CHEMWATCH

Bulletin Board

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ASIA PACIFIC

Specific information requirements – new forms, guides and updated Inventory chemical records now live

2025-07-08

We're pleased to announce that changes to simplify compliance with specific information requirements (SIRs) for listed introductions are now live.

As outlined in our 29 May announcement, these updates are designed to make it easier for chemical importers and manufacturers (introducers) to meet their reporting obligations for listed introductions that have specific information requirements.

What's new?

Improved Inventory chemical records

Enhanced records now include more details about SIRs, links to assessment reports where possible, and links to guidance, making it easier to find information and understand your compliance responsibilities.

See our notice for details about the varied SIR terms of Inventory listing

SIR online forms

We replaced our existing SIR form in AICIS Business Services with 3 new forms that are more fit for purpose for the information that businesses need to submit. These are:

- 'Chemical assessed as a polymer of low concern (PLC)' – use this form if you know that the chemical was assessed as a polymer of low concern (PLC).
- 'SIR details known (excluding chemicals assessed as a PLC)' – use this form if you know the circumstances where there is a specific requirement to provide information, in relation to the chemical introduction.
- Other SIR submissions – use this form if the other 2 forms do not apply. This includes where you want to submit information to AICIS in relation to the introduction of an Inventory-listed chemical, but you do not know the circumstances where there is a specific requirement to provide information.

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AICIS, 28-07-25

https://www.industrialchemicals.gov.au/news-and-notices/specific-information-requirements-new-forms-guides-and-updated-inventory-chemical-records-now-live

Variation of Inventory listings: more details on specific information requirements for NICNAS-assessed chemicals

2025-07-28

The AICIS Executive Director has varied the terms of Inventory listing under section 85 of the Industrial Chemicals Act 2019 for 2,297 chemicals shown in this list.

List of chemicals with varied Inventory terms of listing [XLSX] [178 KB]

The list shows the varied 'specific information requirement' (SIR) term of each Inventory listing. The listings were varied on 25 July 2025.

The reason for the variations is that the Executive Director was satisfied that additional information should be included in the listings. The variations have no regulatory impact.

Read More

AICIS, 28-07-25

https://www.industrialchemicals.gov.au/news-and-notices/variation-inventory-listings-more-details-specific-information-requirements-nicnas-assessed-chemicals

Chemicals added to the Inventory 5 years after issue of assessment certificate - 28 July 2025

2025-07-28

The following industrial chemicals have been added to the Australian Inventory of Industrial Chemicals (Inventory) under section 82 of the *Industrial Chemicals Act 2019* because 5 years have passed since the assessment certificates for the industrial chemicals were issued.

CAS Number	1141331-70-5
Chemical Name	Hexanedioic acid, polymer with 1,3-isobenzofurandione, polymethylenepolyphenylene isocyanate and 1,2-propanediol
Molecular Formula	(C8H4O3.C6H10O4.C3H8O2.Unspecified)x
Specific information requirements	Obligations to provide information apply. You must tell us within 28 days if the circumstances of your importation or manufacture (introduction) are different to those in our assessment.
Listing date	16/07/2025

CAS Number	637-92-3
Chemical Name	Propane, 2-ethoxy-2-methyl-
Molecular Formula	C6H14O
Specific information requirements	Obligations to provide information apply. You must tell us within 28 days if the circumstances of your importation or manufacture (introduction) are different to those in our assessment.
Listing Date	17/07/2025

CAS Number	162201-45-8
Chemical Name	Ethanol, 2-amino-, compds. with polyethylene glycol hydrogen sulfate C12-15-alkyl ethers
Molecular Formula	Unspecified
Specific information requirements	Obligations to provide information apply. You must tell us within 28 days if the circumstances of your importation or manufacture (introduction) are different to those in our assessment.
Listing Date	17/07/2025

CAS Number	254748-33-9
Chemical Name	1-Propanamine, 3-(triethoxysilyl)-, polymer with 1,6-diisocyanatohexane
Molecular Formula	(C9H23NO3Si.C8H12N2O2)x

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CAS Number	254748-33-9
Specific information requirements	Obligations to provide information apply. You must tell us within 28 days if the circumstances of your importation or manufacture (introduction) are different to those in our assessment.
Listing Date	24/07/2025

Read More

AICIS, 28-07-25

https://www.industrialchemicals.gov.au/news-and-notices/chemicals-added-inventory-5-years-after-issue-assessment-certificate-28-july-2025

AMERICA

EPA Announces Reduction in Force, Reorganization Efforts to Save Taxpayers Nearly Three-Quarters of a Billion Dollar

2025-07-18

Today, U.S. Environmental Protection Agency (EPA) announced a reduction in force (RIF) as the agency continues its comprehensive restructuring efforts. With organizational improvements, EPA is delivering $748.8 million in savings.

The RIF will impact the Office of Research and Development. EPA previously announced the extensive enhancement of scientific expertise and research efforts within program offices to tackle statutory obligations and mission essential functions. This included the addition of agency laboratory functions and hundreds of scientific, technical, bioinformatic, and information technology experts to EPA's air, water, and chemical offices on top of the thousands of scientists and engineers employed by EPA within those program offices. In addition, the agency is forging ahead with the creation of the new Office of Applied Science and Environmental Solutions, which will allow EPA to prioritize research and science more than ever before and put it at the forefront of rulemakings and technical assistance to states.

"Under President Trump's leadership, EPA has taken a close look at our operations to ensure the agency is better equipped than ever to deliver on our core mission of protecting human health and the environment

while Powering the Great American Comeback. This reduction in force will ensure we can better fulfill that mission while being responsible stewards of your hard-earned tax dollars," said EPA Administrator Lee Zeldin.

In January 2025, EPA had 16,155 employees. Combined with voluntary retirements, separations, and other announced reductions in force, EPA will have a workforce of 12,448 employees. This includes the 3,201applications received for Fork in the Road, Deferred Resignation Program (DRP) and Voluntary Early Retirement (VERA).

Read More

US EPA, 18-07-25

https://www.epa.gov/newsreleases/epa-announces-reduction-force-reorganization-efforts-save-taxpayers-nearly-three

EPA Releases Memorandum with Additional Context on Occupational Exposure Data for DEHP

2025-007-24

The U.S. Environmental Protection Agency (EPA) is releasing a memorandum that provides additional information on the occupational exposure assessment in the draft risk evaluation for di(2-ethylhexyl) phthalate (DEHP).

This memo provides clarifying information on the draft assessment by providing a calculation of the number of workers and occupational non-users (ONUs) exposed to DEHP for each Occupational Exposure Scenario (OES) identified by the agency in the draft risk evaluation. Normally, a primary difference between workers and ONUs is that workers may handle DEHP and have direct contact with the chemical, while ONUs do not directly handle DEHP but may be indirectly exposed to it as part of their employment. While the calculation of the numbers of different groups of workers that may be exposed to DEHP through each OES does not have implications for risk evaluation, information on the numbers of different groups of workers may inform the strategies for managing any risks identified in the risk evaluation.

This memo also includes additional details on the inhalation monitoring data used to determine inhalation exposure of workers to DEHP in an occupational setting. These details provide clarity on the number of personal breathing zone samples included in the exposure estimates. The memo also identifies the number of samples where, if there was

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DEHP in the air, it was at levels below the limit at which the monitoring equipment could detect DEHP (i.e., "non-detects") and how those values are incorporated in the calculation of inhalation exposure for each OES. The details in this memo do not impact the inhalation exposure estimates presented in the Draft Risk Evaluation for DEHP released in June 2025.

Read More

US EPA, 24-07-25

https://www.epa.gov/system/files/documents/2025-07/epa-hq-oppt-2018-0433-0122_content.pdf

EPA Releases Draft TSCA Risk Evaluation for Phthalate DIBP for Public Comment

2025-07-31

Today, the U.S. Environmental Protection Agency released its draft risk evaluation for diisobutyl phthalate (DIBP) under the Toxic Substances Control Act (TSCA). EPA preliminarily determined that DIBP presents unreasonable risk of injury to human health and the environment under certain conditions of use (COUs).

DIBP Draft Risk Evaluation

EPA is preliminarily determining that DIBP presents unreasonable risk of injury to human health based on risk to workers from two COUs and that DIBP presents an unreasonable risk to the environment from four COUs. EPA did not preliminarily identify a risk of injury to human health or the environment from the other 22 COUs for DIBP. For COUs with unreasonable risk to workers, these preliminary risk determinations do not reflect the use of personal protective equipment (PPE); however, as the draft risk evaluation shows, the use of PPE may reduce exposures and mitigate risk. EPA did not preliminarily determine unreasonable risk of injury to human health for consumers or the general population for DIBP from any COU.

Read More

US EPA, 31-07-25

https://www.epa.gov/assessing-and-managing-chemicals-under-tsca/risk-evaluation-diisobutyl-phthalate-12-benzene

FDA Releases New Tool for Toxicity Screening of Chemicals in Food

2025-07-30

Today, the U.S. Food and Drug Administration (FDA) released its Expanded Decision Tree (EDT) chemical toxicity and risk screening tool that advances the agency's commitment to transparency and enhancement of the food chemical safety program. The tool provides a consistent, systematic, and science-based approach to support evaluation of the safety of chemicals in food based on their structure and estimated toxicity. The EDT was evaluated through external peer-review, marking a significant milestone in its development. The agency will engage stakeholders and the public for further feedback on the tool.

Some chemicals have toxic properties that may pose a risk to human health when we are exposed to them at certain levels. The FDA helps to safeguard the food supply by evaluating the safe use of chemicals as food ingredients and food contact substances. To do this, the FDA uses scientific and regulatory tools to assess the safety of chemicals in food while continually updating these methods to incorporate new approaches.

The EDT is one example of New Approach Methods, which leverage large data sets to achieve faster and less expensive informative new approaches to chemical assessments that can inform risk management decisions and actions. The EDT has gained widespread international support in recent years. This approach to evaluating the safety of chemicals is a modernized version of the original Cramer Decision Tree toolExternal Link Disclaimer and can be used to screen chemicals based on their structural features. The Cramer Decision Tree tool, which is a scientific tool that sorts chemicals into classes of chronic toxic potential using a series of mainly chemical structure-based questions, has been widely used by scientists to provide a quick, preliminary estimate of a new chemical's predicted toxicity, especially when the testing data about a chemical is limited. The updated, expanded, and greatly refined set of fully chemical structure-based questions in the FDA's EDT allows classification of chemicals with greater specificity than the Cramer Decision Tree. The EDT will also help inform the nature and extent of additional testing or evaluation that may be needed to help address potential data gaps for chemicals in food. The EDT is expected to eventually be used in both pre- and post-market evaluation of chemicals in food to help ensure the food supply remains safe. The FDA anticipates that the EDT will provide information that can be

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incorporated into the agency's prioritization of chemicals for post-market review.

Read More

US FDA, 30-07-25

https://www.fda.gov/food/hfp-constituent-updates/fda-releases-new-tool-toxicity-screening-chemicals-food

Persistent Chemicals:Information on EPA's Analysis of Costs for its PFAS Drinking Water Regulation

2025-07-30

Chemicals called per-and polyfluoroalkyl substances—PFAS—have been found in water and are associated with health risks like cancer. The Environmental Protection Agency recently issued a regulation setting maximum levels for some PFAS in drinking water. EPA was required to estimate the costs of the regulation.

The quality of EPA's cost analysis is being challenged in court. Due to the litigation, this Q&A report focused on whether EPA published and sought public comment on various elements of its cost estimate, as required by law. We described the cost estimate and found that EPA did publish and seek public comment on it as required.

What GAO Found

In March 2023, the Environmental Protection Agency (EPA) proposed a drinking water regulation for six types of per- and polyfluoroalkyl substances (PFAS). It also published an accompanying analysis of costs and benefits, as required by the Safe Drinking Water Act (SDWA). EPA's analysis included the initial cost estimate of compliance with the proposed regulation. EPA then collected public comments and, in April 2024, published its response to the comments along with a revised, higher cost estimate to accompany the final regulation. See figure 1 for a timeline of these events in EPA's regulatory process.

Read More

US GAO, 30-07-25

https://www.gao.gov/products/gao-25-107897

EUROPE

Simplification

2025-07-18

To strengthen the EU's long-term competitiveness, while also protecting its economic, social and environmental goals, a simpler regulatory framework is key.

The need for simplification

The EU is determined to strengthen its long-term competitiveness, while also protecting its economic, social and environmental goals. A simpler regulatory framework with reduced administrative burden is a key component of this endeavour, as it will allow EU businesses to flourish and foster a more innovative investment environment.

The call for simplification comes from the highest political level in the EU. In recent years, EU leaders in the European Council have, on several occasions, identified the need to simplify rules to boost the EU's long-term competitiveness and stressed the importance of a simplicity by design approach.

Simplification is one of the main priorities of both the strategic agenda 2024-2029 and the Budapest declaration on the new European competitiveness deal, which called for a 'simplification revolution'.

Read More

European Council, 18-07-25

https://www.consilium.europa.eu/en/policies/simplification/

Half of UK councils still use pesticides in public places, research finds

2025-07-30

Pesticide-free movement has grown, but many local authorities still spray weedkiller linked to wildlife declines and cancer

More than half of councils in the United Kingdom continue to use pesticides in parks, playgrounds, pavements, playing fields and housing estates, research revealed on Wednesday.

But increasingly, local authorities are taking action to end or reduce their use of pesticides, according to research by the Pesticide Action Network.

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The most widely used pesticide by local authorities is the weedkiller glyphosate, which has been linked to cancer. The overuse of pesticides has also been linked to major declines in wildlife, including birds, bees and hedgehogs.

PAN sent freedom of information requests to councils across the UK and had responses from more than 90%. Of the 368 local authorities who replied, 165, or 45% were taking action to end or reduce their use of pesticide.

Nick Mole, a policy manager at PAN UK, said: "While there is still work to do, this survey shows that the pesticide-free movement is growing. A decade ago, no one even knew that pesticides were used in villages, towns and cities. Now we have more than 100 councils taking action to protect the health of residents, wildlife and pets."

Read More

The Guardian, 30-07-25

https://www.theguardian.com/environment/2025/jul/30/uk-councils-pesticides-weedkiller-glyphosate

INTERNATIONAL

EU, China Chart Path Forward on Climate Action

2025-07-30

The Chinese and EU leaders issued a joint statement, emphasizing the UNFCCC and the Paris Agreement on climate change as "the cornerstone of international climate cooperation" and expressing their commitment to submit, before the 2025 UN Climate Change Conference (UNFCCC COP 30), their respective nationally determined contributions (NDCs) covering all economic sectors and all greenhouse gases (GHGs), in alignment with the long-term temperature goal of the Paris Agreement.

The leaders reiterate the importance of the major economies maintaining policy continuity and stability amid today's "fluid and turbulent" international situation. They emphasize the need for all countries to adhere to the principle of common but differentiated responsibilities and respective capabilities (CBDR-RC), in the light of different national circumstances, and agree to demonstrate leadership in driving a global just transition in the context of sustainable development and poverty eradication.

The leaders express their commitment to:

- Upholding the central role of the goals and principles of the UNFCCC and the Paris Agreement;
- Strengthening results-oriented actions to turn their respective climate targets into tangible outcomes;
- Working with all countries to support Brazil as the COP 30 host by promoting an ambitious, equitable, balanced, and inclusive outcome;
- Accelerating the global renewable energy deployment and facilitating access to quality green technologies and products for all countries;
- Enhancing adaptation efforts and support; and
- Enhancing bilateral cooperation on energy transition, adaptation, methane emissions management and control, carbon markets, and green and low-carbon technologies, among other areas.

The leaders issued the statement at the conclusion of their 25th Summit in Beijing, China, on 24 July 2025. They reiterated their commitment to work together to safeguard multilateralism and discussed the various aspects of their bilateral relationship.

Read More

SDG Knowledge Hub, 30-07-25

https://sdg.iisd.org/news/eu-china-chart-path-forward-on-climate-action/

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Biocides fees increase with inflation

2025-07-28

The European Commission has adopted the revised Biocides Fee Regulation to account for inflation. Standard fees for companies related to active substance approvals, Union authorisations and other tasks, such as technical equivalence checks, will increase by 19.5%.

Helsinki, 28 July 2025 – The 19.5% rise in fees reflects the average annual inflation rate in Europe between 2021 and 2023 and is the first fee adjustment since the Biocidal Products Regulation entered into force in 2013.

Reduced fees for micro, small and medium-sized companies (SMEs), along with the eligibility criteria for these reductions, will apply as before. The fee reductions will continue to be calculated as a percentage of the standard fees.

The updated fees will apply from 14 August 2025.

Background

The European Commission adopted the revised Biocides Fee Regulation on 24 July 2025. It enters into force and starts applying 20 days after publication in the Official Journal of the European Union.

Read More

ECHA, 28-07-25

https://echa.europa.eu/-/biocides-fees-increase-with-inflation

UK REACH: rationale for priorities 2025 to 2026

2025-07-31

An explanation of the rationale used to prioritise substances for potential regulatory action under UK REACH.

This document sets out the rationale used by the Department for Environment, Food and Rural Affairs (Defra) and the Scottish and Welsh Governments (the appropriate authorities) to identify priorities for regulatory action under the UK REACH work programme for the 2025 to 2026 financial year.

The appropriate authorities have consulted with the Health and Safety Executive (HSE), the Environment Agency and other stakeholders to set the priorities for the annual UK REACH work programme.

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Read More

UK Gov, 31-07-25

https://www.gov.uk/government/publications/uk-reach-rationale-for-priorities-2025-to-2026

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Janet's Corner

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Who am I?

2025-08-08

I am element number 14. I am a metalloid, meaning I have properties of both metals and nonmetals. You'll find me everywhere in modern technology, forming the basis of computer chips and solar cells due to my unique semiconducting abilities. I'm the second most abundant element in Earth's crust, often found in sand and quartz. I have a relatively high melting point and a grayish, lustrous appearance.

(Send in your answers and get a surprise Chemwatch merch from us for free)

I am element number 14.

Methyl Ethyl Ketone (MEK)

2025-08-08

Methyl ethyl ketone (MEK), also known as butanone, is an organic compound with the molecular formula CH3C(O)CH2CH3. This colourless liquid ketone has a sharp, sweet odour reminiscent of butterscotch and acetone. It is produced industrially on a large scale, and also occurs in trace amounts in nature. It is soluble in water and is commonly used as an industrial solvent.

USES [2,3]

MEK is a liquid solvent used in surface coatings, adhesives, printing inks, chemical intermediates, magnetic tapes and lube oil de-waxing agents. It is also used as an extraction medium for fats, oils, waxes and resins. It is a highly efficient and versatile solvent for surface coatings. Because of its effectiveness as a solvent, MEK is especially valuable in formulating high solids coatings, which help to reduce emissions from coating operations. MEK is a natural component of many foods, including apple juice, beans, chicken, honey and a variety of cheeses.

EXPOSURE SOURCES & ROUTES OF EXPOSURE [3]

Exposure Sources

- Industry sources: The primary sources of MEK emissions are the industries that manufacture it or use it in production, such as the chemical industry, rubber manufacturers, pharmaceutical industry, the semiconductor industry, heavy equipment manufacturing, manufacturers of millwork, veneer and plywood and the manufacturers of paints, inks, varnishes and lacquers. These are emissions to the air unless there is a spill.
- Diffuse sources: Other possible emitters of MEK are commercial and household painting and paint, varnish and lacquer removal, tobacco smoke, and consumer products containing Methyl ethyl ketone. These are emissions to the air unless there is a spill.
- Natural sources: MEK occurs naturally in volcanoes, forest and bush fires, products of biological degradation, and in some foods.
- Transport sources: MEK is found in motor vehicle exhaust.
- Consumer products: Aerosol paints, architectural coatings, automobile and machinery paints and primers, household hard surface cleaners, household dyes and tints, inks, insecticides for yard and garden,

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laundry starches, lubricating greases and oils, automotive chemicals, markers, nail polish and polish remover, paints, varnish and paint and varnish removers and thinners, shoe polish, interior clear finishes, undercoats, and primers, waterproofing compounds, particleboard, and wood office furniture.

Routes of Exposure

- Breathing contaminated air from the production or use of paints, glues, coatings, or cleaning agents containing it.
- Breathing contaminated air near hazardous waste sites.
- Breathing cigarette smoke.
- Sniffing glues.
- Drinking contaminated water from wells near manufacturing or hazardous waste sites.
- Skin contact with the liquid during production or use.

Methyl ethyl ketone (MEK), also known as butanone, is an organic compound with the molecular formula CH3C(O)CH2CH3. [1,2]

HEALTH EFFECTS [4]

Acute Health Effects

- Acute exposure of humans to high concentrations of MEK produces irritation to the eyes, nose, and throat.
- Other effects reported from acute inhalation exposure in humans include central nervous system depression, headache, and nausea.
- Dermatitis has been reported in humans following dermal exposure to MEK.
- Tests involving acute exposure of rabbits have shown MEK to have high acute toxicity from dermal exposure, while acute oral exposure of rats and mice has shown the chemical to have moderate toxicity from ingestion.
- Acute inhalation tests in rats indicate low toxicity from MEK exposure via inhalation.

Carcinogenicity

- No information on the carcinogenicity of MEK in humans was located.
- No studies were available on the carcinogenicity of MEK by the oral or inhalation routes. In a dermal carcinogenicity study, skin tumours were not reported from MEK.

- EPA has classified MEK as a Group D, not classifiable as to human carcinogenicity, based on a lack of data concerning carcinogenicity in humans and animals.

SAFETY

First Aid Measures [5]

- Eye Contact: Check for and remove any contact lenses. Immediately flush eyes with running water for at least 15 minutes, keeping eyelids open. Cold water may be used. Get medical attention.
- Skin Contact: In case of contact, immediately flush skin with plenty of water. Cover the irritated skin with an emollient. Remove contaminated clothing and shoes. Cold water may be used. Wash clothing before reuse. Thoroughly clean shoes before reuse. Get medical attention.
- Serious Skin Contact: Wash with a disinfectant soap and cover the contaminated skin with an anti-bacterial cream. Seek medical attention.
- Inhalation: If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical attention.
- Serious Inhalation: Evacuate the victim to a safe area as soon as possible. Loosen tight clothing such as a collar, tie, belt or waistband. If breathing is difficult, administer oxygen. If the victim is not breathing, perform mouth-to-mouth resuscitation. Seek medical attention.
- Ingestion: Do NOT induce vomiting unless directed to do so by medical personnel. Never give anything by mouth to an unconscious person. Loosen tight clothing such as a collar, tie, belt or waistband. Get medical attention if symptoms appear.

Personal Protective Equipment [5]

The following personal protective equipment is recommended when handling MEK:

- Splash goggles;
- Lab coat;
- Vapour respirator (be sure to use an approved/certified respirator or equivalent);
- Gloves.

Personal Protective Equipment in Case of a Large Spill:

- Splash goggles;

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- Full suit;
- Vapour respirator;
- Boots;
- Gloves;
- A self-contained breathing apparatus should be used to avoid inhalation of the product.
- Suggested protective clothing might not be sufficient; consult a specialist BEFORE handling this product.

REGULATION

United States

Exposure Limit	Limit Values	HE Codes	Health Factors and Target Organs
OSHA Permissible Exposure Limit (PEL) - General Industry See 29 CFR 1910.1000 Table Z-1	200 ppm (590 mg/m³) TWA	HE16	Irritation of the eyes, nose, and throat
OSHA PEL - Construction Industry See 29 CFR 1926.55 Appendix A	200 ppm (590 mg/m³) TWA	HE16	Irritation of the eyes, nose, and throat
OSHA PEL - Shipyard Employment See 29 CFR 1915.1000 Table Z-Shipyards	200 ppm (590 mg/m³) TWA	HE16	Irritation of the eyes, nose, and throat
National Institute for Occupational Safety and Health (NIOSH) Recommended Exposure Limit (REL) (REL listed under ketones)	200 ppm (590 mg/m³) TWA 300 ppm (885 mg/m³) STEL	HE8	Narcosis (central nervous system depression)
		HE16	Irritation of the eyes, nose, and throat

Exposure Limit	Limit Values	HE Codes	Health Factors and Target Organs
American Conference of Governmental Industrial Hygienists (ACGIH) Threshold Limit Value (TLV) (2001) (TLV listed under methyl ethyl ketone [MEK])	200 ppm (590 mg/m³) TWA 300 ppm (885 mg/m³) STEL BEI	HE7	Central nervous system effects and peripheral neuropathy
		HE16	Irritation of the eyes, nose, and throat
CAL/OSHA PELs	200 ppm (590 mg/m³) TWA 300 ppm (885 mg/m³) STEL	HE7	Central nervous system effects and peripheral neuropathy
		HE16	Irritation of the eyes, nose, and throat

References

1. http://en.wikipedia.org/wiki/Butanone
2. http://www.americanchemistry.com/ProductsTechnology/Ketones/Methyl-Ethyl-Ketone-MEK.html
3. http://www.npi.gov.au/resource/methyl-ethyl-ketone
4. http://www.atsdr.cdc.gov/toxfaqs/tf.asp?id=342&tid=60
5. http://www.epa.gov/ttn/atw/hlthef/methylet.html
6. http://www.sciencelab.com/msds.php?msdsId=9927358
7. https://www.osha.gov/dts/chemicalsampling/data/CH_222300.html

First-of-its-kind pill offers 30-lb weight loss on – and it's set for 2026 launch

2025-08-07

It looks likely we'll see oral GLP-1 drugs on the market by next year, with pharmaceutical company Eli Lilly reporting impressive results following a large, robust 72-week trial that saw obese participants lose an average of 27.3 lb, or 12.4% of their body weight with the once-daily pill.

This week the company announced positive results from its Phase 3 ATTAIN-1 trial of the GLP-1 receptor agonist known as orforglipron, given to 3,127 adults with obesity over 72 weeks. In the long study, all doses passed their efficacy and tolerability benchmarks compared to a placebo, with clinically significant results across the board.

Now, the US drug maker is set to apply for global approval of orforglipron by the end of 2025, meaning it's likely to be the first oral weight-loss drug in this class and likely to be on offer in the new year.

"Obesity is one of the most pressing global health challenges of our time, driving global chronic disease burden and impacting more than one billion people worldwide," said Kenneth Custer, executive vice president and president of Lilly Cardiometabolic Health. "With orforglipron, we're working to transform obesity care by introducing a potential once-daily oral therapy that could support early intervention and long-term disease management, while offering a convenient alternative to injectable treatments."

"With these positive data in hand, we are now planning to submit orforglipron for regulatory review by year-end and are prepared for a global launch to address this urgent public health need," he added.

Trial participants on the highest dose lost an average of 27.3 lb (12.4%) at 72 weeks, and 59.6% of participants on this dose lost at least 10% of their body weight. What's more, 39.6% lost at least 15% of their body weight. Orforglipron also significantly lowered cardiovascular disease risk, including non-HDL cholesterol, triglycerides and systolic blood pressure.

Much like current GLP-1 injections, oral orforglipron was well tolerated, with the main side-effects being gastrointestinal-related and mild-to-moderate severity. Importantly, treatment discontinuation on all three doses was lower than those taking the placebo.

The detailed results will be presented next month at the European Association for the Study of Diabetes (EASD) Annual Meeting 2025, before being published in a peer-reviewed journal for closer scrutiny. So too will

the results of the Phase III clinical trial assessing orforglipron in treating type 2 diabetes.

The once-daily pill would be an alternative treatment option to the company's Zepbound, which is currently a weekly injectable medication for obesity.

It's also a big win for Lilly, which has pulled ahead of rival Novo Nordisk in getting the first small molecule oral GLP-1 drug to market. Nonetheless, it wasn't enough to stop the company's shares taking a tumble, with earlier estimates predicting that orforglipron would deliver around 15% weight loss.

However, as we reported late last year, the oral medications are expected to be cheaper than existing injectables, but exactly how much consumers will be expected to pay is yet to be confirmed.

New Atlas, 7 August 2025

https://newatlas.com

Nature's hardest teeth: Chitons offer blueprint for advanced dental and industrial materials

2025-08-07

Researchers at the University of California, Irvine and Japan's Okayama and Toho universities have conducted a first-of-its-kind study to understand how chitons, mollusks that feed on algae growing on intertidal rocks, develop such hard, wear-resistant and magnetic teeth. What they learned is inspiring new ways to produce advanced materials for a variety of applications.

The results are published in Science.

In its study, the team unveiled the process by which chiton-specific, iron-binding proteins called RTMP1 are transported into newly forming teeth through nanoscopic tubules called microvilli. Where and when the proteins are deposited is precisely controlled, ensuring that the creatures develop a hard, strong and tough dental architecture that enables them to perform the repetitive abrasive motions on which their lives depend.

"Chiton teeth, which consist of both magnetite nanorods and organic material, are not only harder and stiffer than human tooth enamel, but also harder than high-carbon steels, stainless steel, and even zirconium oxide and aluminum oxide—advanced engineered ceramics made at

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high temperatures," said co-author David Kisailus, UC Irvine professor of materials science and engineering.

"Chiton grow new teeth every few days that are superior to materials used in industrial cutting tools, grinding media, dental implants, surgical implants and protective coatings, yet they are made at room temperature and with nanoscale precision. We can learn a lot from these biological designs and processes."

There are more than 900 different chiton species worldwide, mostly dwelling within intertidal coastal regions. They can be found in places like Crystal Cove and Laguna Beach near the UC Irvine campus, but Kisailus said the ones investigated in this study are much larger and live in Northwest coastal areas of the United States and off the coast of Hokkaido, Japan. The research team learned that the RTMP1 proteins exist in chitons at disparate locations around the world, which suggests "some convergent biological design in controlling iron oxide deposition," according to Kisailus.

He said that when he and his collaborators began, they were not aware of how and when these iron-binding proteins were conveyed into the chiton teeth. But by using a combination of advanced materials and molecular biological analyses, they discovered that these specialized proteins that were initially found within tissues surrounding immature, nonmineralized teeth were directed through nanostructured tubules into each tooth.

Once inside, the proteins bind to preassembled scaffolds of chitin nanofibers, the structural biopolymer that controls the architecture of the magnetite nanorods in the teeth. Concurrently, iron stored in ferritin, another protein found in the tissue outside the teeth, is released into each tooth, where it binds to the RTMP1, leading to the precise deposition of nanoscale iron oxide, which continues to grow during the tooth maturation into highly aligned magnetite nanorods that ultimately yield the ultrahard teeth.

Kisailus said this project has improved humanity's understanding of cellular iron metabolism while providing insight into the synthesis of next-generation advanced materials.

"The fact that these organisms form new sets of teeth every few days not only enables us to study the mechanisms of precise, nanoscale mineral formation within the teeth, but also presents us with new opportunities toward the spatially and temporally controlled synthesis of other materials for a broad range of applications, such as batteries, fuel cell catalysts and

semiconductors," he said. "This includes new approaches toward additive manufacturing—3D printing—and synthesis methods that are far more environmentally friendly and sustainable."

Setting this study apart, according to Kisailus, was the blending of state-of-the-art materials science techniques, including ultra-high-resolution electron microscopy, X-ray analysis and spectroscopy, with biological methods such as immunofluorescence, gene expression tracking and RNA interference to reveal the full molecular choreography of chiton tooth formation.

"By combining biological and materials science approaches through wonderful, global efforts, we've uncovered how one of the hardest and strongest biological materials on Earth is built from the ground up," Kisailus said.

His collaborators on this project were Michiko Nemoto, Koki Okada, Haruka Akamine, Yuki Odagaki, Yuka Narahara, Kiori Obuse, Hisao Moriya and Akira Satoh of Okayama University and Kenji Okoshi of Toho University.

Phys Org, 7 August 2025

https://phys.org

Millipede Molecules Scramble Ants – And Might Help Heal the Human Brain

2025-07-27

Scientists at Virginia Tech have uncovered a new family of complex molecules in the secretions of a native millipede species. These compounds, potent enough to confuse ants, also interact with human brain receptors linked to pain relief. Now, researchers are racing to synthesize these brain-tweaking molecules, potentially transforming one of nature's oldest creatures into a surprising source of healing.

Millipedes' Secret Weapon: A New Frontier in Drug Discovery

Millipedes get a bad rap — their many legs put people off and could classify them as "creepy crawly." But these anthropods' secretions could hold the key to new drug discovery for the treatment of neurological diseases and pain.

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Chemist Emily Mevers and her team recently discovered a new set of complex structures in millipede secretions that can modulate specific neuroreceptors in ant brains.

The newly discovered structures fall into a class of naturally occurring compounds called alkaloids. The Mevers team named them the andrognathanols and the andrognathines after the producing millipede, Andrognathus corticarius, found on Virginia Tech's Blacksburg campus in Stadium Woods. These discoveries were recently published in the Journal of the American Chemical Society.

Unlocking Hidden Pharmacies in the Forest Floor

Mevers specializes in leveraging the chemistry of underexplored ecological niches, in this case the millipede, in the name of drug discovery. After collecting millipedes from under leaf litter and fallen branches in Stadium Woods, Mevers and team members used a variety of analytical tools to identify the compounds contained in the millipedes' defensive glands. They also learned that the millipedes release these compounds to ward off predators while also sharing their location with their kin.

Mysteries of the Millipede World

Despite their pervasiveness, much about millipedes remains mysterious — including their specific habitats, numbers, diets, behaviors, and chemistry. Mevers, in collaboration with millipede expert Paul Marek in the entomology department, is working to fill in some of these gaps and see if what they uncover could be useful for future medications.

Previously, Mevers and Marek examined a millipede native to the Pacific Northwest, Ishchnocybe plicata, and discovered that related alkaloids potently and selectively interact with a single neuroreceptor called Sigma-1. The interaction suggested that this family of compounds may have useful pharmacological potential for the treatment of pain and other neurological disorders.

The Mevers group discovered that the new alkaloids are actively secreted from the Hokie millipede when it is physically disturbed. The secretions cause disorientation in ants, a presumed natural predator. A subset of these compounds possesses similar interactions with the Sigma-1 neuroreceptor.

From Millipede Trails to Medicine Cabinets

With the newfound complex compounds in hand, the next step is finding people to actually make them in larger quantities and evaluate their biomedical applications.

"These compounds are quite complex, so they're going to take some time to synthesize in the lab," said Mevers.

Once larger quantities are available, Mevers will be able to better study their properties and potential in drug development.

Sci Tech Daily, 27 July 2025

https://scitechdaily.com

Clathrate material's crystal structure finally solved, 80 years after it was first discovered

2025-08-05

The exact crystal structure of the stable form of a widely used semiclathrate hydrate has finally been elucidated – 80 years after the material was first discovered. The work provides deeper understanding for researchers aiming to use these cage-like structures in various industrial applications.

Clathrate hydrates comprise frameworks of water molecules surrounding small, covalent guest molecules. They have applications such as gas storage and water purification. When larger, ionic molecules replace these non-polar guest molecules, they can displace some of the water molecules and insert into the cage structure to form semiclathrate hydrates. The best known and most widely used of these, with potential applications in heat storage and advanced air conditioning technology, is tetrabutylammonium bromide (TBAB) hydrate.

However, like some other semiclathrate hydrates, TBAB hydrate exhibits pseudopolymorphism – a type of structural variation in which the number of bound solvent molecules changes along with the crystal arrangement. When an aqueous solution is simply cooled under ambient conditions, two pseudopolymorphs form. The first, TBAB·38H2 O, is a metastable orthorhombic form, whereas the stable TBAB·26H2 O is tetragonal.

'The molecules are large and the number of water molecules is large,' explains physical chemist David Wu at Academia Sinica in Taipei, Taiwan, who was not involved in the new work. 'You have competing structures

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that are possible and they just differ slightly in how preferred they are. In addition, even for a single pseudopolymorph, it can be hard to tell the difference between candidate structures.' Despite this, researchers in Japan resolved the structure of the metastable form in 2005. However, 80 years after the molecule's discovery, the exact structure of the stable form has remained a mystery.

In the new research, a team led by Sanehiro Muromachi at Yokohama National University in Japan slowly grew perfect crystals of the material in the stable phase from solution before quenching them in liquid nitrogen. They then irradiated them at Japan's Spring-8, the most powerful synchrotron beamline in the world. By interpreting the resulting diffraction patterns, the researchers determined that the structure contains features such as a single bromide ion taking the place of two water molecules – analogous to that seen previously in tetrabutylammonium nitrate. The researchers hope that this exact structure determination will optimise applications of this material and potentially allow for more rational design of new materials in future.

'The principles elucidated in this study, particularly the ability of the TBA cation to adapt to primitive water clusters … extend beyond clathrate hydrates and provide insights applicable to the scalable design of related water-based functional materials, such as clathrates of group 14 elements, surfactants, and functional polymers,' the researchers conclude.

'This is an important structure to know, and they went through and were able to carefully resolve that question,' says Wu. 'It would be interesting to know whether these structural motifs show up in other semiclathrate materials.'

Chemistry World, 5 August 2025

https://chemistryworld.com

Cleaner, cooler and cheaper: Upgraded catalyst system achieves low-temperature oxidation

2025-08-07

What if chemical manufacturers could cut their energy costs while eliminating toxic heavy metals from their processes? Researchers at Nagoya University have developed a catalyst system that does exactly that by converting alcohols to valuable chemical products at lower temperature using safer iodine compounds instead of dangerous heavy metals, expensive precious metals, and reagents.

In 2009, a team led by Professor Kazuaki Ishihara from the Graduate School of Engineering successfully replaced toxic heavy metals and expensive precious metals used in traditional oxidation reactions with safer, more abundant iodine.

Their new iodine-oxone catalyst system allowed them to sustainably convert alcohols into aldehydes or carboxylic acids and ketones, compounds used to manufacture diverse consumer products. However, one problem remained: the process required temperatures of 70°C to work effectively.

Now, the team has decreased the oxidation reaction temperature from 70°C to 30°C by using their catalyst in its pre-activated form and adding a helper chemical to improve mixing. This allowed them to remove the slow startup steps that required high heat. The research was published in Green Chemistry.

Combined with their earlier replacement of toxic metals such as chromium and manganese with iodine-based catalysts, their method produces cleaner chemical reactions at lower temperatures, cutting costs and energy consumption significantly.

Identifying the problem

Oxidation of alcohols to aldehydes and ketones is fundamental to chemical manufacturing. These molecules are essential ingredients for countless consumer products, including medicines, fragrances, and plastics. Any improvements in efficiency or environmental impact have important effects on multiple industries.

To find out why the oxidation process was taking a long time and needed high temperatures to work, the researchers used a technique called nuclear magnetic resonance spectroscopy to observe what happened during the reaction.

They assumed that the main reaction that transformed an alcohol to an aldehyde was the slow part of the process. However, they found that their catalyst, 2-iodoxybenzenesulfonic acid (IBS), was not activating properly at the start of the reaction.

Before it could work, IBS had to be converted from its inactive form pre-IBS to its active form IBS(III). This conversion process was very slow at low temperatures.

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Making matters worse, oxone, the oxidizing agent that drives the conversion of alcohol to aldehydes and ketones, is a powder that does not dissolve well in organic solvents. Therefore, it could not effectively activate the catalyst. This meant pre-IBS took a long time to become active at 30°C, forcing researchers to use high heat (70°C) to speed up the activation process.

Smart solutions, green benefits

"A major limitation in green chemistry is that high temperatures often prevent the synthesis of heat-sensitive compounds used in specialty chemicals and medicines," Professor Ishihara said.

"To overcome these obstacles, we used a pre-activated catalyst by preparing IBS in its ready-to-work form ahead of time. We also added a helper chemical, tetrabutylammonium hydrogen sulfate, that acts like soap to allow oxone to dissolve and mix properly."

The improved system has several advantages: it can perform multiple chemical reactions in one container, called "one-pot synthesis," where the product of the first reaction immediately becomes the starting material for the next reaction. This removes costly and time-consuming purification steps between reactions. Moreover, the low-temperature conditions allow oxidation of many heat-sensitive alcohols that are difficult to process.

Japan, the world's second largest iodine producer, could particularly benefit from the new iodine-oxone-based catalyst system, which could make its chemical industry more efficient and sustainable.

Future research will focus on replacing the remaining chemicals with more environmentally friendly options and finding ways to recycle the catalyst so it can be used repeatedly, making the process even cleaner and more cost-effective.

Phys Org, 7 August 2025

https://phys.org

Rare diamond with unique hexagonal structure is harder than natural counterpart

2025-08-01

The first bulk synthesis of hexagonal diamond marks a milestone for carbon allotropes, offering researchers an opportunity to extensively characterise this unique material.

Diamond is one of the hardest materials known to exist in nature, arising from its structure in which carbon atoms covalently bond together in a perfect tetrahedral arrangement. Nearly 60 years ago, scientists predicted a harder, alternative form known as hexagonal diamond, which has a hexagonal lattice, rather than the cubic lattice adopted by conventional diamond.

Natural hexagonal diamond has been discovered on Earth and is thought to have formed during meteorite strikes when the immense temperatures and pressures can rapidly transform graphite into this rare form of diamond. However, only small grains of this natural hexagonal diamond have ever been discovered, mixed in with cubic diamond and graphite. Methods replicating the heat and pressure of a meteorite strike in the lab have often resulted in nanocrystalline

structures of hexagonal diamond, with these samples often being impure, making it difficult to study hexagonal diamond in isolation.

'Now we have made a millimetre-sized chunk of [near] pure hexagonal diamond,' says Ho-Kwang Mao at the Centre for High Pressure Science and Technology Advanced Research in China.

To do this, Mao and his team in the US and China applied about 200,000 times atmospheric pressure to a single crystal of pure graphite using a diamond anvil cell. In situ x-ray diffraction before and after applying this pressure allowed the scientists to observe the microscopic conversion of graphite to hexagonal diamond. With the sample still under pressure, laser heating at 1400°C stabilised the phase, allowing the researchers to recover and subsequently study the near-pure sample.

'This new two-step method provides the first definitive evidence of hexagonal diamond as a distinct and recoverable bulk material,' says Eiichi Nakamura, an inorganic chemist at the University of Tokyo who has previously worked on carbon allotropes.

Through this method, the team synthesised crystals of near pure hexagonal diamond – containing a few microcrystals of the more familiar cubic diamond. The crystals ranged from 100μm to several millimetres in size, marking a first for forming a distinct and recoverable amount of the material.

'If you make [the bonding pattern of carbon atoms] three dimensional, there are only two ways of packing the layers,' says Mao. 'There's ABC packing within cubic diamond, and AB packing for hexagonal.' High-

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resolution transmission electron microscopy confirmed that the sample had AB stacking of buckled honeycomb layers, a structure indicative of hexagonal diamond.

The scientists probed the structure further using various spectroscopic techniques. 'We found that one of the bonds between the layers is actually shorter, compared to the other three, so this helps explain why the structure is stronger [compared with cubic diamond],' says Mao. Results also showed that all bonds were sp3 σ bonds, with no sp2 π bonds that would signal the presence of graphite.

The team tested the hardness of the material using a 1mm diameter disc of hexagonal diamond, finding that the hardness was comparable to natural diamond, due to minor cubic diamond defects. Future efforts will likely focus on refining synthesis conditions, with Nakamura noting that 'this [synthetic] breakthrough marks a milestone in the study of carbon allotropes'.

Chemistry World, 1 August 2025

https://chemistryworld.com

Hospital food proven bad scientifically – and may undermine health

2025-08-02

Hospital meals have long been the butt of jokes, but new research shows they might actually pose a health risk, with low-quality diets failing to meet basic nutrition standards in hospitals and nursing homes.

Anyone who has been a hospital patient or has visited someone in the hospital during mealtimes can attest, hospital food can be abysmal. Often colorless and cooked beyond recognition, what's served up in healthcare settings has, for a long time, earned itself a bad reputation.

New research by the Potsdam Institute for Climate Impact Research (PIK), Charité – Universitätsmedizin hospital in Berlin, and Stanford University has examined the quality of food served in German hospitals and nursing homes. As the first comprehensive study of its kind, the researchers also analyzed the environmental footprint of the food provided in these institutions.

"We found that meals contained too few healthy plant-based foods such as vegetables, fruits, whole grains and legumes, and too many refined grains, added sugars, salt and saturated fats," said lead and corresponding

author Lisa Pörtner, MD, a researcher at PIK and Charité. "This leads to an inadequate provision of nutrients and low dietary quality."

The researchers gathered meal plans and recipes from two hospitals and three nursing homes across Germany. They measured food quality using the Healthy Eating Index-2020 (HEI-2020), which assessed how well the food met dietary guidelines, and the Planetary Health Diet Index (PHDI), which measured how well it aligned with a diet that supports both human and planetary health. The researchers also compared the provided nutrients to recommended dietary values. To measure environmental impact, they examined the impact of food procurement through factors such as land use, greenhouse gas emissions, and water use.

The HEI-2020 provides a score out of 100, based on 13 dietary components, categorized into "adequacy" (the consumption of foods like fruits, veggies, whole grains, dairy, protein, and healthy fats) and "moderation" (limiting intake of refined grains, salt, saturated fats and added sugars). The higher the score, the better aligned with dietary guidelines. The PHDI was introduced in 2019 to better align nutrition and sustainability targets. It's scored out of a total of 150 points, based on 16 dietary components. Derived from the EAT-Lancet Commission on Food, Planet, Health's recommendation, these components are categorized into adequacy, moderation, optimum, and ratio components. The framework is designed to nourish a global population while minimizing environmental harm.

In terms of dietary quality, the institutions analyzed by the researchers scored low on both HEI-2020 (39 to 57 out of 100) and PHDI (30 to 44 out of 150). Most calories came from animal-source foods like red meat and dairy, refined grains, added sugars and animal fats. Less than 20% of calories came from healthy plant-based foods such as legumes, nuts, and vegetables. The study also exposed nutritional deficiencies. Protein intake met less than 73% of recommended values in nursing homes, highlighting risks for muscle loss, frailty, and delayed recovery. Micronutrients (B vitamins, vitamin C, potassium, magnesium, calcium, iron, and zinc) were critically low, below 67% of recommended values. Whereas salt and saturated fats were far too high.

From an environmental standpoint, the animal-source foods served caused around 75% of the environmental impact, even though they made up only around 33% of food weight and calories and around 60% of protein. Meat alone was responsible for about 38% of greenhouse gas emissions and around 45% of land use impact. Dairy was the second

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largest contributor. Legumes and nuts, which are more sustainable proteins, made up less than 1% of total procurement by weight.

"Calories from wholesome plant-based foods made up less than one-fifth of energy provision in all institutions, which is far lower than the 80% recommended by the Planetary Health Diet," Pörtner said. "At the same time, refined grains made up over 20% of calories, and red meat accounted for 10 to 17% – resulting in poor overall dietary quality. Animal-source foods, namely red meat and dairy products, were also major contributors to negative environmental impacts, including greenhouse gas emissions, land use change and water pollution."

The study had limitations. Only five institutions were chosen, which is a small sample size, and they were not randomly selected. The researchers didn't measure what people actually ate, only what was served to them. They also excluded important factors like cooking methods and simplified environmental estimates (composite foods were broken down by ingredients, but some processing impacts may have been underestimated).

"Our results indicate that food served in healthcare settings poses a health risk if consumed over the long term, as unhealthy diets are a major cause of chronic illness," said the study's senior author, Nathalie Lambrecht, PhD, a nutritional epidemiologist and food systems scholar from Stanford University. "This is particularly troubling as health care institutions should be role models for healthy diets. In addition, we find that their foodservice contributes to environmental degradation and climate change – which also threaten to undermine health."

There have been initiatives aimed at resuscitating the reputation of hospital food. In January 2024, Germany's Federal Government introduced the food and nutrition strategy, Good Food for Germany, to make it easier for people – at school, at home, and in healthcare settings – to eat well and sustainably. The New South Wales government announced in October 2024 that it would be rolling out the Co-Designing Healthy and Enjoyable Food (CHEF) program across 12 public hospitals in the Australian state. The program aims to deliver more delicious and nutritious meals alongside a 52% reduction in food waste.

It would be remiss to lump all hospital meals on the same tray, as it were. Not all hospital meals are created equal, and there are differences between not only healthcare facilities, but countries, as this Food & Wine article from 2022 makes very apparent. But with poor food quality in healthcare a worldwide problem and with up to 40% of hospitalized patients affected

by disease-related malnutrition, it's important that improvements are made when and where they're needed.

"Policymakers and healthcare providers alike urgently need to prioritize food quality, set clear standards and close existing data gaps to ensure meals truly are health-promoting – without harming the planet," Pörtner said.

The study was funded by the Deutsche Bundesstiftung Umwelt (DBU), also known as the German Federal Environmental Foundation, and was published in the journal The Lancet: Planetary Health.

New Atlas, 2 August 2025

https://newatlas.com

Shining a light on a new principle in photochemistry: How microenvironments, not just absorption, shape reactions

2025-08-07

An international team led by QUT researchers continues to challenge a long-held assumption in photochemistry with potential applications in fields ranging from medicine to manufacturing.

Published in the Journal of the American Chemical Society, the research introduces a theory explaining that the effectiveness of light in triggering chemical reactions is not solely determined by how strongly a molecule absorbs it. The paper is titled "Microenvironments as an Explanation for the Mismatch between Photochemical Absorptivity and Reactivity."

The research team, led by principal investigator Distinguished Professor Christopher Barner-Kowollik and lead authors Dr. Joshua Carroll and Fred Pashely-Johnson, from the QUT Soft Matter Materials Group, has identified a new mechanism involving molecular microenvironments that can dramatically influence how molecules respond to light.

"Since light consists of a spectrum of colors, it has been expected for many years that the color that is absorbed the most by a molecule will be the most efficient at triggering any photoreactions," Dr. Carroll said.

"Our experiments confirmed that the microenvironment around each individual absorbing molecule can lead to vastly different properties."

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The QUT team found that these effects can lead to longer excited-state lifetimes, making certain molecules more reactive under lower-energy, red-shifted light.

The behavior was linked to a known phenomenon in fluorescence science called the "red-edge effect" and its influence on photochemical reactivity was confirmed through advanced experimental techniques including fluorescence spectroscopy and photochemical action plots.

Fluorescence spectroscopy is a technique used to study the fluorescent properties of substances—that is how they absorb light at one wavelength and then emit light at a longer wavelength. Photochemical action plots show how effective different wavelengths of light are at driving a specific photochemical reaction.

The QUT research team also comprised Dr. Maciej Klein and Associate Professor Ajay Pandey as well as Professor Andreas Unterreiner and Theresa Stephan from the Karlsruhe Institute of Technology (KIT) and Dr. Michael Walter from the University of Freiburg in Germany.

The potential impact of the observed and rationalized effect will enable researchers to develop more sophisticated photochemical technologies in fields such as photodynamic therapy, 3D printing, organic chemistry, solar energy and many more.

"The implications are enormous," Professor Barner-Kowollik said.

"By controlling microenvironments, through solvent choice or molecular design, we can tune how light affects molecules, allowing for more precision in photochemical drug delivery, polymer engineering and light harvesting."

Phys Org, 7 August 2025

https://phys.org

Gold samples heated to 19,000K without losing their crystalline structure

2025-08-06

Solid gold samples have been superheated to more than 14 times the material's melting point without losing their crystalline structure. The researchers behind the work say that the experiments suggest that, as long as a material is heated fast enough, there may potentially be no limit to how high a solid sample can be superheated before it loses its structure.

For decades, scientists thought it was impossible to heat solid materials to more than three times their melting point.

'Back in the 1940s and 1980s, there were a series of papers asking the question: "How hot can you heat something before it melts?"' explains Thomas White, a physicist at the University of Nevada in the US, who led the project. 'In the 1980s, [Hans] Fecht and [William] Johnson proposed this ultimate limit of superheating, which is that you can never heat anything up to more than three times the melt temperature – they called this the entropy catastrophe.'

'If you go beyond that point, you create a state of matter that just cannot exist,' adds White. 'The simple way of thinking about it is that you would have a crystal or a solid that is more disordered than liquid.'

Beyond the entropy catastrophe threshold

However, exploring this theoretical upper temperature limit has, until now, been extremely challenging due to intermediate destabilising events – colloquially known as the hierarchy of catastrophes – that occur at far lower temperatures, typically resulting in the material melting before the threshold is reached.

In their experiment, White and his team used high energy, highly focused lasers to rapidly heat 50-nanometre thick gold films. This fast heating rate meant that they bypassed these destabilising processes, enabling them to show that the metal could reach over 14 times its melting point without changing state and losing its crystalline structure.

'What we've done in our experiment is heat this gold up so rapidly that it doesn't have time to expand. If you heat it up faster than that expansion then you redo this entropy calculation, you find that the lines don't cross anymore. We're not breaking any laws of physics, we're just able to heat far beyond this three times the melt temperature.'

White explains that while this level of superheating may have been done before, measuring these upper temperature limits has been a long-standing challenge. However, the team was able to overcome this by using a technique called inelastic x-ray scattering, in which the atoms or molecules in a sample absorb photons from an x-ray laser and re-emit photons of a different frequency.

'This is a very cool, 3km-long x-ray laser,' he says. 'We were able to scatter the x-rays off the atoms as they move, and measure that Doppler shift, just to get the atom velocities and relate that to temperature.'

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'Technically, it's quite a hard experiment and one of the reasons is that we don't get much scattering from the sample. One way to increase the scattering is to use a higher atomic number element. Gold is a pretty high atomic number element, so it makes the experiment, technically quite easy.'

However, White and his team didn't originally set out to investigate entropy catastrophe or superheating in gold at all. 'We wanted to look at the rate at which it heated, that was what we were focusing on,' he explains. 'And after the experiment, we were looking at this temperature rise in the gold … and somebody just said, "Wait a minute, that's really hot. Is that real? Is it really that hot?" It got to 19,000 Kelvin before it melted – that is really hot, but I didn't know if it meant anything.'

'Now we have this temperature diagnostic, we can investigate a whole range of interesting materials,' adds White. 'And so just last week, we did the experiment on compressed hot iron and conditions that you find inside planets. That's pretty exciting for us.'

Martin Thuo, an expert in materials science and engineering at North Carolina State University in the US, told Chemistry World the method could be 'very revolutionary' but there are still some unanswered questions. 'To be able to superheat any object to this extent is amazing. What is however missing is an understanding of "why"– what is the driving force?' he says.

Thuo adds that he had some concerns about how the temperature was measured. 'I don't see any corrections for surface mobility or plasmonic transfer of incident light along the surface,' he explains.

'In the [experiment], the entropy of the 'solid' gold film would be way past the entropy catastrophe point proposed by [Robert] Cahn. However, this was not measured so I hope the study can be validated as this is a whole new area in the gold energy landscape.'

Chemistry World, 6 August 2025

https://chemistryworld.com

Solving a Primordial Puzzle: Scientists Recreate a Key Step in Life's Origin

2025-07-28

Researchers have taken a pivotal step toward understanding how living cells could have originated from nonliving matter.

At some point in Earth's history, nonliving, inorganic substances gave rise to the first forms of life. This transition from lifeless matter to living organisms remains one of science's most profound and unresolved questions. Today, researchers are engineering synthetic cells that behave like real biological cells in an effort to uncover insights into how life might have originally emerged on our planet.

Although there is no universally agreed-upon definition of life, scientists generally recognize three key features that appear across all living systems:

- Compartmentalization, which creates a boundary between the cell's internal environment and the world outside
- Metabolism, the chemical processes that build up and break down molecules to sustain cellular activity
- Selection, where some molecules are naturally favored over others due to their properties or performance

Historically, much of the research in this field has concentrated on understanding compartmentalization. However, metabolism is just as essential. It enables living systems to adapt, reproduce, and evolve by continuously processing molecules in response to environmental changes.

Synthetic Cells with Metabolism

Now researchers from the University of California San Diego have designed a system that synthesizes cell membranes and incorporates metabolic activity. Their work appears in Nature Chemistry and is featured on the cover of the June 2025 issue.

"Cells that lack a metabolic network are stuck — they aren't able to remodel, grow, or divide," stated Neal Devaraj, the Murray Goodman Endowed Chair in Chemistry and Biochemistry at UC San Diego and principal investigator on the paper. "Life today is highly evolved, but we want to understand if metabolism can occur in very simple chemical systems, before the evolution of more complex biology occurred."

Lipids are fatty compounds that play a crucial role in many cell functions. In living cells, lipid membranes serve as barriers, separating cells from the external environment. Lipid membranes are dynamic, capable of remodeling themselves in response to cellular demands.

As a crucial step in understanding how living cells evolved, Devaraj's lab designed a system where lipids can not only form membranes, but through metabolism, can also break them down. The system they created

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was abiotic, meaning only nonliving matter was used. This is important in helping understand how life emerged on prebiotic Earth, when only nonliving matter existed.

"We are trying to answer the fundamental question: what are the minimal systems that have the properties of life?" said Alessandro Fracassi, a postdoctoral scholar in Devaraj's lab and first author on the paper.

A Chemical Cycle That Builds and Breaks

The chemical cycle they created uses a chemical fuel to activate fatty acids. The fatty acids then couple with lysophospholipids, which generate phospholipids. These phospholipids spontaneously form membranes, but in the absence of fuel, they break down and return to the fatty acid and lysophospholipid components. The cycle begins anew.

Now that they've shown they can create an artificial cell membrane, they want to continue adding layers of complexity until they have created something that has many more of the properties we associate with "life."

"We know a lot about living cells and what they're made of," stated Fracassi. "But if you laid out all the separate components, we don't actually understand how to put them together to make the cell function as it does. We're trying to recreate a primitive yet functional cell, one layer at a time."

In addition to shedding light on how life may have begun in an abiotic environment, the development of artificial cells can have a real-world impact. Drug delivery, biomanufacturing, environmental remediation, biomimetic sensors are all possibilities over the coming decades as we continue to deepen our understanding of how life on Earth came to be.

"We may not see these kinds of advancements for 10 or 20 years," Devaraj noted. "But we have to do the work today, because we still have so much to learn."

Sci Tech Daily, 28 July 2025

https://scitechdaily.com

'Nature's Ozempic' triggers weight-loss pathway without the side effects

2025-08-03

Byproducts from gut bacteria breaking down tryptophan, a dietary amino acid, can restore hormone-secreting gut cells reduced by obesity, a new study found. It opens the door to a natural, side-effect-free alternative to GLP-1 drugs like Ozempic.

Specialized gut cells called enteroendocrine cells (EECs) secrete important hormones such as glucagon-like peptide 1 (GLP-1), which help regulate insulin production and appetite. Yes, it's the GLP-1 that drugs like Ozempic and Wegovy mimic.

New research by scientists from Marshall University, West Virginia, has uncovered how obesity significantly reduces the number of EECs, leading to metabolic dysfunction. They also found that byproducts produced by gut bacteria when they break down certain amino acids can restore them.

"Our findings suggest that microbial metabolites derived from dietary tryptophan can reverse obesity-associated reductions in hormone-secreting cells," said Alip Borthakur, PhD, assistant professor at Marshall University's Joan C. Edwards School of Medicine (JCESOM) and the study's senior author. "This points to a potential therapeutic strategy that leverages gut microbes to improve metabolic outcomes in obesity."

If you're a fan of the TV series Seinfeld, you'd no doubt be aware of the amino acid tryptophan. In the episode "The Merv Griffin Show," Jerry and George give a woman called Celia turkey and red wine, both containing tryptophan, to make her fall asleep so they can play with her toy collection.

Tryptophan is an essential amino acid, meaning that the body can't make it, and we need to get it from our diet. It plays a crucial role in making proteins and is a precursor to several important molecules, including serotonin and melatonin (presumably where the sleepy claim came from, although that has been confirmed to be a myth). Studies have shown that when gut bacteria break down tryptophan, one of the byproducts that's produced is indole. Indole is known to regulate the gut's immune response by activating the transcription factor aryl hydrocarbon receptor (AhR). Transcription factors are proteins that bind to DNA and regulate gene expression.

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The researchers induced obesity in rats by feeding them a high-fat diet and then measured EEC levels via chromogranin A (CHGA), a marker for EECs, and levels of transcription factors that guide stem cells to become EECs. They treated human gut organoids, "mini organs" grown from healthy human colon tissue, with indole and with Lactobacillus acidophilus bacteria grown with and without tryptophan, to mimic bacterial metabolite exposure. To confirm if AhR played a role, they added an AhR antagonist called CH-223191 to block its function and measured whether it reversed the effects of indole and tryptophan metabolites.

In the obese rats, the researchers found that CHGA levels and EEC numbers dropped by around 60%. Important transcription factors for EEC differentiation were also significantly lowered. Fewer GLP-1-producing cells were found in the obese rats. In the human organoids, indole treatment significantly increased CHGA mRNA and protein, suggesting it promoted EEC formation. L. acidophilus grown with tryptophan caused a greater increase in CHGA than L. acidophilus grown without it. Blocking AhR with CH-223191 prevented these increases, confirming that AhR activation is required for the EEC-boosting effect.

There are some limitations to the study. The organoids were from healthy individuals, which limits insight into how obese tissues specifically respond to these treatments. Further, obese individuals may have altered signaling pathways that affect EEC differentiation. Also, the researchers' focus was only on colon tissue, so results may not reflect what happens in the small intestine or other gut regions. And, although promising, results from organoids and rats may not fully translate to humans without clinical studies to confirm them.

Nonetheless, the study is important in terms of its potential real-world implications. The findings suggest a non-drug strategy for restoring GLP-1 production in obesity by encouraging the growth of tryptophan-metabolizing gut bacteria (e.g., probiotics like L. acidophilus) and using dietary supplements rich in tryptophan to fuel these bacteria. Unlike synthetic GLP-1 drugs, which can cause side effects like nausea, this approach may naturally stimulate the body's own GLP-1 production with fewer risks. The study also highlights the potential for personalized nutrition and microbiome therapies where tailored diets or supplements are used to boost microbial production of beneficial metabolites to prevent or treat obesity and the metabolic dysfunction, such as type 2 diabetes, that often accompanies the condition.

The study was published in the International Journal of Molecular Sciences.

New Atlas, 3 August 2025

https://newatlas.com

Portable Mass Spectrometer Can Sniff Out Fentanyl in Seconds

2025-07-24

A portable device for atmospheric flow tube-mass spectrometry (AFT-MS) could speed up drug screening at border control.

Researchers at the Pacific Northwest National Laboratory (PNNL) have developed a new system that can detect trace levels of fentanyl, cocaine, explosives and other dangerous substances in the air.

The portable, non-contact, real-time vapor detection device – based on technology developed by PNNL scientists in a 2022 study – is being commercialized by the Silicon Valley company BaySpec Inc., which presented the results of a test conducted at a US border crossing point at the 2025 meeting of the American Society for Mass Spectrometry in Baltimore.

Contactless analysis through atmospheric flow tube mass spectrometry

The device is intended to improve screening for drugs and drug residue by measuring the ambient air around an item of interest, eliminating the need for physical swabbing.

"Current trace detection systems rely on physically swiping a surface to pick up residue from drugs. These systems involve contacting the surface and hopefully detecting a substance. Non-contact vapor detection can provide the ability to screen a larger area in less time," PNNL chemist Robert Ewing, PhD, told Technology Networks.

Most narcotics and explosives have a low vapor pressure, meaning that relatively few of these molecules are released into the gas headspace above a sample. Historically, this has made the direct vapor detection of these compounds very difficult. However, contactless detection is feasible through the use of atmospheric flow tube-mass spectrometry (AFT-MS) – a technique that is able to detect ultra-trace levels of fentanyl vapor down to the low parts-per-quadrillion (1015) range. To put that scale into

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perspective, one part per quadrillion is equivalent to roughly 1 second of time in the span of 31.7 million years.

As Ewing explains, this AFT-MS technology was developed by PNNL scientists and is central to the method's increased sensitivity for low vapor pressure compounds. In essence, the AFT is a long tube which the sample is made to pass through, where it meets "reagent ions" generated by an ionization source. The high proton affinity of drugs and the electronegativity of explosives contribute to their interactions with these ions, leading to chemical ionization and detection through MS.

"The AFT is an ionization source that provides a region where electric charge can be transferred to the analyte – the drug molecules in the air. These charged molecules can then be detected and identified in the mass spectrometer," Ewing said.

"The AFT provides a space where the ionization can occur with longer reaction times (2–3 seconds) than conventional MS (a few milliseconds). This results in a gain in sensitivity of several orders of magnitude," he explained.

PNNL houses a high-end benchtop AFT-MS instrument that is the size of a small refrigerator. While incredibly sensitive, such a device is not well-suited for use in the field. To solve this problem, scientists at PNNL and BaySpec – an instruments manufacturing company – developed a more portable system that could be used for field testing.

For the field tests run at a US border control point in Nogales, Arizona, the team was able to shrink the system down to the size of a microwave oven. This portable laboratory version of the equipment weighs less than 40 pounds but is still able to detect trace fentanyl levels down to as low as six parts-per-trillion.

Improving drugs and explosives detection

Immunoassay testing, benchtop Fourier transform infrared spectroscopy (FTIR) and benchtop gas chromatography-mass spectrometry (GC-MS) are the testing solutions that are currently applied in border patrol's portable laboratories for on-site testing.

While these tests are generally effective, they each come with their own set of drawbacks. For example, immunoassays for fentanyl detection can output a result in under five minutes, but they are also prone to false positives and cannot differentiate between different fentanyl analogs. FTIR can detect a wider array of drugs, but takes up to 10 minutes with

moderate false positive and negative rates. GC-MS, while considered the gold standard for analysis, with its very low false positive and negative rates and sub-parts-per-billion detection limits, can take up to 30 minutes to conduct a single run.

In field tests, the portable AFT-MS device was able to directly detect various drug vapors from uncrushed, unmodified pills that had been seized at the border. In addition to fentanyl and its analogs, the system was also effective at screening for and detecting trace amounts of other common narcotics, including methamphetamine, MDMA (ecstasy), cocaine and ketamine.

"The device was a breadboard, but we learned that it worked outside of a laboratory and in a real-world environment," commented Ewing. "Through this field visit, we recognized the importance of having a portable instrument. We are planning for additional visits to better understand what the background looks like and see if there are any detection challenges or how the instrument could be implemented."

"The new portable device, using PNNL's AFT and BaySpec's mass spectrometer, is still being optimized. It is currently producing great sensitivity, but it is about 50 to 100 times less sensitive than the benchtop AFT-MS," Ewing added. "There is usually a sacrifice when making a system more portable. We are currently working with BaySpec to improve the system, hoping to achieve sensitivities close to the benchtop version."

The BaySpec scientists are continuing to reduce the size of the system, planning to produce a commercial product based on this technology for portable narcotics and explosive detection later this year. PNNL scientists are also working with the US Department of Homeland Security to continue developing this technology, which could be used to rapidly screen cargo, baggage or mail.

"We view the AFT-MS as a way to provide rapid, non-contact screening for explosives and drugs. It would be used to identify the potential presence of these materials in packages, containers and vehicles," Ewing said. "The future direction [for our research] involves developing an instrument that can be evaluated in the field. Feedback received can be used to improve system performance and the user interface."

Technology Networks, 24 July 2025

https://technologynetworks.com

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Individual atoms tracked during real-time chemical bond formation

2025-08-06

Researchers at European XFEL in Germany have tracked in real time the movement of individual atoms during a chemical reaction in the gas phase. Using extremely short X-ray flashes, they were able to observe the formation of an iodine molecule (I_2) after irradiating diiodomethane (CH_2I_2) molecules by infrared light, which involves breaking two bonds and forming a new one.

At the same time, they were able to distinguish this reaction from two other reaction pathways, namely the separation of a single iodine atom from the diiodomethane, or the excitation of bending vibrations in the bound molecule. The results, published in Nature Communications, provide new insights into fundamental reaction mechanisms that have so far been very difficult to distinguish experimentally.

So-called elimination reactions in which small molecules are formed from a larger molecule are central to many chemical processes—from atmospheric chemistry to catalyst research. However, the detailed mechanism of many reactions, in which several atoms break and re-form their bonds, often remains obscure. The reason: The processes take place in incredibly short times—in femtoseconds, or a few millionths of a billionth of a second.

An innovative experimental approach was now used at the SQS instrument at European XFEL to visualize such reaction dynamics. The researchers irradiated diiodomethane molecules with ultrashort infrared laser pulses, which triggered the molecular reactions. Femtoseconds later, intense X-ray flashes shattered the molecules, causing their atomic components to fly apart in a "Coulomb explosion."

The trajectories and velocities of the ions were then recorded by a detection device called the COLTRIMS reaction microscope (COLd Target Recoil Ion Momentum Spectroscopy)—one of the detection instruments at the SQS experimental station that is made available to users.

"Using this method, we were able to precisely track how the iodine atoms assemble while the methylene group is cleaved off," explains Artem Rudenko from Kansas State University, U.S., the principal investigator of the experiment. The analysis revealed that both synchronous and asynchronous mechanisms contribute to the formation of the iodine molecule—a result that was supported by theoretical calculations.

Remarkably, "Although this reaction pathway only accounts for about 10% of the resulting products, we were able to clearly distinguish it from the other competing reactions," explains Rebecca Boll from the European XFEL's SQS (Small Quantum Systems) instrument in Schenefeld near Hamburg. This was made possible by the precise selection of specific ion fragmentation channels and their time-resolved analysis.

Furthermore, the researchers were able to track the vibrational motion of the newly formed iodine molecule. "Now, we can more directly observe how an isolated molecule breaks and forms bonds during a chemical reaction—in real time and with atomic precision," says Xiang Li, the first author of the publication and a scientist at the SLAC National Accelerator Laboratory in the United States.

This is a crucial step toward truly understanding chemical processes. These observations not only provide a detailed picture of reaction mechanisms but also open up new avenues for investigating more complex chemical processes.

In the future, these techniques will be extended to even larger molecules and more complex reactions. Thanks to planned technical improvements to the European XFEL X-ray laser, even faster and more detailed insights into the world of ultrafast molecular dynamics can be gained in the future.

Phys Org, 6 August 2025

https://phys.org

Reactivity of helium could be unlocked by a combination of fluorine and extreme pressures

2025-08-05

A team of researchers in the US and China has calculated that extreme pressure could theoretically allow stable covalent helium–fluorine bonds to form, challenging the idea that helium is a chemically inert element.

Noble gases get their name due to their inherent reluctance to react. Their complete electron configurations lead them to have exceptionally high ionisation energies, resulting in an unwillingness to form compounds. Despite this, there have been numerous examples of heavier noble gas compounds forming under non-ambient conditions, notably a range of xenon fluorides. Helium equivalents, however, are much rarer, with such compounds often being unstable or existing only briefly as transition states.

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Now, using an algorithmic search that varies the chemical composition and pressure, scientists have identified a compound where helium actively participates in chemical bonding. At pressures in the tera-pascal range – about 10 times the pressure found at the centre of the Earth – the energetically stable compound He3F2 forms. This molecule consists of HeF2 chains and interstitial helium atoms. Within each chain, helium forms polar covalent bonds to three fluorine atoms, with helium donating electron charge. Molecular orbital calculations of each HeF3 cluster reveal that extreme pressure allows the helium 1s and fluorine 2p orbitals to form bonds.

The emergence of helium–fluorine bonding further challenges the idea that noble gases are unreactive. The researchers say that helium-bearing interiors of giant planets may contain similar compounds. Such extreme pressures needed to synthesise these materials may be achievable in the lab, but only at a few select research facilities.

Chemistry World, 5 August 2025

https://chemistryworld.com

Earth's 'kryptonite twin' could power a million EVs, but it's still out of reach

2025-08-04

With a chemical formula nearly identical to fictional kryptonite, unique mineral jadarite has the potential to power a million electric vehicles each year. But it remains firmly underground, beneath a picturesque valley in rural Serbia – the only place it's been found – more than 20 years after it was discovered.

You may not have heard of jadarite, but it's been at the center of an international battle since exploratory mining by Australian-British company Rio Tinto first unearthed this rare mineral and quickly realized its worth.

In 2004, while prospecting for borates in western Serbia's Jadar Valley, geologists from the mining giant found something strange: A soft, white, powdery mineral that didn't match any known records. Chemically, it's unique – containing both lithium and boron – and so far found nowhere else on the planet. With a chemical formula of LiNaSiB3O7(OH), it's almost identical to kryptonite.

"While lacking any supernatural powers the real jadarite has great potential as an important source of lithium and boron," said Michael Page, a scientist from Australia's Nuclear Science and Technology Organisation (ANSTO). "In fact, the Jadar deposit where it was first discovered is considered one of the largest lithium deposits in the world, making it a potential game-changer for the global green energy transition."

What Rio Tinto found beneath the sleepy valley was Europe's largest deposit of lithium, and the company believed it could extract 2.3 million tonnes of it, which would power a million cars for a few decades. What's more, jadarite's lithium can be mined easier than existing sources extracted from spodumene.

"Jadarite is an economically attractive ore mineral because it holds up to 3.39 wt% lithium and 14.65 wt% boron, the latter of which can be recovered as an extremely useful co-product," researchers noted. "The lithium content of jadarite is comparable to the mineral spodumene (3.61 wt%), which currently supplies most of the world's hard-rock lithium; jadarite, however, can be processed using less energy-intensive methods. Jadarite is found as white nodules hosted by dolomitic marls and shales deposited within a closed volcano–sedimentary basin. Such basins are common across the Balkans, with many containing borates and oil shales, but only Jadar has jadarite."

During the formation of the Jadar Basin, volcanic ash rich in lithium gathered in a shallow lake. Over time, as water evaporated, the area became highly alkaline, which also turned volcanic deposits into gel-like silica. These then kicked off a chain of reactions that led to the jadarite nodules and other minerals forming. In this process, smectite clay was degraded, releasing lithium that would then also form jadarite.

And it's these unique geological and environmental processes that have made the Jadar Valley the only place, so far, that the mineral has been found.

However, jadarite remains in the ground, where it was first found two decades ago – despite Rio Tinto moving forward with the Jadar Project and a timeline for mining. Environmental impact statements hinted at the scope of damage that the project would likely cause. After nationwide protests, the government canceled mining permits in January 2022, putting the ambitious project on ice. Eighteen months later, the project was revived, but it remains in the planning stage and mining is unlikely to start before 2028 at the earliest (if it gets past the many challenges it faces, both environmental and societal).

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The story of jadarite is emblematic of the clean energy paradox we're now facing: How to mine the minerals needed in order to move away from fossil fuels for a greener future, without simply replacing one destruction for another?

There is some potential good news, though. Last year, scientists detailed how they were able to create a novel synthetic version of jadarite. However, it remains a proof of concept. Nevertheless, this lab-created form of the mineral could help pave the way for alternative lithium materials that bypass current methods of extraction.

While jadarite may never power an EV, it stands as a testament to how rare and extraordinary Earth's chemistry can be – and a stark reminder that even when pushing for a more green-powered future, there are complex and significant environmental trade-offs to be reckoned with in the process of getting there.

The research was published in the journal Nature Geoscience.

New Atlas, 4 August 2025

https://newatlas.com

Ultrasound system can remove common plastic pollutant from water

2025—08-06

Researchers at a Scottish university have found a new way to remove a common pollutant from water using controlled waves of ultrasound, without the use of additional chemicals.

The system, developed by chemists from the University of Glasgow, can scrub up to 94% of the traces of Bisphenol A (BPA) from samples of contaminated water by using ultrasound to create conditions similar to the surface of the sun in bubbles of contaminated water.

In the future, scaled-up versions of their prototype could be used in water treatment plants to help remove BPA from water supplies. It could also help industry remove BPA and other hard-to-treat pollutants from wastewater before it is discharged into public waterways.

Currently, around 10 billion kilograms of BPA are produced each year, mainly for use in plastics. When traces of BPA enter the human body, they can build up over time, disrupting the endocrine system and upsetting the delicate balance of hormone production. Exposure to BPA has been shown

to have negative effects on fetal development and has been linked to the development a range of serious health conditions in adults.

Although BPA's use in common consumer goods like food packaging, reusable bottles and thermal paper receipts has been reduced in recent years, its decades of widespread use in the plastics industry has made it a common pollutant in water supplies around the globe.

In a paper published in the journal Ultrasonics Sonochemistry, researchers from the University of Glasgow's School of Chemistry show how they developed a dual-frequency ultrasound system to help eradicate BPA from water.

It works by generating millions of highly-energetic microscopic bubbles in contaminated water through the application of controlled ultrasound. When these bubbles grow and collapse, they briefly create extreme conditions of high temperature and pressure, creating highly-reactive "hot spots."

The conditions in these hot spots are intense enough to break BPA molecules down into harmless substances like carbon dioxide, safely removing the pollutant from the water.

Combining two frequencies of ultrasound during the process enabled the researchers to produce more powerful effects than a single frequency of ultrasound could achieve.

In the lab, they tested the system's effectiveness by measuring both the direct removal of BPA molecules and the broader reduction of organic pollutants when they were exposed to frequencies combined at either 20 kHz and 37 kHz, or 20 kHz and 80 kHz.

The 20 kHz / 37 kHz achieved the best results in the 40-minute tests, degrading 94% of the BPA in samples of polluted water and creating a 67% reduction in chemical oxygen demand.

Chemical oxygen demand is a metric often relied on by the water industry to assess water quality. It is used as an indirect measure of the amount of carbon-based matter in water by measuring the oxygen needed to chemically oxidize all of this matter to harmless species like carbon dioxide.

Shaun Fletcher, the paper's first author, said, "Traditional water treatment facilities aren't fully equipped to deal with BPA pollution. At the moment, where they do try to deal with it, the focus is on removal with activated

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sludge, or with absorption on activated carbon. Once removed from water, the BPA hangs around in this sludge or carbon, and still needs disposed of. We've focused on actively degrading the chemical itself, with no secondary treatment required.

"What we've been able to show for the first time is that ultrasound alone can offer an effective method of removing BPA from water.

"Previous work in this area has required combining ultrasound with catalysts or other chemicals, but our dual-frequency approach is much simpler. You don't need to worry about removing your catalyst or further purifying your water by removing anything you've added to it in the treatment process."

Paper co-author Dr. Lukman Yusuf said, "The key to this approach is the quality of the bubbles we're generating using ultrasound. We've shown in this that we can reliably generate bubbles with the conditions required to degrade BPA, building on previous research from the group which demonstrated its effectiveness in removing methylene blue, another common water pollutant.

"Ultimately, we'd like to expand this technique to help tackle a wide range of pollutants, including 'forever chemicals' like PFAs. We're currently in discussions with water companies to explore how this technology might be adopted in industry in the years to come."

The research is the latest development from the School of Chemistry's Symes Group in the field of sonochemistry, which uses controlled sound waves to drive chemical reactions.

In June, the team showed how ultrasound can be used to produce nitrate from air and water, a breakthrough development which could help farmers sustainably generate their own fertilizer.

Professor Mark Symes leads the group and is the paper's corresponding author. He said, "Sonochemistry is a technique which is only just starting to realize its full potential as sophisticated ultrasound technology becomes more affordable and researchers around the world are more readily able to explore what it can do. This paper is a robust demonstration of ultrasound's potential to clean up our waterways, which could help reduce the health impacts of BPA.

"Ultrasound won't replace conventional sewage treatment—those 120-year-old systems work fine for regular sewage and they're cheap.

But we're going to see an increasing need for new solutions for targeted applications, particularly for these sorts of toxins.

"That's where ultrasound can really excel, because the conditions inside those tiny bubbles are literally out of this world, yet we can stand right next to the process and watch the degradation happen without any protective equipment."

The team is now working to scale up their laboratory prototype to handle larger volumes of water, as well as continuing to explore the potential of ultrasound to remove a wider variety of pollutants from contaminated water.

Dr. Zeliha Ertekin also co-authored the paper, titled "Sonochemical degradation of bisphenol A: A synergistic dual-frequency ultrasound approach."

Phys Org, 6 August 2025

https://phys.org

A shocking new way to make ammonia, no fossil fuels needed

2025-07-05

The team have successfully developed a more straightforward method to produce ammonia (NH3) in gas form. Previous efforts by other laboratories produced ammonia in a solution (ammonium, NH4+), which requires more energy and processes to transform it into the final gas product.

The current method to generate ammonia, the Haber-Bosch process, comes at great climate cost, leaving a huge carbon footprint. It also needs to happen on a large scale and close to sources of cheap natural gas to make it cost-effective.

The chemical process that fed the world, and the Sydney team looking to revolutionize it

Naturally occurring ammonia (mostly in the form of bird droppings), was once so high in demand it fueled wars.

The invention of the Haber-Bosch process in the 19th century made human-made ammonia possible and revolutionized modern agriculture and industry. Currently 90 percent of global ammonia production relies on the Haber-Bosch process.

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"Industry's appetite for ammonia is only growing. For the past decade, the global scientific community, including our lab, wants to uncover a more sustainable way to produce ammonia that doesn't rely on fossil fuels.

"Currently, generating ammonia requires centralized production and long-distance transportation of the product. We need a low-cost, decentralized and scalable 'green ammonia'," said lead researcher Professor PJ Cullen from the University of Sydney's School of Chemical and Biomolecular Engineering and the Net Zero Institute. His team has been working on 'green ammonia' production for six years.

"In this research we've successfully developed a method that allows air to be converted to ammonia in its gaseous form using electricity. A huge step towards our goals."

The research was published in AngewandteChemie International edition.

Ammonia contains three hydrogen molecules, meaning it can be used as an effective carrier and source of hydrogen as an energy source, even potentially as an effective means of storing and transporting hydrogen. Industry bodies have found they can access the hydrogen by 'cracking' ammonia to separate the molecules to use the hydrogen.

Ammonia is also a strong candidate for use as a carbon-free fuel due to its chemical make-up. This has caught the interest of the shipping industry which is responsible for about 3 percent of all global greenhouse gas emissions.

Cracking a chemical conundrum

Professor Cullen's team's new method to generate ammonia works by harnessing the power of plasma, by electrifying or exciting the air.

But the star is a membrane-based electrolyser, a seemingly non-descript silver box, where the conversion to gaseous ammonia happens.

During the Haber-Bosch process, ammonia (NH3) is made by combining nitrogen (N2) and hydrogen (H2) gases under high temperatures and pressure in the presence of catalyst (a substance that speeds up a chemical reaction).

The plasma-based method Professor Cullen's team developed uses electricity to excite nitrogen and oxygen molecules in the air. The team then passes these excited molecules to the membrane-based electrolyser to convert the excited molecules to ammonia.

The researchers said this is a more straightforward pathway for ammonia production.

Professor Cullen said the findings signal a new phase in making green ammonia possible. The team is now working on making the method more energy efficient and competitive compared to the Haber-Bosch process.

"This new approach is a two-step process, namely combining plasma and electrolysis. We have already made the plasma component viable in terms of energy efficiency and scalability.

"To create a more complete solution to a sustainable ammonia productive, we need to push the energy efficiency of the electrolyzer component," Professor Cullen said.

Science Daily, 5 July 2025

https://sciencedaily.com

Concrete Reinvented: AI Simulates 4 Billion Atoms To Build Better Materials

2025-08-03

Researchers at USC have developed a powerful AI model, Allegro-FM, capable of simulating over 4 billion atoms at once. This breakthrough enables the design of next-generation concrete that captures carbon dioxide and could last for centuries—possibly even rivaling the durability of ancient Roman structures.

Toward Smart, Sustainable Concrete

Picture a future where the concrete used in buildings and bridges not only resists aging and extreme conditions, such as intense wildfire heat, but also repairs itself or absorbs carbon dioxide from the air.

Scientists at the USC Viterbi School of Engineering have now introduced a groundbreaking artificial intelligence model capable of simulating billions of atoms at once. This advancement unlocks a new era in material design, enabling discoveries at a scale previously thought impossible.

Climate change is rapidly intensifying. Droughts, melting glaciers, and increasingly destructive storms and wildfires are becoming more frequent and severe. A key factor driving global warming is the steady release of carbon dioxide into the atmosphere.

From Wildfires to Innovation

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After witnessing the devastating January wildfires in Los Angeles, USC Viterbi professor Aiichiro Nakano (who specializes in computer science, physics, astronomy, and computational biology) began rethinking how science could help. He contacted longtime research collaborator Ken-Ichi Nomura, a fellow USC Viterbi professor with expertise in chemical engineering and materials science. The two have worked together for over two decades.

Their conversation led to the creation of Allegro-FM, an advanced AI-powered simulation platform. In their theoretical research, the model revealed something remarkable: it may be possible to reabsorb the carbon dioxide released during concrete production by embedding it back into the same material.

"You can just put the CO2 inside the concrete, and then that makes a carbon-neutral concrete," Nakano said.

CO2 Sequestration, Reimagined

Nakano and Nomura, along with Priya Vashishta, a USC Viterbi professor of chemical engineering and materials science, and Rajiv Kalia, a USC professor of physics and astronomy, have been doing research on what they call "CO2 sequestration," or the process of recapturing carbon dioxide and storing it, a challenging process.

By simulating billions of atoms simultaneously, Allegro-FM can test different concrete chemistries virtually before expensive real-world experiments. This could accelerate the development of concrete that acts as a carbon sink rather than just a carbon source — concrete production currently accounts for about 8% of global CO2 emissions.

The breakthrough lies in the model's scalability. While existing molecular simulation methods are limited to systems with thousands or millions of atoms, Allegro-FM demonstrated 97.5% efficiency when simulating over four billion atoms on the Aurora supercomputer at Argonne National Laboratory.

This represents computational capabilities roughly 1,000 times larger than conventional approaches.

Predicting Across the Periodic Table

The model also covers 89 chemical elements and can predict molecular behavior for applications ranging from cement chemistry to carbon storage.

"Concrete is also a very complex material. It consists of many elements and different phases and interfaces. So, traditionally, we didn't have a way to simulate phenomena involving concrete material. But now we can use this Allegro-FM to simulate mechanical properties [and] structural properties," Nomura said.

Concrete is a fire-resistant material, making it an ideal building choice in the wake of the January wildfires. But concrete production is also a huge emitter of carbon dioxide, a particularly concerning environmental problem in a city like Los Angeles. In their simulations, Allegro-FM has been shown to be carbon neutral, making it a better choice than other concrete.

Echoes of Ancient Engineering

This breakthrough doesn't only solve one problem. Modern concrete only lasts about 100 years on average, whereas ancient Roman concrete has lasted for over 2,000 years. But the recapture of CO2 can help this as well.

"If you put in the CO2, the so-called 'carbonate layer,' it becomes more robust," Nakano said.

In other words, Allegro-FM can simulate a carbon-neutral concrete that could also last much longer than the 100 years concrete typically lasts nowadays. Now it's just a matter of building it.

Behind the Scenes

The professors led the development of Allegro-FM with an appreciation for how AI has been an accelerator of their complex work. Normally, to simulate the behavior of atoms, the professors would need a precise series of mathematical formulas — or, as Nomura called them, "profound, deep quantum mechanics phenomena."

But the last two years have changed the way the two research.

"Now, because of this machine-learning AI breakthrough, instead of deriving all these quantum mechanics from scratch, researchers are taking [the] approach of generating a training set and then letting the machine learning model run," Nomura said. This makes the professors' process much faster as well as more efficient in its technology use.

A Unified Atomic Model

Allegro-FM can accurately predict "interaction functions" between atoms — in other words, how atoms react and interact with each other.

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Normally, these interaction functions would require lots of individual simulations.

But this new model changes that. Originally, there were different equations for individual elements within the periodic table, with several unique functions for these elements. With the help of AI and machine-learning, though, we can now potentially simulate these interaction functions with nearly the entire periodic table at the same time, without the requirement for separate formulas.

"The traditional approach is to simulate a certain set of materials. So, you can simulate, let's say, silica glass, but you cannot simulate [that] with, let's say, a drug molecule," Nomura said.

Efficiency and Quantum-Level Accuracy

This new system is also a lot more efficient on the technology side, with AI models making lots of precise calculations that used to be done by a large supercomputer, simplifying tasks and freeing up that supercomputer's resources for more advanced research.

"[The AI can] achieve quantum mechanical accuracy with much, much smaller computing resources," Nakano said.

The Road Ahead

Nomura and Nakano say their work is far from over.

"We will certainly continue this concrete study research, making more complex geometries and surfaces," Nomura said.

This research was published recently in The Journal of Physical Chemistry Letters and was featured as the journal's cover image.

Sci Tech Daily, 3 August 2025

https://scitechdaily.com

Immovable rubber ducks demonstrate highest-performing underwater adhesive hydrogel polymer

2025-08-06

Hydrogels are a permeable soft material consisting of polymer networks and water with applications ranging from biomedical engineering to contact lenses. Intrinsic to hydrogels is the ability to endow diverse characteristics by modifying their polymer networks.

Professor Gong's research lab at WPI-ICReDD, Hokkaido University, specializes in hydrogel technology and has engineered hydrogels with self-strengthening, self-healing, underwater adhesion properties and more. For adhesive hydrogels, achieving instant, strong, and repeatable underwater adhesion is a prevailing challenge.

Through a combination of data mining and machine learning, Professor Gong, Professor Takigawa, Professor Fan, graduate student Liao, and colleagues have recently developed the strongest underwater-adhesive hydrogels to date with adhesive strengths (Fa) exceeding 1 MPa.

The gels' strength was both instant and repeatable and they are functional across various surfaces under variable levels of salinity, from pure water to seawater. This research is published in Nature.

For reference, if these hydrogels were cut to the size of a single postage stamp (2.5 x 2.5 cm), they could theoretically support ~63 kg (e.g. an adult human). The researchers demonstrated the hydrogel's adhesive strength by applying it to a rubber duck on a seaside rock where it withstood repeated ocean tides and wave impacts.

Taking inspiration from biology, these hydrogels were designed with polymer networks derived from adhesive proteins found in archaea, bacteria, eukaryotes, and viruses.

Despite the diversity across these organisms, these proteins share common sequence patterns that endow adhesion in wet environments. For this, ~25,000 adhesive protein datasets, collected from the National Center for Biotechnology Information (NCBI) protein database, were data mined for relevant amino acid sequences important for underwater adhesion.

They replicated these sequences into polymer networks and synthesized 180 hydrogels—each containing unique polymer networks. The data compiled from studying these hydrogels were analyzed with machine learning, which further extrapolated the most significant polymer sequences.

The original 180 gels synthesized from data mining demonstrated adhesive qualities greater than gels previously reported in the literature. However, the gels inspired by machine learning were more incredible, exceeding the highly desired qualities mentioned above.

Repeatable and instant adhesion are highly desired qualities for applications ranging from biomedical engineering and deep-sea

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exploration. These qualities were confirmed in an experiment in which the water leak from a damaged pipe could be covered instantly and repeatedly.

Phys Org, 6 August 2025

https://phys.org

The chemistry behind why flash floods are getting worse

2025-07-24

July 2025 is one for the atmospheric record books. The month brought one of the worst flooding seasons in US history, inundating parts of West Virginia; New Mexico; Maryland; Virginia; Washington, DC; and Pennsylvania. Heavy flooding has also hit other parts of the globe, including Mexico, Brazil, Nigeria, and Nepal. The rising waters have claimed many lives; prompted dramatic rescues, including from subway cars; and caused millions of dollars' worth of property damage.

On July 4, heavy rainfall in Texas led to the country's sixth-deadliest freshwater flooding disaster on record, according to NASA. Over the course of a few hours, the Guadalupe River rose over 6 meters, overflowing its banks and leading to more than a hundred casualties.

A cluster of thunderstorms, boosted by moisture left over from Tropical Storm Barry in June, fueled the floods, says Alexander Gershunov, a climate scientist at Scripps Institution of Oceanography in California. The Guadalupe River, he says, is part of a small watershed that floods quickly following intense rainfall.

Though floods naturally occur, increased moisture and rising temperatures from climate change are in some cases supercharging storms. According to a study in Nature, between 2020 and 2100, the size of the global population exposed to flood hazards is estimated to increase by 15.8%.

"The frequency of extreme events is increasing. That's the concern," says Armin Sorooshian, a professor of chemical and environmental engineering at the University of Arizona.

How does air pollution affect precipitation?

Greenhouse gases such as carbon dioxide absorb and trap infrared radiation from Earth's surface, heating the planet and increasing water evaporation, which leads to more rainfall.

But there are other factors at play in how climate change and air pollution influence atmospheric chemistry, Sorooshian says.

Clouds are made up of natural aerosols—small airborne particles of sea salt, dust, and volcanic emissions—that form what are called seeds. These seeds cause water vapor, an abundant atmospheric gas, to condense into droplets and ice crystals that eventually fall as precipitation. The interaction of these natural aerosols with synthetic aerosols from air pollution, such as particulate matter (PM), polycyclic aromatic hydrocarbons (PAHs), and various metal oxides and inorganic salts from burning fuels, can influence the amount of rain that falls.

For example, the bigger the particles, the more rain a cloud will produce. That's because larger droplets are more likely to bump into smaller ones, join together, and become weighted enough to fall as rain.

Sorooshian also notes a seemingly counterintuitive twist to how pollutant emissions influence the water cycle.

In very polluted areas, when synthetic aerosols interact with warm clouds lower in the atmosphere, the aerosols increase the number of the clouds' water droplets while making them smaller. This phenomenon can sometimes suppress rainfall, because the resulting droplets aren't big enough to fall as precipitation, according to Science.

But this suppression won't necessarily stop rain entirely, Sorooshian says. "If you suppress the rainfall initially, that cloud might be able to live longer and maybe grow deeper. It accumulates more energy and water and eventually can drop more water."

An atmospheric double whammy

Natural large-scale fluctuations in climate, including El Niño, La Niña, and the North Atlantic Oscillation, also influence the precipitation that will occur each year and drive extreme weather events in some parts of the globe.

"Rainfall is complicated to predict in weather models," says Ferran López Martí, a PhD student in the department of earth sciences at Uppsala University.

Still, there's no question more-severe precipitation events are on the rise because of climate change, López Martí says.

For example, he coauthored a recent study in the journal Earth System Dynamics that modeled how atmospheric rivers—long, narrow bands

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of moist air that carry a lot of water—interact with explosive cyclones—fast-intensifying storms with strong winds and low pressure—to cause dangerous storms and resulting floods.

The study found that as the planet warms, these two types of events are expected to overlap more often, especially if greenhouse gas emissions continue to increase.

Drought, urbanization worsen flash floods

In the case of flash floods, terrain also plays a role, explains María Tereza Cavazos, a climatologist in the department of physical oceanography at the Ensenada Center for Scientific Research and Higher Education.

In drought-stricken areas, such as Texas, the soil cannot absorb water effectively. In New York City, Pennsylvania, and other rapidly growing cities, excess cement not only generates heat but also prevents rainwater from being absorbed into the ground. That impermeability, mixed with poor sewage systems and other structural problems, creates more flooding.

"In terms of the phenomena that produce [floods], each event is different, even in the same city, because it depends on the season of the year," Cavazos says.

In some parts of the world, including Texas, climate change is already contributing to longer drought cycles.

Complexity of atmospheric chemistry

After the Guadalupe River overflowed in Texas, former US special forces commander Pete Chambers blamed the event on the US National Weather Service using cloud seeding—the act of injecting silver iodide particles in clouds to promote rainfall.

Though state aircraft do administer cloud seeding in Texas in some cases of major drought, the practice "did not lead to these floods," says Sorooshian, adding that the weather system that led to the storm would have happened independently of cloud seeding.

Yet such misinformation, in this case posted on the platform X, showcases the complexities of atmospheric chemistry and how to communicate it to the public.

"The interactions between aerosols and clouds [is] thought to be the largest uncertainty in estimates of future climate change," said Sorooshian.

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Clouds don't last long in the air, they're changing with time, and "you cannot bring a cloud in your laboratory."

The best method for studying their chemical dynamics is flying research airplanes in real time, an expensive endeavor that's usually done during the summer, when warmer temperatures trigger more chemical reactions in the air.

And rainfall statistics are difficult to compile because the atmosphere is chaotic, storm records are spatially sparse, and there's a need for better observational systems, Gershunov says.

Although scientists can observe trends in changing weather patterns, predicting the exact timing and intensity of a specific extreme precipitation event remains a major scientific challenge.

"We're still doing very aggressive research," Sorooshian says, "to try to figure out when an aerosol may suppress rainfall or enhance it."

C&EN, 24 July 2025

https://cen.acs.org

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Technical Notes

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CHEMICAL EFFECTS

~tAnalysis of the ecotoxicity of waste generated in a laundry in the textile center of the Agreste region of Pernambuco using zebrafish (Danio rerio) as a bioindicator

Healthcare professionals' knowledge of organic foods and their health impact: a survey-based analysis

Public willingness to pay for chemicals regulation policies in South Korea: Insights from socio-economic factors

ENVIRONMENTAL RESEARCH

Mapping the evidence of the effects of environmental factors on the prevalence of antibiotic resistance in the non-built environment

Degradation behavior and environmental impacts of a hemp-containing "eco-friendly" compostable plastic in natural environments

PHARMACEUTICAL/TOXICOLOGY

Role of Antidrug Antibodies in Oncolytic Viral Therapy: A Dynamic Modelling Approach in Cancer Patients Treated with V937 Alone or in Combination

Elevated urinary phthalate levels in endometrial cancer patients: Evidence from a comparative study

Effectiveness of a Parent Empowerment Program for Parents of Children with Autism: A Randomized Controlled Trial

OCCUPATIONAL

Hand Eczema and Facial Skin Problems - Association with Occupational Exposures among Community Care Personnel in Sweden: A Cross-sectional Study

Improving heat stress prevention through targeted education in hot and humid workplaces: a study in a foundry industry