

Streamflow records going back to 1970 show that few of 161 selected river basins had low water flow levels relative to their normal flow (red line), even after a short drought in 1983 (left gray area). However, the lengthy Millennium drought, which lasted from around 1997 to 2010 (large gray

**“It wasn’t the most severe drought” the region has ever experienced, but it was the longest period of low rainfall in the region since about 1900.**



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## Curiosities

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area on the right), may have forced some of the rivers into a low-flow state — a new normal that many have stayed in even after the rains returned in 2010.

What's changed in these river basins isn't yet clear, Peterson says. The precipitation post drought was similar to predrought precipitation, and the water isn't ending up in the streamflow, so it must be going somewhere else. The team examined various possibilities: The water infiltrated into the ground and was stored as groundwater, or it never made it to the ground at all — possibly intercepted by leaves, and then evaporating back to the air.

But none of these explanations were borne out by studies of these sites, the researchers report. The remaining, and most probable, possibility is that the environment has changed: Water is evaporating from soils and transpiring from plants more quickly than it did predrought.

Peterson has long suggested that under certain conditions rivers might not, in fact, recover — and this study confirms that theoretical work, says Peter Troch, a hydrologist at the University of Arizona in Tucson. Enhanced soil evaporation and plant transpiration are examples of such positive feedbacks, processes that can enhance the impacts of a drought. "Until his work, this lack of resilience was not anticipated, and all hydrological models did not account for such possibility," Troch says.

"This study will definitely inspire other researchers to undertake such work," he notes. "Hopefully we can gain more insight into the functioning of [river basins'] response to climate change."

Indeed, the finding that rivers have "finite resilience" to drought is of particular concern as the planet warms and lengthier droughts become more likely, writes hydrologist Flavia Tauro in a commentary in the same issue of Science.

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# Bulletin Board

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