

# Bulletin Board

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**\* While Chemwatch has taken all efforts to ensure the accuracy of information in this publication, it is not intended to be comprehensive or to render advice. Websites rendered are subject to change.**

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### ASIA PACIFIC

#### Key NSW environment act celebrates 25 years

2024-08-08

This year the NSW Environment Protection Authority (EPA) marked 25 years since the groundbreaking Protection of the Environment Operations Act commenced in NSW.

On 1 July, 1999 the framework for environmental protection in NSW was transformed when several pieces of legislation covering the regulation of air, noise, water and waste pollution were integrated.

A landmark day for environmental law in Australia, the start of the Act marked a significant shift in the state's approach to environmental regulation and accountability.

For the first time in the state's history, fragmented environmental licensing systems were unified under one piece of legislation, ensuring industries such as manufacturing, mining, waste management and chemical processing were regulated as part of the same framework and by the same regulatory body.

The Act also granted the NSW EPA enhanced powers as the lead agency responsible for administering and enforcing the new laws, including authority to issue a range of environment protection notices and stronger powers to investigate individuals and corporations accused of violating environmental law.

NSW EPA Director Legislation and Legal Advice, Melinda Murray, said the POEO Act had been instrumental in holding polluters accountable and reducing both pollution and the environmental impacts of certain industries.

"Reflecting on a quarter of a century since this legislation was first introduced, it's clear that it has played a critical role in helping us tackle environmental challenges head on," Ms Murray said.

[Read More](#)

EPA NSW, 08-08-24

<https://www.epa.nsw.gov.au/news/media-releases/2024/epamedia240808-key-nsw-environment-act-celebrates-25-years>

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#### India Delays Quality Control Order for 3 Chemicals

2024-08-07

Once implemented, the QCOs shall mandate the manufacturer to apply for a Grant of License by the Bureau of Indian Standard (BIS) to use the Standard Mark.

On August 6, 2024, India's Department of Chemical and Petrochemicals (DCPC) released a notification on the Gazette of India to further delay the implementation of Quality Control Orders (QCOs) for Acetic Acid, Aniline, and Methanol for 1 year.

The QCOs do not apply to chemicals for export only (click here to know more about exemptions). The chemical products conforming to the requirements of the Orders shall bear the Standard Mark under the Grant of License by the Bureau of Indian Standards. Any person who contravenes the provisions of the Orders shall be punished according to the Bureau of Indian Standards Act (BIS Act), 2016.

[Read More](#)

Chemlinked, 07-08-24

<https://chemical.chemlinked.com/news/chemical-news/india-delays-quality-control-order-for-3-chemicals-20240807154106>

#### No grounds to reassess glyphosate

2024-08-06

A decision-making committee has found no grounds to reassess the use of glyphosate and glyphosate-containing substances, such as Roundup.

In February 2024, the Environmental Law Initiative (ELI) formally requested we determine whether there are grounds to reassess the substance, citing significant new information about the negative effects of the substance.

"We carefully weighed the information provided by the applicant alongside a large amount of other evidence and consider that products containing the substance are safe to use if the existing rules are followed," says Dr Chris Hill, General Manager Hazardous Substances and New Organisms.

What we received from the applicant does not meet the criteria for significant new information and does not justify a reassessment of this substance – particularly when considered alongside the findings of other international regulators.



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We will review any new research on glyphosate that shows a change in the risks and is relevant to the New Zealand context.

[Read More](#)

EPA NZ, 06-08-24

<https://www.epa.govt.nz/database-search/hsno-application-register/view/APP204718>

### Korea Adopts New Exemption from K-REACH Registration

2024-08-05

South Korea's MoE detailed the requirements for exemption from chemical registration under K-REACH for chemical substances manufactured by recycling wastes.

South Korea's Ministry of Environment (MoE) recently notified WTO of the draft amendments to the Enforcement Rules of the Act on Registration and Evaluation of Chemical Substances (hereinafter referred to as the "K-REACH Enforcement Rules"), announcing the proposal of adopting the exemption criteria for chemical substances manufactured by recycling wastes under K-REACH. The proposal is expected to be in force on October 10, 2024.

[Read More](#)

Chemlinked, 05-08-24

<https://chemical.chemlinked.com/news/chemical-news/korea-adopts-new-exemption-from-k-reach-registration>

## AMERICA

### 1-Bromopropane up next on EPA's chopping block

2024-08-05

Under TSCA, the agency proposes a ban on most uses of the cleaning and degreasing agent

In the latest action on a chemical targeted under the Toxic Substances Control Act (TSCA), the US Environmental Protection Agency has proposed new rules on 1-bromopropane (1-BP).

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If finalized, the rules would prohibit all but one consumer use of the solvent and degreaser and ban some workplace uses. For most of the industrial and commercial uses that would not be banned, the EPA is proposing additional worker protections.

"The science shows that 1-BP can cause cancer and other serious health problems, and today's action is an important step to use the power of our nation's chemical safety law to finally protect people from this dangerous chemical and prevent cancer-causing exposure," Michal Freedhoff, assistant administrator for the EPA's Office of Chemical Safety and Pollution Prevention, says in a statement. "Our proposal would end all unsafe consumer exposures from this chemical and put strict protections in place for workers to ensure critical uses can continue safely."

In its 2022 final risk determination of 1-bromopropane, the EPA concluded that the chemical poses unreasonable risks to human health under current use. The risks include cancer; liver, kidney, and nervous system damage; and toxicity to reproductive and developmental systems.

1-Bromopropane is used in multiple industrial and commercial applications, including spot cleaners, degreasers, spray adhesives, insulation, and dry cleaning. The EPA's proposed rule would ban all consumer uses except insulation since the final determination did not find this use to be an unreasonable risk.

[Read More](#)

c&n, 05-08-24

<https://cen.acs.org/policy/chemical-regulation/1-Bromopropane-next-EPAs-chopping/102/web/2024/08>

### EPA Reconsiders New Risk Management Program Regulations, but Regulations Remain in Effect

2024-08-08

The D.C. Circuit Court of Appeals placed the challenges to the U.S. Environmental Protection Agency's ("EPA") risk management regulation on hold for 120 days while the EPA reconsiders the concerns raised by challengers. Order, *Oklahoma v. EPA*, No. 24-1125 (D.C. Cir. July 30, 2024). The underlying revisions to the rule, in effect on May 10, 2024, are unchanged by this action. While both the Court and the EPA have authority to stay the rule pending reconsideration, neither have done so.



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On March 11, 2024, the EPA published a final rule in the Federal Register updating the Clean Air Act Risk Management Program (“RMP”) regulations. The final rule, titled Accidental Release Prevention Requirements: Risk Management Programs Under the Clean Air Act; Safer Communities by Chemical Accident Prevention (“Final Rule”), 89 Fed. Reg. 17622 (Mar. 11, 2024), requires facilities with processes that contain threshold quantities of hazardous chemicals to provide backup power for accidental release monitors; requires third-party compliance audits in certain circumstances, with final reports to company Boards of Directors; requires facilities to provide justification for declining certain audit recommendations; increases the employee participation requirements; requires facilities to provide more information about the covered processes available to the public; and alters language to “emphasize” certain provisions that the EPA believes have always been required by the regulations.

Generally, facilities have three years from the effective date of the Final Rule, May 10, 2024, to comply with the new obligations established by the Final Rule. Facilities have four years to revise their risk management plans to include the new data elements contained in Subpart G of the regulations.

On May 9, 2024, states and industry groups filed Petitions for Review of the Final Rule in the U.S. Court of Appeals for the D.C. Circuit challenging the Final Rule as unlawful, arbitrary, and capricious, and asked that the Final Rule be vacated. The petitions for review were consolidated in *Oklahoma v. EPA*, No. 24-1125.

On May 10, 2024, states and industry groups also sent a Petition for Reconsideration to the EPA. In the petition, the states and industry groups argue that the EPA imposed certain requirements that were not described in the proposed rule, failed to justify the economic impacts of the Final Rule, imposed requirements that put facility safety at risk, and exceeded its statutory authority under the Clean Air Act.

After the Petition for Review was filed, the parties jointly moved the D.C. Circuit to hold the case in abeyance to allow the EPA to address the Petition for Reconsideration, which the Court granted. Notably, although the case is stayed for 120 days, the Court has not stayed implementation of the Final Rule. While both the Court and the EPA have authority to stay the rule pending reconsideration, neither have done so. As a result, the Final Rule remains fully in effect, and RMP-covered facilities should plan to comply with the rule pending further action by the EPA or the Court.

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Read More

JDSupra, 08-08-24

<https://www.jdsupra.com/legalnews/epa-reconsiders-new-risk-management-6316472/>

### Some E-Cigarette Chemicals Mimic Nicotine, Possibly Bypassing Regulation

2024-08-07

In what appears to be an effort to bypass public health regulations covering vaping products, some tobacco companies have begun replacing nicotine in e-cigarettes with related chemicals that have similar properties but unknown health effects, Duke Health researchers report.

In a research letter appearing Aug. 7 in *JAMA*, study authors at Duke and Yale University also found that the quantity of these chemicals, known as nicotine analogs, are not accurately disclosed on the packaging.

“Vaping products containing nicotine are subject to federal laws that prohibit sales to people under the age of 21,” said study co-author Sairam V. Jabba, D.V.M., Ph.D., a senior research scientist at Duke University School of Medicine.

“Nicotine analogs are currently not subject to the FDA process and have not been studied for their health effects,” Jabba said. “Our analysis of some of these analog-containing vaping products sold in the U.S. found significant and concerning inaccuracies in the ingredients these products claim to contain and what they actually contain. Further, it’s possible manufacturers are attempting to avoid FDA tobacco regulation.”

One chemical, known as 6-methyl nicotine, has been shown in rodent experiments to be far more potent than nicotine in targeting the brain’s nicotine receptors and more toxic than nicotine. Another, called nicotinamide, is marketed as targeting the same brain receptors as nicotine, despite evidence it does not bind to these receptors.

The nicotine analogs were included in flavored e-cigarettes, which prior research has indicated are preferred by youths and those who vape for the first time.



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Duke Health, 07-08-24

<https://corporate.dukehealth.org/news/some-e-cigarette-chemicals-mimic-nicotine-possibly-by-passing-regulation>

### What To Know About Perchlorate As Report Finds 'Measurable' Levels Of Chemical In Baby Products And Food

2024-08-07

Perchlorate, a chemical used in rocket fuel, plastic and other substances, has been found in common grocery store and fast foods—with the highest levels in baby and kid foods—and previous research has found the chemical can cause thyroid issues and stunt brain growth in infants.

Researchers from the nonprofit Consumer Reports tested 196 samples of 73 grocery store foods and fast food items, and discovered roughly 67% contained “measurable” levels of perchlorate, according to the report published Wednesday.

Perchlorate is both a naturally occurring and man-made chemical that’s mostly used in the U.S. for rocket fuel and missiles, but is also found in soil, groundwater, surface water, certain plastics and many fertilizers, according to the Department of Toxic Substances Control.

Though the exact brands weren’t disclosed, the types of food products tested included beverages, seafood, meat products, dairy, baked products and grains, fast food, fruits and vegetables and baby and kid foods.

The 67% of foods with measurable perchlorate levels ranged from amounts of 2 parts per billion, to 79 ppb, and the highest average levels of the chemical found in baby and kid foods—with an average level of 19.4 ppb of perchlorate—followed by fresh fruits and vegetables and fast food.

[Read More](#)

Forbes, 07-08-24

<https://www.forbes.com/sites/ariannajohnson/2024/08/07/what-to-know-about-perchlorate-as-report-finds-measurable-levels-of-chemical-in-baby-products-and-food/>

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## Regulatory Update

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### Regulatory Report: The Window on PFAS is Closing 'PFAST'

2024-08-07

State action on PFAS is ongoing, and many states are currently seeking to adopt new rules for PFAS in food packaging or expand the scope of existing laws

In response to emerging scientific and medical data concerning the ubiquity of thousands of per- and polyfluoralkyl substances (PFAS) used worldwide for many decades, academia, the media, and virtually every branch of state and federal government are focused on reducing exposure, assessing the risk, and allocating responsibility. New regulations and laws concerning PFAS have impacted nearly all industries, and the food industry is no exception.

Notwithstanding the heightened focus on these chemicals and their widespread use in food processing and packaging, the U.S. Food and Drug Administration (FDA) has not yet established maximum levels in food for PFAS. At present, FDA exercises discretion on a case-by-case basis to determine whether substances present in a food product render it adulterated or misbranded under the Federal Food, Drug, and Cosmetic Act (FDCA). For example, in March 2024, prompted by testing data on food, FDA issued an Import Alert to detain food products with PFAS (and other chemicals) on the grounds that they “may render the product injurious to health.”

[Read More](#)

Food Safety Magazine, 07-08-24

<https://www.food-safety.com/articles/9664-regulatory-report-the-window-on-pfas-is-closing-pfast>

## EUROPE

### Expiry of the approval of the active substance famoxadone

2024-08-07

Following a review of its approval as an active substance for use in plant protection products in GB, HSE has decided that famoxadone no longer



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meets the approval criteria set out in assimilated Regulation 1107/2009 (the Regulation).

On 10 January 2024 HSE issued an ebulletin that proposed withdrawal of the GB approval of famoxadone following a review that indicated it no longer met the approval criteria, required under the Regulation. The ebulletin referred to the next stage of the withdrawal process being consultation with trading partners via the World Trade Organisation (WTO).

This consultation has now concluded.

The GB Administrations have given consent for HSE to carry out the decision-making function arising from this review.

In addition to the new knowledge that triggered the review, the comments that were made under the WTO process were also taken into account. HSE has concluded that an acceptable risk to birds cannot be demonstrated and therefore the approval criteria required under the Regulation are no longer met (Section 3.8.1. of Annex II of the Regulation).

The approval for famoxadone ended at its expiry date of 30 June 2024.

Further details can be found by viewing the GB approval register on the HSE website.

To allow existing stocks to be removed from the supply chain safely, HSE has agreed a phased withdrawal programme:

- producers will be permitted 6 months from the expiry date to sell and distribute authorised famoxadone products until 31 December 2024
- users will be permitted a further 1 year to dispose of, store, and use existing stocks of authorised famoxadone products until 31 December 2025

Read More

HSE, 07-08-24

<https://www.hse.gov.uk/pesticides/active-substances/register.htm>

### Conversion of the farm accountancy data network (FADN) to a farm Sustainability Data Network (FSDN)

2024-06-20

The European Green Deal and its 'farm to fork' and biodiversity strategies have proposed environmental and climate targets for the farming sector,

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in order to contribute to the EU's goal to be climate-neutral by 2050.

The progress towards reaching these targets needs to be measured by means of appropriate data and indicators. In the 'farm to fork' strategy, the European Commission announced a proposal to convert the farm accountancy data network (FADN) into a farm sustainability data network (FSDN), with a view to collect farm level data addressing the sustainability data needs. The FADN is a database of microeconomic and accountancy data collected every year, based on a common methodology, from a sample of more than 80 000 EU farms. The farms participate voluntarily and the sample is built so that it is statistically representative of the EU farms considered commercial on the basis of their economic size. Launched in 1965 to assess farms' economic and financial situations, the FADN has been constantly updated to address the informative needs for the conception and evaluation of the common agricultural policy (CAP).

On 22 June 2022, the Commission adopted its proposal on the conversion of the FADN into FSDN, which consisted firstly in amending the FADN basic act and successively in putting forward secondary legislation (both delegated and implementing acts) to adapt the data collection to the requirement of the future FSDN. Overall, the proposal did not aim to drastically change the current sample survey, but to add new variables to measure the environmental and social performance of agricultural holdings, in addition to the economic dimension. The proposal also introduced a number of technical changes to improve the data collection. For example, the FSDN would include a unique farm ID, which - if introduced in other official data collections - could help linking the databases. This aspect relates to the concern about potential additional costs and administrative burden on both Member States and farmers due to the enlargement of the scope of the data collection. Moreover, the introduction of additional definitions, such as 'processing data', 'metadata', and 'pseudonymised data', would make it easier to manage the data while reinforcing the individual data protection rules. The proposal also involved an increase of the fee paid to national authorities to contribute to the costs of data collection. Such increase, which will be better assessed once the extended scope of the survey is detailed by the secondary legislation, would aim to cover incentives to participating farmers, IT adjustments, etc. Finally, based on Commission's findings and analysis, and considering that some Member States already included the FADN under national statistics which provide an obligation for farmers to provide the requested information, the proposal stated that, when selected as FSDN returning holding, farmers should provide the data and that it should be possible for



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AUG. 16, 2024

the Member States to adopt national rules to address cases of returning holdings not complying with such an obligation.

[Read More](#)

European Parliament, 20-06-24

<https://www.europarl.europa.eu/legislative-train/theme-a-european-green-deal/file-farm-sustainability-data-network>

### Expiry of the approval of the active substance indoxacarb

2024-08-07

Following a review of its approval as an active substance for use in plant protection products in GB, HSE has decided that indoxacarb no longer meets the approval criteria set out in assimilated Regulation 1107/2009 (the Regulation).

On 10 January 2024 HSE issued an ebulletin that proposed withdrawal of the GB approval of indoxacarb following a review that indicated it no longer met the approval criteria, required under the Regulation. The bulletin referred to the next stage of the withdrawal process being consultation with trading partners via the WTO.

This consultation has now concluded.

The GB Administrations have given consent for HSE to carry out the decision-making function arising from this review.

In addition to the new knowledge that triggered the review and information provided by the producers, the comments that were made under the WTO process, were also taken into account. HSE has concluded that non-dietary exposure was above the toxicological reference value (AOEL/AAOEL) for operators, workers, residents, and bystanders for the uses of indoxacarb and therefore the approval criteria required under the Regulation are no longer met (Article 4 (3) (b) the Regulation).

The expiry date of indoxacarb has been brought forward to 31 August 2024 when approval will end.

Further details can be found by viewing the GB approval register on the HSE website.

To allow existing stocks to be removed from the supply chain safely, HSE has agreed a phased withdrawal programme:

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- producers will be permitted 6 months from the expiry date to sell and distribute authorised indoxacarb products until 28 February 2025
- users will be permitted a further 1 year to dispose of, store, and use existing stocks of authorised indoxacarb products until 28 February 2026

[Read More](#)

HSE, 07-08-24

<https://www.hse.gov.uk/pesticides/active-substances/register.htm>

## INTERNATIONAL

### US-China fentanyl cooperation deepens as Beijing tightens controls for precursor chemicals

2024-08-07

Washington hails 'valuable step forward' following Chinese ministry's announcement of three substances to be singled out from September 1

Beijing is tightening its regulation and control of three chemicals used to produce fentanyl, Washington said on Tuesday, signalling closer bilateral cooperation in America's push to stem a nationwide crisis.

A US National Security Council spokesman hailed China's decision subjecting key precursor chemicals to the potent synthetic opioid to greater control as "a valuable step forward".

China's Ministry of Public Security on Monday stated that three substances would be managed under the regulation for chemical auxiliary substances that may be used to produce drugs starting on September 1.

The substances named in the ministry's announcement were fentanyl precursors known as 4-AP, 1-Boc-4-AP and norfentanyl.

Almost 75,000 people died from fentanyl overdoses last year, making it a leading cause of death for Americans younger than 45. The US has called China a "primary source" of ingredients used in producing fentanyl, but Beijing has long denied any involvement.

According to the applicable Chinese regulation, those who produce such precursors should report their production and sales details including the type and quantity of chemicals as well as major sales flows to local authorities within 30 days of operation.



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[Read More](#)

South China Morning Post, 07-08-24

<https://www.scmp.com/news/china/article/3273471/us-china-fentanyl-cooperation-deepens-beijing-tightens-controls-precursor-chemicals>

### **Assessment of performance of the profilers provided in the OECD QSAR toolbox for category formation of chemicals**

2024-08-07

Growing restrictions and bans on animal testing for chemical safety assessment under different regulations have led to an increasing use of alternative methods. Read-across is one of the major approaches used for this purpose, which relies on the identification of toxicological hazards of a data-poor or untested (target) chemical from data on other already-tested (source) similar chemicals. This requires the target substance to be first assigned to a group or category of 'similar' chemicals. The 'similarity' may be in terms of structural features alone, or in combination with certain rules that are based on mechanistic and/or toxicological aspects. In this regard, the OECD QSAR toolbox—a major free-access in silico platform—is widely used to derive toxicity predictions for a range of (eco) toxicological endpoints. The Toolbox allows the user to identify a set of similar chemicals (analogues) by computational 'profilers' that incorporate different structural alerts, or a combination of structural alerts and physicochemical and/or toxicokinetic rules relevant to a specific toxicological endpoint. The overall aim of this study was to assess the performance of the in silico profilers provided in the OECD QSAR Toolbox for reliability for identifying chemical analogues for category formation in a number of high-quality databases on mutagenicity, carcinogenicity, and skin sensitisation. The study also aimed to identify the reasons for any limitations in the performance of the profilers, and propose ways to improve their overall accuracy. The results showed that whilst some structural alerts are fit-for-purpose as such within the acceptable limits, others need refinement or a consideration for their possible exclusion from the profiler. Such refinements are imperative for a reliable use of the profilers in read-across and grouping/categorisation for classification, labelling and risk assessment of chemicals.

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[Read More](#)

Scientific Reports, 07-08-24

<https://www.nature.com/articles/s41598-024-69157-1>



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## REACH Update

AUG. 16, 2024

### Public consultation on alternatives: call for information

2024-08-08

**Deadline:** 1 October 2024**HSE has received an application for authorisation for the following use/substances:****Reference:** AFA057-01**Applicant:** Robert Stuart Limited**Application type:** Initial**Substances:** Chromium trioxide (CT), Sodium dichromate (SD), Potassium dichromate (PD)**Use:** The use of hexavalent chromium (Cr(VI)) substances for the surface treatments of engineering components for the aerospace and defence industry to ensure that the performance requirements set by the Design authority are followed and achieved. The processes comprise conversion coating (SD), hard chrome plating (CT/PD), anodising (CT) and post anodise sealing (SD).

HSE has announced a public consultation for this application.

View details on the public consultation

Article 64 in the UK REACH Regulation makes provisions for HSE to obtain and use additional information on possible alternatives or technologies as part of the opinion forming process.

Any third parties with an interest in the application are strongly encouraged to share any relevant information.

Read More

HSE, 08-08-24

<https://content.govdelivery.com/accounts/UKHSE/bulletins/3ad85b0>

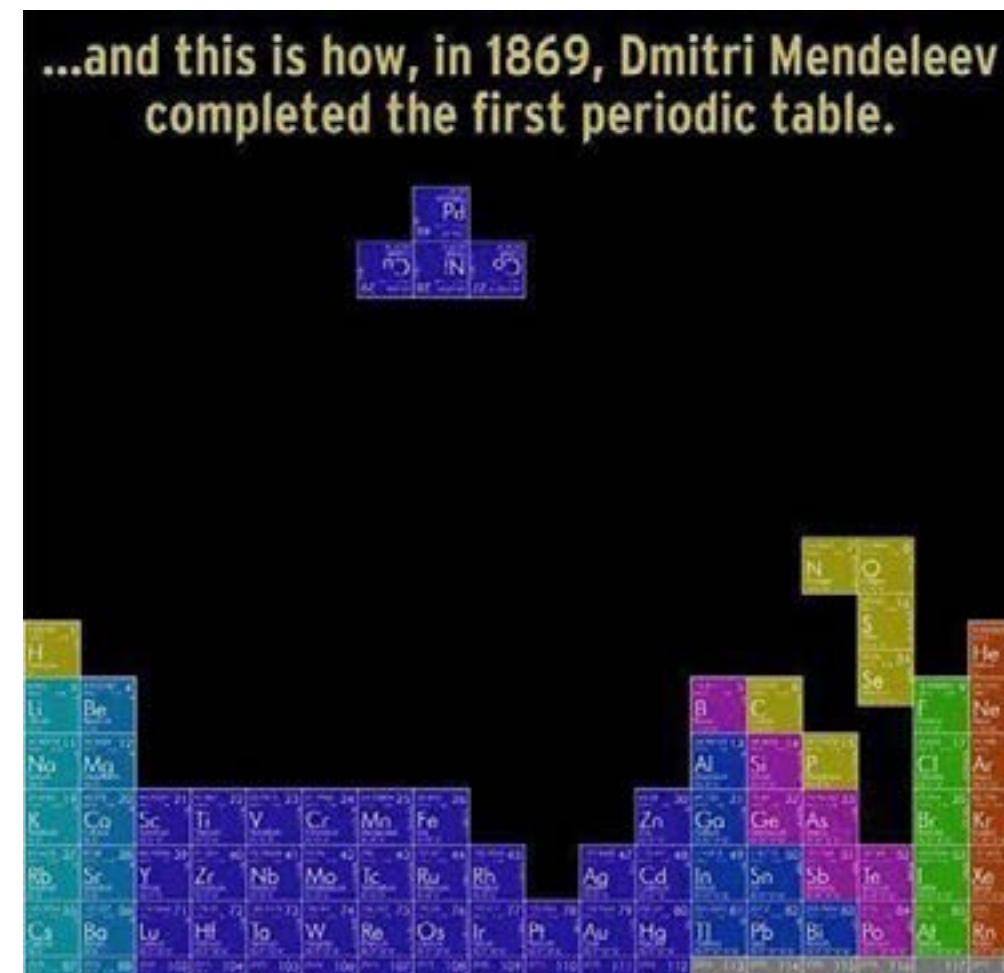
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## Janet's Corner

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### First Periodic Table

2024-08-16



<http://chemicalengineeringnews.org/top-50-funny-science-memes-funny-pictures-about-science/>

undefined.



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## Hazard Alert

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### Acrylamide

2024-08-16

#### USES [2,3]

Acrylamide is prepared on an industrial scale by the hydrolysis of acrylonitrile by nitrile hydratase. Most acrylamide is used to synthesise polyacrylamides, which find many uses as water-soluble thickeners. These include use in wastewater treatment, gel electrophoresis (SDS-PAGE), papermaking, ore processing, and the manufacture of permanent press fabrics. Some acrylamide is used in the manufacture of dyes and the manufacture of other monomers. In addition, acrylamide has many other uses in molecular biology laboratories, including the use of linear polyacrylamide (LPA) as a carrier, which aids in the precipitation of small amounts of DNA. The majority of acrylamide is used to manufacture various polymers. These are used as binding, thickening or flocculating agents in grout, cement, sewage/wastewater treatment, pesticide formulations, cosmetics, sugar manufacturing, soil erosion prevention, ore processing, food packaging and plastic products. Polyacrylamide is also used in some potting soil.

#### EXPOSURE SOURCES & ROUTES OF EXPOSURE [3]

##### Exposure Sources

The primary source of exposure for the general population is ingestion of contaminated food. Acrylamide is formed in foods that are rich in carbohydrates when they are fried, grilled or baked. Starchy foods such as potato-based products typically contain the highest levels of acrylamide, whereas protein-based foods contain smaller amounts. Exposure can also occur in places near plastic and dye plants and drinking water may contain acrylamide. Furthermore, exposure may occur through inhalation of tobacco smoke (including second-hand smoke). Occupational exposure may occur in people involved in the production or use of acrylamide and acrylamide-containing products. Exposure may also occur in laboratories utilising polyacrylamide gels.

##### Routes of Exposure

The main routes of exposure to acrylamide are via inhalation, dermal adsorption and ingestion. When inhaled, acrylamide is readily and rapidly absorbed following inhalation and oral exposure, and somewhat less rapidly following dermal exposure. Once absorbed, acrylamide is widely

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distributed throughout the body. Acrylamide is rapidly metabolised; glycidamide is the principle toxicologically significant metabolite. It is then excreted from the body as metabolites in the urine.

#### HEALTH EFFECTS [4]

##### Acute Health Effects

Central and peripheral nervous system damage, with effects such as drowsiness and hallucinations, has been observed in humans acutely exposed to acrylamide through inhalation exposure. Acrylamide (when occurring as a monomer) is a potent neurotoxicant at low levels. Acute oral exposure to acrylamide has resulted in neurotoxic effects in rats and effects on the kidney in monkeys exposed by injection.

##### Carcinogenicity

Two studies have been carried out examining worker exposure to acrylamide and cancer mortality. EPA considers both of these studies to be inadequate to determine cancer risk due to the small populations studied and incomplete exposure data. In rats orally exposed to acrylamide, significantly increased incidences of tumours at multiple sites have been observed. These include mammary tumours, central nervous system tumours, thyroid follicular tumours, and uterine adenocarcinoma in female rats and thyroid follicular tumours and scrotal mesothelioma in males. EPA has classified acrylamide as a Group B2, probable human carcinogen.

##### Other Effects

No information is available on the reproductive or developmental effects of acrylamide in humans. In one animal study, decreases in body weight and body weight gain and an increase in preimplantation loss were observed in rats orally exposed to acrylamide. In mice orally exposed to acrylamide, decreased sperm counts were reported.

#### SAFETY

##### First Aid Measures [5]

- **Eye Contact:** Check for and remove any contact lenses. In case of contact, immediately flush eyes with plenty of water for at least 15 minutes. Cold water may be used. Get medical attention.
- **Skin Contact:** In case of contact, immediately flush skin with plenty of water for at least 15 minutes while removing contaminated clothing



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and shoes. Cover the irritated skin with an emollient. Cold water may be used. Wash clothing before reuse. Thoroughly clean shoes before reuse. Get medical attention immediately.

- **Serious Skin Contact:** Wash with a disinfectant soap and cover the contaminated skin with an anti-bacterial cream. Seek immediate 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:** If swallowed, 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 immediately.

### Workplace Controls & Practices [4]

Use process enclosures, local exhaust ventilation, or other engineering controls to keep airborne levels below recommended exposure limits. If user operations generate dust, fume or mist, use ventilation to keep exposure to airborne contaminants below the exposure limit.

### Personal Protective Equipment [5]

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

Personal Protection in Case of a Large Spill:

- Splash goggles;
- Full suit;
- Dust respirator;
- Boots;
- Gloves;
- A self contained breathing apparatus should be used to avoid inhalation of the product.

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**Note:** Suggested protective clothing might not be sufficient; consult a specialist BEFORE handling this product.

### REGULATION

#### United States

- **OSHA:** The United States Occupational Safety & Health Administration has set the following Permissible Exposure Limit (PEL) for acrylamides:
  - General Industry: 29 CFR 1910.1000 Z-1 Table-- 0.3 mg/m<sup>3</sup> TWA; Skin
  - Maritime: 29 CFR 1915.1000 Table Z-Shipyards -- 0.3 mg/m<sup>3</sup> TWA; Skin
- **ACGIH:** The American Conference of Governmental Industrial Hygienists has set a Threshold Limit Value (TLV) for acrylamide of 0.03 mg/m<sup>3</sup> TWA; Skin; Appendix A3 (Confirmed Animal Carcinogen with Unknown Relevance to Humans)
- **NIOSH:** The National Institute for Occupational Safety and Health has set a Recommended Exposure Limit (REL) for acrylamide of 0.03 mg/m<sup>3</sup> TWA; Skin; Appendix A - Potential Occupational Carcinogen

### REFERENCES:

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3. <http://www.epa.gov/ttn/atw/hlthef/acrylami.html>
4. <http://www.sciencelab.com/msds.php?msdsId=9927422>
5. [https://www.osha.gov/dts/chemicalsampling/data/CH\\_217200.html](https://www.osha.gov/dts/chemicalsampling/data/CH_217200.html)
6. <http://www.npi.gov.au/substances/acrylamide/health.html>



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Scientists Make Breakthrough in Replicating the Enzyme That Captures Carbon

2024-07-19

Scientists from King's College London have recreated the active site of Acetyl-CoA Synthase, an enzyme involved in capturing carbon from the atmosphere. The research, carried out in collaboration with Imperial College London, advances our understanding of this important enzyme, and offers a potential new solution to capture CO<sub>2</sub> from the atmosphere in the fight against climate change.

Led by Dr Rebecca Musgrave from the Department of Chemistry and Dr Daniel Wilson from UCL, the team successfully recreated an active site – the site where the chemical reactions occur - of the enzyme Acetyl-CoA synthase (ACS). ACS transforms CO<sub>2</sub> into 'acetyl coenzyme-A' – an essential molecule used in living beings. Their findings are published today in the Journal of the American Chemical Society.

ACS is most famously known for its role in the acetic acid cycle or Krebs Cycle - a series of chemical reactions in living things, in which acetic acid is oxidized to produce energy. It is therefore vital for storing and releasing energy and for capturing CO<sub>2</sub> from the atmosphere and storing it as carbon. The team's new model was able to replicate this chemical reaction in the lab, capturing atmospheric carbon and storing it as acetyl coenzyme-A.

Enzymes are proteins that function as biological catalysts by accelerating chemical reactions. As such, they carry out vital functions in nature, including in human biology. The chemical pathways created by enzymes have developed over billions of years into large, complex biological systems, and are therefore very challenging to study and replicate in the lab. Scientists often recreate smaller, molecular versions of enzymes - models of the 'active site' in the lab, to study them.

The ACS enzyme is found in bacteria and some single-celled organisms and functions without oxygen, building complex organic molecules from carbon dioxide and hydrogen. Whilst attempts had been made to model the enzyme's active site in the lab, they were not able to accurately replicate the shape and electronic environment of the active site to capture carbon.

Dr Daniel Wilson, lead researcher from UCL, said: "Scientists have been studying the ACS enzyme for decades, but it has been difficult to decipher the mechanism that produces acetyl coenzyme-A in the active site of

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the enzyme. In our study, we report an active site model – a molecular cluster featuring two nickel atoms – which mimics the shape and size with remarkable similarity to the ACS enzyme active site.

"Excitingly, exposure of our model to carbon monoxide resulted in successful synthesis, imitating the way the ACS enzyme makes acetyl Co-A in nature."

Working with Dr Maxie Roessler at Imperial, the team used a technique called Electron Paramagnetic Spectroscopy to study the steps involved and believe the results will provide valuable insight for scientists studying the ACS enzyme – and other enzymes related to atmospheric carbon fixation, or carbon capture.

Dr Rebecca Musgrave said, "Our new model opens the way to better understand how this reaction works. By studying the individual reaction steps with Electron Paramagnetic Resonance spectroscopy and other techniques, we can use what we learn to inform the design of man-made catalysts for industrial use.

"This could be applied across a range of fields including new methods for capturing CO<sub>2</sub> from the atmosphere and using it as a feedstock to produce carbon-based chemicals such as biofuels for cars or pharmaceuticals."

The researchers also hope that those working in enzyme spectroscopy – the field of enzyme study – will be able to take their new model and adapt it for use in their own studies.

Dr Musgrave said, "Enzymes in nature carry out these incredible transformations so quickly and efficiently, in a way that is very difficult to reproduce in the lab. Our new model brings us one step closer to understanding how these biological systems do it so well, so we can design catalysts at an industrial scale to replicate the transformative ability of nature, to tackle key societal issues such as climate change."

**Reference:** Wilson DWN, Thompson BC, Collauto A, et al. Mixed valence {Ni<sup>2+</sup>Ni<sup>1+</sup>} clusters as models of acetyl coenzyme A synthase intermediates. J Am Chem Soc. 2024. doi: 10.1021/jacs.4c06241

Technology Networks, 19 July 2024

<https://technologynetworks.com>



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### Scientists achieve more than 98% efficiency removing nanoplastics from water

2024-08-13

University of Missouri scientists are battling against an emerging enemy of human health: nanoplastics. Much smaller in size than the diameter of an average human hair, nanoplastics are invisible to the naked eye.

Linked to cardiovascular and respiratory diseases in people, nanoplastics continue to build up, largely unnoticed, in the world's bodies of water. The challenge remains to develop a cost-effective solution to get rid of nanoplastics while leaving clean water behind.

That's where Mizzou comes in. Recently, researchers at the university created a new liquid-based solution that eliminates more than 98% of these microscopic plastic particles from water.

"Nanoplastics can disrupt aquatic ecosystems and enter the food chain, posing risks to both wildlife and humans," said Piyuni Ishtaweera, a recent alumna who led the study while earning her doctorate in nano and materials chemistry at Mizzou. "In layman's terms, we're developing better ways to remove contaminants such as nanoplastics from water."

The innovative method -- using water-repelling solvents made from natural ingredients -- not only offers a practical solution to the pressing issue of nanoplastic pollution but also paves the way for further research and development in advanced water purification technologies.

"Our strategy uses a small amount of designer solvent to absorb plastic particles from a large volume of water," said Gary Baker, an associate professor in Mizzou's Department of Chemistry and the study's corresponding author. "Currently, the capacity of these solvents is not well understood. In future work, we aim to determine the maximum capacity of the solvent. Additionally, we will explore methods to recycle the solvents, enabling their reuse multiple times if necessary."

Initially, the solvent sits on the water's surface the way oil floats on water. Once mixed with water and allowed to reparate, the solvent floats back to the surface, carrying the nanoplastics within its molecular structure.

In the lab, the researchers simply use a pipette to remove the nanoplastic-laden solvent, leaving behind clean, plastic-free water. Baker said future studies will work to scale up the entire process so that it can be applied to larger bodies of water like lakes and, eventually, oceans.

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Ishtaweera, who now works at the U.S. Food and Drug Administration in St. Louis, noted that the new method is effective in both fresh and saltwater.

"These solvents are made from safe, non-toxic components, and their ability to repel water prevents additional contamination of water sources, making them a highly sustainable solution," she said. "From a scientific perspective, creating effective removal methods fosters innovation in filtration technologies, provides insights into nanomaterial behavior and supports the development of informed environmental policies."

The Mizzou team tested five different sizes of polystyrene-based nanoplastics, a common type of plastic used in the making of Styrofoam cups. Their results outperformed previous studies that largely focused on just a single size of plastic particles.

Science Daily, 13 August 2024

<https://sciencedaily.com>

### Layered material displays strength of ceramic with toughness of metal

2024-08-02

A new technique allows ceramics to become more ductile without losing their strength. It involves the controlled growth of a metal layer on the ceramic surface, which allows its structure to rearrange under stress rather than failing. The researchers behind the work suggest that the method could allow ceramics to be used in biomedical and aerospace applications for which they are currently ill-suited.

The extreme strength and rigidity of chemical bonds in ceramics makes them useful for applications like drill bits and high-temperature insulation. This is a double-edged sword, however, as when the bonds do eventually give way the structure tends to fail catastrophically. In metals, by contrast, the atoms can slip past each other and bond to new atoms more easily, allowing the materials to bend rather than break. A long-standing goal of materials scientists is to combine the deformation resistance, or strength, of ceramics with the energy absorption, or toughness, of metals.

In 2022, Kexin Chen at Tsinghua University in Beijing and colleagues toughened silicon nitride by sintering it into dual-phase grains. When compressed, these grains dissipated energy by changing to the high-pressure phase. But tensile stress is trickier to manage because when a



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crack is introduced, the stress concentrates at the crack tip and acts to pull the lattice apart.

In the new work, Chen and her colleagues combined the properties of ceramics and metals by literally combining the two materials. The researchers used mixed aqueous precursors of lanthanum oxide and molybdenum in solution before drying and sintering the resulting gel. The material comprised strongly bonded, lattice-matched layers of metal and ceramic.

The material's resistance to elastic deformation was at least as high as that of conventional lanthanum oxide. At the point at which lanthanum oxide fractured catastrophically, however, their material simply extended slightly, releasing stress that had built up in the structure. Models suggested that dislocations had nucleated in the metal lattice and slipped into the lanthanum, endowing the combined material with the strength of the ceramic and the toughness of the metal. The researchers also tested the process using cerium oxide in place of lanthanum oxide, finding similar results.

Materials scientist Nitin Padture from Brown University in Rhode Island, US says the work is a 'clever idea.' 'The free surface of a regular ceramic is essentially an infinite source of dislocations, but the stress threshold to punch them out is very high,' he says. 'Having a metal with a low dislocation-nucleation threshold epitaxially in contact with the ceramic likely makes it easier to "borrow" dislocations, the coherency strain notwithstanding.'

However, Padture questions how likely this is to increase the macroscopic ductility and toughness of the ceramic as, once available, dislocations still have to move through the bulk of the ceramic itself, where the crystal structure is complex and the bonding is still strong. If it does not, he says, the material 'is likely to be of limited utility.'

Metallurgist Aashish Rohatgi from the Pacific Northwest National Laboratory in Washington state, US agrees that the work is 'very interesting' but also says that, for the researchers' approach to work, dislocations generated at metal interface would have to move not just through grains of the ceramic but across grain boundaries. 'This seems like a start, but many things have to be solved before someone can truly claim that they've made a ceramic that behaves like a metal,' he concludes.

Chen's team agrees that these are important issues, but argues the data presented shows evidence of dislocation migration across grain

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boundaries. 'Our further work will focus on the detailed mechanisms of the nucleation, movement, and multiplication of dislocations in ceramics,' says Chen. 'We plan to continue addressing the tensile plasticity of other oxide or covalent-bonded ceramics and aim to achieve plasticity and practical applications in large-scale macroscopic ceramics.'

The researchers also intend to develop applications of the materials. 'Any materials involving ceramic and metal components can benefit from this strategy,' says Chen. Lanthanum oxide-molybdenum composites are promising materials for electron emission, for example, but because they are brittle and hard to process the standard material is instead a radioactive thorium composite. Chen suggests that her team's strategy could change this. She also points to turbine blades and artificial bone joints as other potential uses of ceramics with enhanced tensile plasticity.

Chemistry World, 2 August 2024

<https://chemistryworld.com>

### Potential New Drug Regimens Developed for Multidrug-Resistant Meningitis

2024-08-15

In a preliminary study with a small number of humans, rabbits and mice, researchers at Johns Hopkins Children's Center say they have developed four new regimens that have the potential to treat and save the lives of people with multidrug-resistant (MDR) tuberculous (TB) meningitis.

While TB meningitis — which affects the brain and spine — is extremely rare in the United States, worldwide it is believed to be the deadliest form of TB.

In a report published Aug. 14 in Nature Communications, the investigators present the regimens, mainly composed of antibiotics already approved by the U.S. Food and Drug Administration (FDA) for other uses, or antibiotics currently in clinical trials. Study investigators say the regimens could be readily evaluated in new clinical studies or used to treat people with MDR-TB meningitis on a case-by-case basis now.

According to the World Health Organization, tuberculosis remains a global public health threat, with the largest number of cases occurring in the Southeast Asian region and Africa and is a leading killer by a single infectious agent, the tubercle bacillus. There are no FDA-approved antibiotic treatments specifically effective for tuberculous meningitis,



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although antibiotic treatments developed for TB of the lungs are widely available.

A previous Johns Hopkins Children's Center study led by Sanjay Jain, M.D., senior author of the new study and director of the Johns Hopkins Center for Infection and Inflammation Imaging Research, showed that the FDA-approved regimen of three antibiotics currently used for treating drug-resistant pulmonary TB — bedaquiline, pretomanid and linezolid (BPaL) — is not effective in treating TB meningitis, because bedaquiline and linezolid can't efficiently cross the blood-brain barrier — a network of cells that prevents the entry of germs and toxins into the brain.

The new study used positron emission tomography (PET) scan and CT scan technology on people, rabbits and mice to show how different antibiotics penetrate the brain and other areas of the body, says Jain, who is also a pediatric infectious diseases specialist at Johns Hopkins Children's Center.

For the new experiments, researchers first created a chemically identical and scan-friendly version of the antibiotic pretomanid, and conducted a whole-body study in eight people: six healthy volunteers and two patients newly diagnosed with pulmonary TB. Using PET and CT imaging, researchers measured the antibiotic's penetration into the brain and lung tissue and found that pretomanid penetrated the brain more than two times better than the lungs of all human subjects. Pretomanid levels in the cerebrospinal fluid (CSF) were also different from those in the brain.

"We have found that CSF levels of antibiotics often have no relation to those in the brain," says Xueyi Chen, M.D., one of the study's first authors and a pediatric infectious diseases fellow at the Johns Hopkins University School of Medicine.

Next, using PET imaging, the researchers tested four different antibiotics (chemically identical and imageable versions) active against MDR-TB — pretomanid, sutezolid, linezolid and bedaquiline — and their penetration into the lung and brain tissues in mouse and rabbit models of TB meningitis.

All four antibiotics distributed well in the body, but with significantly different brain and lung tissue penetration. While pretomanid levels were significantly higher in the brain versus lung tissue, sutezolid, linezolid and bedaquiline had at least three times higher levels in lung tissue — with bedaquiline demonstrating levels almost tenfold higher than in the brain. "Interestingly, pretomanid brain levels were double the amount in the plasma. In contrast, while bedaquiline brain levels were almost one-fifth

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the plasma levels, the lung levels were double the amount in the plasma. This preferential accumulation of different antibiotics in brain or lung tissues is very important and explains why certain antibiotics are highly effective in the lungs, but not in the brain and vice versa," says Jain.

Researchers next created computer models that parallel and measure how drugs behave in living systems, so called pharmacokinetics, for pretomanid, sutezolid, linezolid and bedaquiline. Mathematical simulations based on the models were then used to predict which tissue exposures and doses would be necessary to attain therapeutic brain penetration of each antibiotic. Only pretomanid achieved therapeutic brain tissue exposures at the standard human oral dosing. Even at a dose four times the standard human oral dose, bedaquiline brain tissue exposures were predicted to be only one-third of the target levels.

Researchers found that the three pretomanid-based multidrug regimens — BPa50LZ (bedaquiline, pretomanid, linezolid, pyrazinamide), Pa100LZ (pretomanid, linezolid, pyrazinamide), and Pa50LMxZ (pretomanid, linezolid, moxifloxacin, pyrazinamide) — were highly effective in treating TB meningitis in animal models when administered at human equivalent dosing. Each regimen's ability to kill bacteria in the brain was several magnitudes higher than both the standard TB treatment (R10HZ) and the BPaL regimen (BPa50L).

Since MDR-TB strains can also be resistant to pyrazinamide, researchers developed a fourth regimen, one without pyrazinamide: Pa100SMx (pretomanid, sutezolid, moxifloxacin). They found it was as effective as the first-line standard TB treatment, and 10 times better in reducing the bacterial burden in the brain than the BPaL regimen.

Investigators cautioned that their experiments were limited by the small quantities of the imageable version of antibiotics used per subject. However, several studies support that dosing with small quantities of a drug are a reliable predictor of a drug's bodily distribution.

Technology Networks, 15 August 2024

<https://technologynetworks.com>



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**Why do plants wiggle? New study provides answers**

2024-08-15

In a new study, physicists from the United States and Israel may have gotten to the bottom of a quirky behavior of growing plants -- and a mystery that intrigued Charles Darwin himself during the later decades of his life.

For many humans, plants might seem stationary and even a little dull. But green things actually move a lot. If you watch a timelapse video of a sunflower seedling poking up from the soil, for example, it doesn't just shoot straight up. Instead, as the sunflower grows, its crown spins in circles, twists into corkscrews and, in general, wiggles around -- albeit very slowly.

Now, researchers co-led by Orit Peleg at CU Boulder and Yasmine Meroz at Tel Aviv University have discovered one role for these chaotic movements, also known as "circumnutations." In greenhouse experiments and computer simulations, the group showed that sunflowers take advantage of circumnutations to search the environment around them for patches of sunlight.

"A lot of people don't really consider the motion of plants because, as humans, we're usually looking at plants at the wrong frame rate," said Peleg, a co-author of the study and an associate professor in the BioFrontiers Institute and Department of Computer Science.

The team published its findings Aug. 15 in the journal *Physical Review X*.

The findings could one day help farmers to come up with new strategies for growing an array of crops in more efficient arrangements.

"Our team does a lot of work on social interactions in insect swarms and other groups of animals," said Chantal Nguyen, lead author and a postdoctoral researcher at BioFrontiers.

"But this research is particularly exciting because we're seeing similar dynamics in plants. They're rooted to the ground."

**Darwin's cucumbers**

Nguyen added that plants don't usually shift around like animals but, instead, move by growing in different directions over time. This

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phenomenon enchanted Darwin long after he returned from his voyage on the HMS Beagle, according to historical accounts.

In the 1860s, Darwin, who was then suffering from a range of ailments that limited his own mobility, spent days observing plants at his home. He planted seeds from cucumbers and other species, then traced how their crowns moved around from day to day -- the resulting maps look wild and haphazard.

"I am getting very much amused by my tendrils -- it is just the sort of niggling work which suits me," he wrote a friend in 1863.

Amused or not, Darwin couldn't explain why some of his tendrils twisted.

It's a mystery that has also perplexed Meroz, a physicist by training. One 2017 study pointed her in the right direction. In it, scientists led by the University of Buenos Aires grew lines of sunflowers under cramped conditions. They discovered that the plants naturally and consistently arranged themselves into a zig-zag pattern, almost like the teeth of a zipper. The arrangement likely helps the plants maximize their access to sunlight as a group.

Meroz wondered if plant wiggles could be the engine that drives such patterns in plant growth.

"For climbing plants, it's obvious that it's about searching for supports to twine on," said Meroz, a professor of plant sciences and food security. "But for other plants, it's not clear why it's worth it."

**Here comes the sun**

To find out, she and her colleagues grew five, one-week-old sunflowers in rows. Then, like Darwin before them, they mapped out how the plants moved over the course of a week.

Next, Nguyen and Peleg developed a computer program to analyze the patterns behind the sunflower growth. The researchers could also use their computer simulations to see what would happen if the sunflowers moved more or less -- in other words, if they wiggled haphazardly or in a slow and steady pattern.

If the digital plants didn't wiggle at all, the group discovered, they would all wind up all leaning away from each other in a straight line. If they wiggled too much, in contrast, they would grow in a random pattern. If they moved with just the right amount of randomness, however, the sunflowers formed that tell-tale zig-zag, which, in real life plants,



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provides a lot of access to sunlight. Nguyen explained that plants seem to circumnate to find where the best light is coming from, then grow in that direction.

“When you add a little bit of noise into the system, it allows the plant to explore its surroundings and settle into those configurations that allow each plant to find maximum light exposure,” she said. “That happens to lead to this nice zig-zag pattern that we see.”

In future experiments, the researchers will test out how sunflowers grow in more complicated arrangements. Meroz, for her part, is glad to see plants get some credit for the movers and shakers they really are.

“If we all lived at the same time scales as plants, you could walk down the street and see them moving,” she said. “Maybe we’d all have plants as pets.”

Science Daily, 15 August 2024

<https://sciencedaily.com>

### **Turmeric and green tea among health supplements putting people in hospital**

2024-08-05

More than 15 million Americans may be putting their liver health at risk, simply by trying to better their overall health. New research has revealed the extent of the damage being caused by taking popular botanical supplements including turmeric, green tea, the stress-relieving ashwagandha and weight-loss aid Garcinia cambogia.

Health researchers from the University of Michigan, Ann Arbor, looked at data from 2017 to 2021, covering 9,685 people, and found that nearly 4.7% of US adults had used one of the six potentially toxic supplements within the previous 30 days. Those supplements were turmeric, green tea, ashwagandha, G. cambogia, black cohosh and red yeast rice.

Supplement users were mostly taking these botanicals of their own accord, not due to medical directives, for a range of issues: turmeric for joint health and arthritis, green tea extract to boost energy levels, G. cambogia for weight loss, black cohosh to manage hot flushes and red yeast rice for heart health. We should add that when the study talks of green tea, it’s specifically concerned with green tea extract, not drinking tea (which has no link to liver toxicity – though a limit of eight cups a day is recommended).

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And while news of liver toxicity connected to these supplements is not new, having been reported to be on the rise for some time now, including in this 2022 study, medical researchers are concerned that people are unaware that they come with a serious risk of overdose that results in emergency department presentations. Hospitalizations increased from 7% to 20% over the decade between 2004 and 2014.

“Use of herbal and dietary supplements (HDSs) accounts for an increasing proportion of drug hepatotoxicity cases,” said the researchers, led by Alisa Likhitsup, an assistant professor of gastroenterology.

Drug-induced hepatotoxicity is an acute or chronic liver injury also known as toxic liver disease, with a host of symptoms including yellowing of the skin, fatigue, nausea, rash, itching and upper-right abdominal pain. While it can be treated by removing the toxic trigger, it can lead to serious consequences, including the patient needing a liver transplant or even dying from it if it is untreated or missed.

While hospitalizations due to misuse of herbal supplements are on the rise, the researchers are not campaigning for abstinence, but for users to be vigilant with ingredients and dosages, especially if they’re taking a combination of them or other medicines to treat chronic conditions.

“In light of the lack of regulatory oversight on the manufacturing and testing of botanical products, it is recommended that clinicians obtain a full medication and HDS use history when evaluating patients with unexplained symptoms or liver test abnormalities,” they wrote in the study. “Considering widespread and growing popularity of botanical products, we urge government authorities to consider increasing the regulatory oversight on how botanicals are produced, marketed, tested, and monitored in the general population.”

They also point out that the regulatory processes surrounding these supplements are not as stringent as for prescription medicines, and that chemical testing of products has revealed inconsistencies between what’s advertised on the bottle and what dose is in a tablet.

What’s more, clinical trials into the efficacy of these supplements have not provided robust evidence of their benefits compared to their risks when they’re taken at higher doses. Safe amounts of each supplement of course depends on any prescription medicines an individual may be taking, as well as their baseline liver health and other medical conditions. As such, recommendations of safe doses should ideally be personalized.



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“The safety and efficacy of HDSs are not well established due to the lack of regulatory requirements by the US Food and Drug Administration for human pharmacokinetic or prospective clinical trials prior to marketing,” the researchers added.

In 2023, the Australian FDA equivalent, the Therapeutic Goods Association (TGA), issued a warning that highlighted the risk of liver injury from consuming turmeric and/or curcumin. While they cautioned that serious injury is rare, the risk varied depending on an individual’s bioabsorption and liver health.

“The risk of liver injury does not appear to relate to *Curcuma longa* (turmeric) when consumed in typical dietary amounts as a food,” the TGA added, offering a pinch of good news for those who cook with the popular orange spice.

The study was published in the journal *JAMA Network Open*.

New Atlas, 5 August 2024

<https://newatlas.com>

### Chemical cocktail from plastics: Pilot study describes degradation and leaching process of plastic consumer products

2024-08-12

Plastic waste in rivers and oceans is constantly releasing chemicals into the water. Until now, it was unknown how large these quantities are and which substances are released particularly strongly. In the large-scale P-LEACH project, experts from four research institutes of the Helmholtz Association have now analyzed the composition and concentrations of many different substances. The main focus was on the question of how the sun’s UV radiation increases the release of chemicals.

Hundreds of thousands of tons of plastic waste are floating in rivers and oceans. The impact of waves, the sun’s UV radiation and salty seawater cause the plastic to gradually break down into smaller and smaller fragments and ultimately float in the oceans as tiny microplastic particles.

In numerous studies, researchers have investigated the extent to which marine animals ingest these particles and whether they become ill from them. Far less well researched to date is how the ingredients of various plastic products—including additives such as heavy metals, flame

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retardants, plasticizers, dyes and many other ingredients, that give plastic its versatile properties—affect marine life.

For this reason, more than 30 scientists joined forces two years ago in a major Helmholtz Association project to investigate in detail how quickly and to what extent plastic releases its additives into water—and to what extent these substances may harm marine life.

The first project results of the experts from the Helmholtz-Zentrum Hereon in Geesthacht, the GEOMAR Helmholtz Centre for Ocean Research Kiel, the Alfred Wegener Institute, Helmholtz Centre for Polar and Marine Research (AWI) in Bremerhaven and the Helmholtz Centre for Environmental Research (UFZ) in Leipzig have now been published in the *Journal of Hazardous Materials*. The focus of this first research article from the P-LEACH consortium is on the chemical analysis of plastic ingredients—and the question of how the sun’s UV radiation contributes to the release of chemical substances from plastics.

### Focus on common types of plastic

For their experiments, the scientists first bought eight typical mass-produced items made from frequently used plastics and cut them up into pieces just a few millimeters in size—including polyethylene (PE) greenhouse film, polyvinyl chloride (PVC) tubes and PET plugs. They then placed these pieces in a water bath and irradiated them with a special UV lamp that mimics sunlight over Central Europe for several months. For comparison, they stored some of the plastic in water containers that were not irradiated.

After the experiment, the plastic particles were removed using filters and the water was then thoroughly analyzed for possible release of tiny plastic particles and plastic additives—especially metal compounds and certain organic substances. Of particular interest were those chemicals that are suspected of being harmful to human health and the environment but are not banned or regulated.

The results were striking: considerably higher concentrations of metal ions were found in the water of UV-irradiated samples than in non-irradiated samples. The picture was more differentiated for the organic substances: some substances were also present in significantly higher concentrations in the UV-irradiated samples. For other organic molecules, however, concentrations were surprisingly low.



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“However, this is not an all-clear,” says environmental chemist Dr. Frank Menger, first author of the research article and an expert in organic chemistry at Hereon. “We expect that these substances are also released from the plastic into the water, but then they are transformed into smaller organic compounds by UV light so that the original compounds are no longer directly detectable.”

**Search for known and unknown chemicals**

When analyzing the organic substances, the researchers examined two things in detail. Firstly, water samples were analyzed for 71 known substances that are well known to be used in many plastic products—including the UV protection molecule UV-328, which was added to the list of the Stockholm Convention a year ago—a list of particularly hazardous chemicals whose use is restricted or in some cases completely banned.

The scientists also searched for unknown substances and degradation products in the water samples. Special mass spectrometers were used for this purpose, which can recognize certain molecular structures or fragments of molecules to draw conclusions about the original substance. This also makes it possible to identify chemicals that are still relatively new to the market and relatively unknown—for example, new classes of plasticizers. Considering that around 16,000 different additives are used in plastic production worldwide, it becomes clear how challenging the analysis is, despite modern mass spectrometry.

Dr. Menger is excited about the study scope and the entire project. He explains, “We brought together the analytical technologies and the relevant expertise from four research institutes.” This was the only way it was possible to analyze water samples so comprehensively.

Dr. Lars Hildebrandt, one of the Hereon scientists who worked on the complex analysis of microplastic particles and heavy metals as part of the study, adds, “I am hardly aware of any comparable studies to date in which the release of metal compounds as well as known and unknown organic compounds and also small plastic particles from plastic products have been investigated so extensively, with special consideration given to weathering caused by UV radiation.”

However, it should be remembered that UV radiation is only one factor that affects plastic in the environment. There is also salt content or degradation by microorganisms. The age, size, shape and porosity of the plastic also influence the extent to which additives enter the water. In this

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respect, further studies are needed in future that take these parameters into account and investigate their diverse effects.

“The P-LEACH project gives us a unique opportunity to comprehensively investigate release of organic and inorganic chemicals as well as microplastic particles from weathering plastic objects and possible effects, taking into account various disciplines such as environmental chemistry, ecotoxicology and human toxicology,” says Prof. Dr. Annika Jahnke from the UFZ, who is coordinating the project.

Further scientific articles by the P-LEACH team are due to be published in the coming months. These will include results on how water contaminated with plastic substances affects bacteria, the metabolism of algae, snails and living cells, including cells from the human body.

Phys Org, 12 August 2024

<https://phys.org>

**Every Fish Sample Tested in Northern Illinois Rivers Found Contaminated with PFAS**

2024-07-31

Scientists tested nine fish species from four northern Illinois rivers for contamination with per- or polyfluoroalkyl substances, synthetic chemicals found in numerous industrial and commercial products and known to be harmful to human health. They found fish contaminated with PFAS in every one of their 15 test sites. Elevated levels of PFOS, one type of PFAS compound, were found in nearly all fish tested.

The findings are reported in the journal *Science of the Total Environment*.

The qualities that make PFAS desirable for industrial uses — their durability and stability under stresses such as high heat or exposure to water, for example — also make these chemicals particularly problematic in the environment and hazardous to human and animal health, said Joseph Irudayaraj, a professor of bioengineering at the University of Illinois Urbana-Champaign who led the new study.

“PFAS contain multiple carbon-fluorine bonds, one of the strongest bonds in organic chemistry,” Irudayaraj said. “Because of this, they are also very hard to break down. They persist for a long time because they are very, very stable.”



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There are nearly 15,000 PFAS chemicals, according to the U.S. Environmental Protection Agency. These are classified either as short-chain PFAS, which have less than six carbon-fluorine bonds, and long-chain PFAS, with six or more of these bonds, Irudayaraj said.

Long-chain PFAS were widely used before awareness grew about the hazards of these chemicals. More recently, many industries switched to using short-chain PFAS.

"It was thought that the short-chain PFAS were less toxic, and that they could more easily degrade," he said. "But surprisingly, that was not the case."

Now, both types of PFAS are found in groundwater, soil and human tissues.

"About 99% of people living in the U.S. have PFAS in their system," Irudayaraj said.

Despite a voluntary phasing out of some PFAS in industry in the U.S. and efforts to reduce PFAS pollution, these chemicals are still found in drinking water, household products, food packaging and agricultural products, he said.

The researchers focused on fish in northern Illinois rivers because they are close to urban and industrial areas. Industrial emissions and urban rainwater runoff may further contaminate local waterways with PFAS. Sport fishing is also popular across the state, including in areas inside and near Chicago. More than 666,000 fishing licenses were issued across the state of Illinois in 2020.

The researchers focused on fish in the Pecatonica River, Rock River, Sugar River and Yellow Creek from 2021-22. The team collected dozens of samples from nine species of fish, including bluegill, channel catfish, common carp, northern pike, smallmouth bass and walleye. The fish represented different levels of the food chain, from those that feed only on plants, like bluegill, to those eating other fish, such as channel catfish and northern pike.

Back in the lab, the scientists analyzed fish tissues for 17 PFAS chemicals. They found PFAS-contaminated fish in every river they tested and in every one of their 15 sampling sites. Fish from the Rock River had the highest concentrations of PFAS in their tissues. Contamination levels were highest in channel catfish, at the top of the food chain, and lowest in the plant eaters.

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Four chemicals known as perfluorooctanesulfonic acids or PFOS were detected in fish from every site tested.

"These are long-chain PFAS that have been in use over the past few decades," Irudayaraj said. "They were found in all the sites, along with a few short-chain PFAS."

Because fish are mobile, it is problematic to tie their contamination levels to the locale where they were sampled, he said. But the finding is worrisome for people who are exposed to the water or eating the fish from these sites.

"Further studies are warranted to comprehensively evaluate the occurrence and sources of PFAS throughout the state of Illinois," the researchers wrote. "Such information is crucial to better understand the distribution and potential risks of these compounds to the environment."

Technology Networks, 31 July 2024

<https://technologynetworks.com>

### Findings challenge current understanding of nitrogenases and highlight their potential for sustainable bioproduction

2024-08-14

Nitrogenases are among the most geochemically important enzymes on Earth, providing all forms of life with bioavailable nitrogen in the form of ammonia (NH<sub>3</sub>). Some nitrogenases can also directly convert CO<sub>2</sub> into hydrocarbon chains, making them an exciting target for the development of biotechnological processes.

A team of researchers in Marburg, Germany, led by Max Planck scientist Johannes Rebelein, has now provided a comprehensive insight into the substrate specificity and preferences of nitrogenase. Their results challenge the current understanding of nitrogenases and highlight their potential for sustainable bioproduction. The research is published in the journal Science Advances.

Nitrogen is one of the main building blocks of our cells. However, most of the nitrogen on Earth occurs as gaseous N<sub>2</sub> and is chemically unusable by cells. Only a single family of enzymes is able to convert N<sub>2</sub> into the bioavailable form of ammonia (NH<sub>3</sub>): nitrogenases.



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Researchers led by Johannes Rebelein from the Max Planck Institute for Terrestrial Microbiology in Marburg have discovered that some nitrogenases can also deal with another important substrate: They reduce the greenhouse gas CO<sub>2</sub> to hydrocarbons (methane, ethylene, ethane) and formic acid.

All these products are potential energy sources and industrially important chemicals. With a view to sustainable, carbon-neutral bioproduction, the team wanted to know: How well can the enzymes discriminate between CO<sub>2</sub> and N<sub>2</sub>? And do microorganisms that grow on N<sub>2</sub> also reduce CO<sub>2</sub> under normal, physiological conditions?

**Two isoenzymes**

To answer these questions, the researchers focused on the photosynthetic bacterium *Rhodobacter capsulatus*, which harbors two isoenzymes: the molybdenum (Mo) nitrogenase and the iron (Fe) nitrogenase, which the bacterium needs as a reserve in the event of molybdenum deficiency.

The researchers isolated both nitrogenases and compared their CO<sub>2</sub> reduction using biochemical tests. They found that the Fe nitrogenase actually reduces CO<sub>2</sub> three times more efficiently than its molybdenum containing counterpart and produces formic acid and methane at atmospheric CO<sub>2</sub> concentrations.

When both enzymes were offered CO<sub>2</sub> and N<sub>2</sub> at the same time, another important difference became apparent: while Mo-nitrogenase selectively reduces N<sub>2</sub>, Fe-nitrogenase tends to choose CO<sub>2</sub> as a substrate.

“Normally, a higher reaction speed in enzymes comes at the expense of accuracy. Interestingly, Mo-nitrogenase is both faster and more selective, showing its advantage in N<sub>2</sub> reduction. The lower specificity of Fe nitrogenase and its preference for CO<sub>2</sub> make it a promising starting point for the development of novel CO<sub>2</sub> reductases,” says Frederik Schmidt, Ph.D. student in Johannes Rebelein’s lab and co-author of the study.

**Wide-spread CO<sub>2</sub> reduction in nature?**

The low selectivity was not the only surprise.

“We analyzed which fraction of electrons ended up in which product and found that methane and high concentrations of formic acid derived from CO<sub>2</sub> conversion by Fe nitrogenase were secreted by the bacteria even when no additional CO<sub>2</sub> was added to the culture: the metabolically derived CO<sub>2</sub> was sufficient to drive this process. This finding suggests that

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Fe nitrogenase-catalyzed CO<sub>2</sub> reduction may indeed be widespread in nature,” says Niels Oehlmann, co-first author of the study.

This also means that the availability and exchange of one-carbon substrates is likely to influence microbial communities in different environments.

The work challenges the traditional view of nitrogenases as true nitrogen-converting enzymes. Photosynthetic bacteria such as *R. capsulatus*, which use light energy to stimulate nitrogenases to convert the greenhouse gas CO<sub>2</sub>, could play a key role not only in their environmental impact, but also in the societal shift towards a sustainable circular economy, says Johannes Rebelein.

“The idea is that we can store the energy from the sunlight captured by the microorganism’s photosynthetic apparatus in the hydrocarbons produced by nitrogenase. In the future, we want to further develop the iron nitrogenase in order to use it for CO<sub>2</sub> fixation and utilization.”

Phys Org, 14 August 2024

<https://phys.org>

**Can PrISMa Save Our Planet? Inside the New Carbon Capture Phenomenon**

2024-08-14

PrISMa revolutionizes the field of carbon capture by combining insights from materials science, engineering, and economic analysis to predict the effectiveness of new technologies.

This innovative platform not only enhances the development of carbon capture solutions but also ensures their sustainability and economic viability, effectively closing the gap between laboratory research and practical implementation.

Mitigating the effects of climate change has become a major focus worldwide, with countries and international organizations developing various strategies to address the problem. Lowering CO<sub>2</sub> emissions is at the top, with carbon capture technologies being a promising way forward.

Nonetheless, bridging the gap between research and practical implementation of carbon capture solutions has proven so difficult, it has an actual name: “Valley of Death.” The challenge is compounded by



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the need to take into account the perspectives and priorities of different stakeholders along the process.

### Innovating Carbon Capture With PrISMa

Traditionally, carbon capture tech development begins with chemists designing materials and engineers developing processes, while economic and environmental impacts are assessed later. The results are often suboptimal and only delay the implementation of real-world solutions.

In response to this, scientists led by Berend Smit at EPFL and Susana Garcia at Heriot-Watt University have developed the PrISMa (Process-Informed design of tailor-made Sorbent Materials) platform: an innovative tool that seamlessly connects materials science, process design, techno-economics, and life-cycle assessment by taking into account multiple stakeholder perspectives from the outset.

Using advanced simulations and machine learning, PrISMa can identify the most effective and sustainable solutions, and predict the performance of new materials, which sets it apart as a powerful tool in the fight against climate change.

### Key Performance Indicators of PrISMa

PrISMa evaluates four Key Performance Indicators (KPIs), or “layers,” to assess the viability of a carbon capture material from its initial development to its implementation into a complete carbon capturing plant.

- **Materials Layer:** Using experimental data and molecular simulations, the platform predicts the adsorption properties of potential sorbent materials.
- **Process Layer:** PrISMa computes process performance parameters, such as purity, recovery, and energy requirements.
- **Techno-Economic Analysis Layer:** PrISMa assesses the economic and technical viability of a carbon capture plant.
- **Life-Cycle Assessment Layer:** PrISMa evaluates the environmental impacts over the plant’s entire life cycle, ensuring comprehensive sustainability.

### Real-World Applications and Predictive Abilities

The scientists used PrISMa to compare over sixty real-world case studies, in which CO<sub>2</sub> is captured from different sources in five world regions with different technologies. By taking into account multiple stakeholder

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perspectives, PrISMa helped identify the most effective and sustainable solutions.

“One of the unique features of the PrISMa platform is its ability to predict the performance of new materials using advanced simulations and machine learning,” says Berend Smit. “This innovative approach accelerates the discovery of top-performing materials for carbon capture, surpassing traditional trial-and-error methods.”

### Molecular Simulations Enhance Predictions

The platform integrates density functional theory (DFT) and molecular simulation to predict material properties needed for process design. The team tested this approach on a CO<sub>2</sub> capture plant looking at the indirect emissions over 30 years of the plant’s operation, and coupled this with a techno-economic assessment, which evaluated the cost of the process.

“We succeeded in connecting the movement of electrons at the DFT level to calculate the total amount of CO<sub>2</sub> captured over the 30-year lifetime of a capture plant, and at which costs,” says Berend Smit.

### Stakeholder Insights and New Material Discovery

PrISMa provides invaluable insights for various stakeholders, offering engineers the tools to design the most efficient and cost-effective carbon capture processes, and guiding chemists on the molecular characteristics that enhance material performance.

Environmental managers gain access to comprehensive evaluations of environmental impacts, enabling more informed decision-making, while investors benefit from detailed economic analyses that reduce the risks and uncertainties associated with investing in new technologies.

### Discovering New Materials

PrISMa can accelerate the discovery of top-performing materials for carbon capture, surpassing traditional trial-and-error methods. Its interactive tools allow users to explore over 1,200 materials, understanding the trade-offs between cost, environmental impact, and technical performance.

This comprehensive approach ensures that chosen solutions capture CO<sub>2</sub> efficiently while minimizing overall environmental impacts.

One way that Smit envisions PrISMa being used is in the discovery of metal-organic frameworks (MOFs), porous materials with a wide range



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of applications, including carbon capture. "The idea is that chemists can upload the crystal structures of their MOFs, and the platform ranks these materials for all kinds of capture processes," he says. "So, even chemists who do not have detailed knowledge of carbon capture technologies can get feedback on which MOF is the best performing and why."

PrISMa can accelerate the development of carbon capture technologies, helping achieve net-zero emissions by uniting all relevant stakeholders early in the research process. By providing a comprehensive evaluation of materials and processes, PrISMa enables more informed decision-making, leading to the development of more effective and sustainable carbon capture solutions.

For more on this research, see [This Platform Could Change Carbon Capture Forever](#).

Sci Tech Daily, 14 August 2024

<https://scitechdaily.com>

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### Common drug restores youthful function to clean up aging brains

2024-08-15

A drug used to induce labor in pregnant women has been shown to reactivate tiny waste-clearing pumps in the brains of old mice. The finding could hold promise as a new way to fight Alzheimer's and Parkinson's diseases and overall cognitive decline.

When our brains are working properly, there is an excess of proteins that build up from the energy intensive processes that take place between our neurons. Those proteins need to be removed in order for the brain to continue to operate properly. When they aren't, they can gunk up the works, leading to the beta amyloid and tau protein tangles that are a hallmark of Alzheimer's disease or the build up of alpha-synuclein that accompanies Parkinson's.

In 2012 Danish neuroscientist, Maiken Nedergaard first described the system that uses cerebrospinal fluid (CSF) to remove waste from the brain and termed it the glymphatic system. Now, Nedergaard and her colleagues have looked deeper into the glymphatic system, focusing on lymph vessels called lymphangions. These are a series of tiny pumps in the neck that are responsible for moving dirty CSF out of the brain and into the lymph system where it ultimately reaches the kidneys to be processed.

Using advanced particle tracking in mice models, they found that as the rodents aged, the contractions in these pumps decreased. As a result, they found that older mice had 63% less dirty CSF flowing out of their brains compared to younger mice, setting the stage for the rodents to suffer cognitive decline.

Wondering if they could jump start the pumps and get them back into action, Nedergaard focused on the fact that lymphangions are lined with smooth muscle cells. So they looked to a drug called prostaglandin F<sub>2α</sub>, which works on these types of cells and is commonly used to induce labor in pregnant women. Sure enough, administering the drug to the elderly mice with a topical cream got the pumps working again to the point that the team saw the flow of dirty CSF out of the brain return to the same level of efficiency seen in younger mice.

Should the results hold in human trials, the finding could offer a brand-new way to combat the effects of cognitive impairment and brain-related diseases.



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“These vessels are conveniently located near the surface of the skin, we know they are important, and we now know how to accelerate function,” said study co-author Douglas Kelley, from the University of Rochester’s Hajim School of Engineering and Applied Sciences. “One can see how this approach, perhaps combined with other interventions, could be the basis for future therapies for these diseases.”

The research has been published in the journal *Nature Aging*.

*New Atlas*, 15 August 2024

<https://newatlas.com>

### Ice Cream Made From Horse’s Milk May Be Better for Your Gut Than the Regular Dessert

2024-08-08

Do you ever wish your summer scoop of ice cream was just a tad healthier but still just as delicious? Well, you may want to give horse ice cream a try!

Yes, according to a new study, mare’s milk is not only as viable as cow’s milk when it comes to making ice cream, but richer in probiotic bacteria that could benefit digestion.

The results were published in *PLoS ONE*.

Straight from the horse’s...

Horse’s milk is more similar in structure to human milk than cow’s milk, due to its low casein-to-whey protein ratio, low mineral content and high levels of lactose and polyunsaturated fatty acids – the latter of which are known to benefit gut health and reduce inflammation.

To gauge the quality of ice cream made from such milk, researchers from the West Pomeranian University of Technology, Szczecin, Poland, developed four varieties of mare’s milk ice cream.

The milks were first pasteurized then inoculated with different strains of bacteria, many belonging to the order *Lactobacillales*.

The first milk was mixed with *Streptococcus thermophilus* and *Lactobacillus delbrueckii* bacteria. The second was inoculated with inulin, a prebiotic that can encourage the growth of certain bacteria. The third included the bacteria *Lactocaseibacillus rhamnosus* and inulin, while the fourth was given *Lactiplantibacillus plantarum* and inulin.

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After allowing for fermentation, the milks were cooled, blended and frozen to form four separate ice creams.

None of the creams differed significantly in their melting rates or levels of protein and fat. Acidity, however, was affected. The first ice cream without inulin had the highest acidity level, a finding that suggests that inulin keeps acidity in check.

All ice creams were deemed to have a “high overall sensory quality.”

The *Lactobacillales* bacteria survived well in all three creams with inulin, reaching 7 log colony forming units per gram (cfu/g) in some samples, above the level deemed to have “therapeutic” value (6 log cfu/g). The same type of bacteria fared more poorly in the first ice cream without inulin, however.

As such, the researchers conclude that inulin may be necessary to guarantee the probiotic benefits of mare’s milk.

If these kinds of bacterial boons can be secured, they say horse-derived ice cream could well have a place in ice cream trucks of the future.

“Obtained products seem to be good candidates to introduce mare’s milk to the diet of western consumers, which are not familiar with this milk type,” the authors concluded.

**Reference:** Szkolnicka K, Mituniewicz-Małek A, Dmytrów I, Bogusławska-Wąs E. The use of mare’s milk for yogurt ice cream and synbiotic ice cream production. *PLoS ONE*. 2024;19(8):e0304692. doi: 10.1371/journal.pone.0304692

*Technology Networks*, 8 August 2024

<https://technologynetworks.com>

### Children Can Inherit Early Aging Symptoms From Parents Who Abuse Alcohol, Researchers Find

2024-08-08

Researchers at the Texas A&M School of Veterinary Medicine and Biomedical Sciences (VMBS) have discovered that parents who struggle with alcohol use disorders can pass along symptoms of early aging to their children, affecting them well into adulthood.

These accelerated aging effects — including high cholesterol, heart problems, arthritis and early-onset dementia — can be passed down



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from either mom or dad individually, but they become worse when both parents have an issue with alcohol abuse, especially in male offspring.

“Scientists have wondered what causes children who grow up in homes where there is alcohol abuse to be more susceptible to becoming sick,” said Dr. Michael Golding, a professor in VMBS’ Department of Veterinary Physiology and Pharmacology. “For example, we know that these children have behavioral problems that make it difficult to cope with stress and might lead to conflict with school systems or law enforcement.”

But what scientists didn’t know was the cause behind the early aging and disease susceptibility — was it stress or something inherited from these children’s parents?

“Now we know that they’re inheriting dysfunction in their mitochondria as a result of their parents’ substance abuse,” Golding said. “The dysfunction causes these individuals to show early signs of age-related disease when they’re still considered young, usually in their 40s.”

With this new understanding, Golding hopes that doctors can work with patients to improve their mitochondrial health — and possibly delay the inherited dysfunction as they age — using methods like exercise and increasing intake of certain vitamins.

### Alcohol And Aging

As adults get older, they develop a biological condition called senescence, which is when cells slow down and stop dividing, limiting the body’s ability to replace deteriorating cells.

“Senescence is a key marker of aging, especially in the brain, where it leads to cognitive dysfunction and memory problems,” Golding said. “Scientists have known for a long time that heavy alcohol use can cause early onset of senescence in adults.”

Using a mouse model, research by Golding and his team revealed that senescence also happens to be one of the early-aging symptoms that offspring can inherit from parents who daily drink alcohol to the legal limit or more.

“We also see fat increase in the liver, which creates scar tissue,” Golding said. “It’s especially common in male offspring. In fact, if both parents have an issue with alcohol abuse, it can have a compounded effect on male offspring, making them even more likely to get liver disease.”

### Parental Drinking And Child Health

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Golding’s lab focuses on the biological relationship between parental alcohol use and child development. His lab recently uncovered that fathers — not just mothers — can contribute to children developing Fetal Alcohol Syndrome, or FAS. As a result, he also continues to advocate for parents reducing their alcohol consumption prior to conception.

“There are all sorts of problems that children can develop right after they’re born because of FAS,” Golding said. “But what we haven’t understood well until now is how parental drinking habits might go on to affect these children into adulthood and influence their ‘healthspan’ — the number of years someone is healthy without chronic and debilitating disease.

“Both the birth defects that come with FAS — like abnormal facial features, low birth weight and/or height, and attention and hyperactivity issues — and the stress from living with them create unique challenges. So do any environmental issues that these children may grow up with, including adoption and the foster system,” he said. “But now, we understand that there’s yet another component — early aging — that is inherited directly from one or both parents.”

### Understanding Multi-Generational Health

This latest discovery also suggests that parents can pass along the benefits of healthy living to their children. According to Golding, healthy lifestyle choices also compound generationally, making efforts to reverse aging — through things like diet and exercise — beneficial for generations to come.

“Parental health pre-conception — both parents’ overall health before pregnancy — is critical for the health of offspring,” he explained. “The more you can do as a prospective parent to get into a healthy mindset and a healthy lifestyle, the more significant effects you’ll have on the health of your kid both right at birth and even into their 20s and 40s.”

Technology Networks, 8 August 2024

<https://technologynetworks.com>

### Fine fragrances from test tubes: A new method to synthesize ambrox

2024-08-14

Mankind has been craving pleasant smells and therefore working on perfumes since ancient times—fine scents have always been considered a source of inspiration, and a good fragrance has always been a sign



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of health. The scarce natural product (–)-ambrox, which is traditionally isolated from ambergris, a waxy substance from the digestive tract of sperm whales, has been one of the most popular fragrances in the world for a long time.

More than 30 tons are produced annually. Importantly, only one mirror image out of 16 possible variants of the chiral molecule delivers the particularly pleasant odor sensation, which necessitates a stereoselective synthesis that only produces the desired mirror image.

Fortunately, it is no longer necessary to gather it from whales, but it can be obtained via partial synthesis from (–)-sclareol, a natural product that occurs in large amounts in a certain type of sage. However, the plant-based process to obtain ambrox requires multiple steps and is dependent on the availability of clary sage, which is subject to fluctuations.

Now a research group led by Prof. Benjamin List, Director at the Max Planck Institut für Kohlenforschung, has succeeded in synthesizing the fragrant and highly complex chiral molecule in the laboratory. The researchers have published their results in the journal *Nature* in their article titled “The catalytic asymmetric polyene cyclization of homofarnesol to ambrox.”

“In biology, polyene cyclizations are complex reactions that convert simple starting materials into complicated molecular structures—in just one step,” explains Mathias Turberg, one of Prof. List’s doctoral students and one of the lead authors of the study. “We were inspired by nature—we also wanted to provide a method for synthesizing complex molecules from rather simple starting materials.”

His colleague, Dr. Na Luo, postdoctoral researcher in Prof. List’s group and lead author of the paper, says, “Imitating nature in the laboratory is a major yet appealing challenge for chemists.” Prof. List himself says that this reaction is “a provocation by nature to us chemists,” as nature with its large enzymes can guide the polyene to fold itself so that it easily makes the desired isomer.

For the List group’s method, the renewable C15 building block nerolidol, which occurs in many plant sources and can also be synthesized on a technical scale, forms the starting material. In a collaboration with the Chemical Company BASF, nerolidol is converted from a C15 into the C16 building block homofarnesol, which is then selectively converted to (–)-ambrox.

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“With our strongly acidic and confined catalyst and a special, fluorinated solvent, we managed to selectively synthesize the desired natural product, one out of 16 possible isomers,” says Luo. While the List group has expertise in this certain type of confined catalysts, Luo was responsible for sharpening the “molecular tool” for this specific reaction.

Whereas the catalyst pre-organizes the starting material and initiates the transformation into the product, the specific solvent stabilizes reactive intermediates and serves, among other things, as a “boost” to the catalysts and therefore makes things even faster. Quite successful: While the state-of-the-art biocatalytic reaction takes three to four days, the new method provides the product overnight.

“We managed to run our reaction under relatively mild conditions—and also in one single step. The outcome is highly selective,” explains Luo.

“Key to the high selectivity of the process is the conversion of homofarnesol to (–)-ambrox in a concerted fashion, which mimics enzyme-catalyzed polyene cyclizations,” adds Turberg.

The scientists could also demonstrate that their approach is readily scalable. Another advantage of the List group’s synthesis is that catalyst and solvent can be recovered and reused for more reactions. Both aspects are promising for potential future industrial applications.

Phys Org, 14 August 2024

<https://phys.org>

### US FDA refuses to approve MDMA for PTSD therapy – now what?

2024-08-15

We were this close to seeing Ecstasy being incorporated into therapy in the US in 2024. Now, we have to wait either a little or a lot – depending on how the chips fall. Let’s have a closer look at where we’re currently at.

#### Wait, we were going to get Ecstasy for therapy?

Well, to be clear, you wouldn’t get the party drug version of Ecstasy, aka Molly, aka MDMA, aka 3,4-methylenedioxy-methamphetamine, for just any reason. You’d get a similar concoction of the compound formulated for assisted therapy to treat post-traumatic stress disorder (PTSD).



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A licensed therapist would guide you through sessions that combined talk therapy with use of the empathogen, to help you deal with your condition in a safe environment.

Activists have been advocating for MDMA in therapy for roughly two decades now, but getting it approved has been a struggle. It was classified as a Schedule 1 drug in the US (read: illegal) in the 1980s. That has kept it out of reach for any sort of clinical or recreational use since it made a splash in the 70s as a party drug.

### How does MDMA help treat PTSD?

PTSD is an awful condition to go through. It's responsible for intense fear and crippling panic attacks brought on by traumatic memories. It's worryingly common among military veterans: 7 out of every 100 Veterans will have PTSD.

MDMA stimulates the release of a mood-regulating neurotransmitter called serotonin. That then releases oxytocin, which is responsible for feelings of closeness.

"MDMA can allow you to process deep-seated trauma by enabling the transformation of fear memories in a part of the brain called the amygdala in a manner that doesn't make you withdraw or detach out of shame or fear, but instead helps you to accept and heal," explains Jennifer Mitchell, PhD, professor of neurology and of psychiatry and behavioral sciences at University of California, San Francisco.

### What's the holdup?

In many cases, the US has been known to lead the charge in permitting the use of drugs in various treatments, with other countries following suit. The FDA's drug approval process is known to be stringent: new drug applications can take between 12-15 years to go through the necessary testing and get approved.

About 13 million US adults were estimated to suffer from PTSD as of 2020, and there have been no new medications approved by the FDA to treat the condition in 25 years. So yeah, this was a high-stakes situation.

### What just happened?

On August 9, Lykos Therapeutics, a US-based drug maker, said its application to the FDA to allow the use of MDMA for treatment of PTSD was not approved. The agency, for its part, "determined that it could not be

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approved based on data submitted to date," and asked Lykos to conduct an additional Phase 3 trial to make its case.

That's a crushing blow to the effort to legitimize MDMA for medicinal use in the US – particularly after the application's FDA review was slated to be fast tracked so it'd take place within six months.

This follows the concerns that arose from a FDA advisory committee meeting to review Lykos' trials in June. A panel of experts wasn't convinced the clinical trial was designed to appropriately establish placebo controls in the study.

In other words, the panel questioned whether it was truly possible to 'blind' people in the study and remove bias in their response to receiving treatment – whether they received MDMA or an inactive placebo.

That committee then voted 9-2 that there was insufficient evidence to support Lykos' prescribed treatment.

There's more. Just a day after the FDA's decision came to light, Psychopharmacology – an international journal that publishes research on how drugs impact human cognition – retracted three Lykos studies on MDMA therapy that appeared in 2020, citing "unethical conduct at the [MP4] study site by researchers associated with this project."

### What happens now?

Following the 1-2 punch that Lykos just took on the chin, it's likely not going to be easy to make MDMA-assisted therapy a reality in the US soon.

Lykos will appeal the decision, but if that doesn't go through, its only option is to conduct another Phase 3 trial – the last major step before a new drug application is submitted for approval – which the company has said "will take several years."

### Hope down under

Australia has surprisingly taken the lead in allowing MDMA to be used in therapy.

Last July, its government authorized psychiatrists to prescribe MDMA for PTSD, and psilocybin (found in magic mushrooms) for treatment-resistant depression (TRD).

Of course, it's not exactly an over-the-counter situation. Psychiatrists must first apply to become Authorized Prescribers following drug agency



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guidelines. And even then, it's classified as a scheduled drug for only these specific conditions.

Beyond having psychiatrists go through several hoops before they can prescribe these drugs, it's also worth noting that MDMA treatment ain't cheap or quick.

Clarion Clinics, which opened in January in a suburb of Melbourne, offers MDMA-assisted treatment over the course of nine months. That includes just two dosing sessions, with several screenings before, and lots of psychotherapy in between and after.

A treatment package will set you back by up to AUD 27,500 (which converts to around US\$18,200).

As The Guardian noted in its piece on the clinic in February, there are still several unknowns as to the best sort of patient for this treatment, and how it will play out through the course of treatment and beyond.

Until that's all worked out – and treatments can be streamlined, if that's even possible – MDMA-assisted therapy for PTSD might only be available to a small sliver of the population suffering from this condition.

New Atlas, 15 August 2024

<https://newatlas.com>

### Smart fabric converts body heat into electricity

2024-08-14

Imagine a coat that captures solar energy to keep you cozy on a chilly winter walk, or a shirt that can monitor your heart rate and temperature. Picture clothing athletes can wear to track their performance without the need for bulky battery packs.

University of Waterloo researchers have developed a smart fabric with these remarkable capabilities.

The fabric has the potential for energy harvesting, health monitoring, and movement tracking applications.

The new fabric developed by a Waterloo research team can convert body heat and solar energy into electricity, potentially enabling continuous operation with no need for an external power source.

Different sensors monitoring temperature, stress, and more can be integrated into the material.

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It can detect temperature changes and a range of other sensors to monitor pressure, chemical composition, and more.

One promising application is smart face masks that can track breath temperature and rate and detect chemicals in breath to help identify viruses, lung cancer, and other conditions.

"We have developed a fabric material with multifunctional sensing capabilities and self-powering potential," said Yuning Li, a professor in the Department of Chemical Engineering.

"This innovation brings us closer to practical applications for smart fabrics."

Unlike current wearable devices that often depend on external power sources or frequent recharging, this breakthrough research has created a novel fabric which is more stable, durable, and cost-effective than other fabrics on the market.

This research, conducted in collaboration with Professor Chaoxia Wang and PhD student Jun Peng from the College of Textile Science and Engineering at Jiangnan University, showcases the potential of integrating advanced materials such as MXene and conductive polymers with cutting-edge textile technologies to advance smart fabrics for wearable technology.

Li, director of Waterloo's Printable Electronic Materials Lab, highlighted the significance of this advancement, which is the latest in the university's suite of technologies disrupting health boundaries.

"AI technology is evolving rapidly, offering sophisticated signal analysis for health monitoring, food and pharmaceutical storage, environmental monitoring, and more. However, this progress relies on extensive data collection, which conventional sensors, often bulky, heavy, and costly, cannot meet," Li said.

"Printed sensors, including those embedded in smart fabrics, are ideal for continuous data collection and monitoring. This new smart fabric is a step forward in making these applications practical."

The next phase of research will focus on further enhancing the fabric's performance and integrating it with electronic components in collaboration with electrical and computer engineers. Future developments may include a smartphone app to track and transmit



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data from the fabric to healthcare professionals, enabling real-time, non-invasive health monitoring and everyday use.

Science Daily, 14 August 2024

<https://sciencedaily.com>

### **New cobalt complex triggers ferroptosis in cancer cells**

2024-08-14

In programmed cell death, certain signaling molecules initiate a kind of suicide program to cause cells to die in a controlled manner. This is an essential step to eliminate damaged cells or to control the number of cells in certain tissues, for example. Apoptosis has long been known as a mechanism for programmed cell death.

Ferroptosis is another mechanism that has recently been discovered which, in contrast to other cell death mechanisms, is characterized by the accumulation of lipid peroxides. This process is typically catalyzed by iron—ferrum in Latin—which is where the name ferroptosis derives from.

Research carried out by Dr. Johannes Karges' Medicinal Inorganic Chemistry group in collaboration with doctoral student Nicolás Montesdeoca and two Bachelor students, Lukas Johannknecht and Elizaveta Efanova, has been published in the journal *Angewandte Chemie International Edition*.

"Searching for an alternative to the mechanism of action of conventional chemotherapeutic agents, we specifically looked for a substance capable of triggering ferroptosis," explains Karges.

His group synthesized a cobalt-containing metal complex that accumulates in the mitochondria of cells and generates reactive oxygen species, more precisely hydroxide radicals.

These radicals attack polyunsaturated fatty acids, resulting in the formation of large quantities of lipid peroxides, which in turn trigger ferroptosis. The team was thus the first to produce a cobalt complex designed to specifically trigger ferroptosis.

#### **Effectiveness demonstrated on artificial microtumors**

The researchers from Bochum used a variety of cancer cell lines to show that the cobalt complex induces ferroptosis in tumor cells. On top of that, the substance slowed down the growth of artificially produced microtumors.

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"We are confident that the development of metal complexes that trigger ferroptosis is a promising new approach for cancer treatment," as Karges sums up the research, adding, "However, there's still a long way to go before our studies result in a drug."

The metal complex must first prove effective in animal studies and clinical trials. What's more, the substance doesn't currently selectively target tumor cells, but would also attack healthy cells. This means that researchers must first find a way to package the cobalt complex in such a way that it damages nothing but tumor cells.

Phys Org, 14 August 2024

[https:// https://phys.org/news/2024-08-cobalt-complex-triggers-ferroptosis-cancer.html](https://phys.org/news/2024-08-cobalt-complex-triggers-ferroptosis-cancer.html)

### **A taste for carbon dioxide**

2024-08-14

The remarkable affinity of the microbial enzyme iron nitrogenase for the greenhouse gas CO<sub>2</sub> makes it promising for future biotechnologies.

Nitrogenases are among the most geochemically important enzymes on Earth, providing all forms of life with bioavailable nitrogen in the form of ammonia (NH<sub>3</sub>). Some nitrogenases can also directly convert CO<sub>2</sub> into hydrocarbon chains, making them an exciting target for the development of biotechnological processes. A team of researchers in Marburg, Germany, led by Max Planck scientist Johannes Rebelein, has now provided a comprehensive insight into the substrate specificity and preferences of nitrogenase. Their results challenge the current understanding of nitrogenases and highlight their potential for sustainable bioproduction.

Nitrogen is one of the main building blocks of our cells. However, most of the nitrogen on Earth occurs as gaseous N<sub>2</sub> and is chemically unusable by cells. Only a single family of enzymes is able to convert N<sub>2</sub> into the bioavailable form of ammonia (NH<sub>3</sub>): nitrogenases.

Researchers led by Johannes Rebelein from the Max Planck Institute for Terrestrial Microbiology in Marburg have recently discovered that some nitrogenases can also deal with another important substrate: They reduce the greenhouse gas CO<sub>2</sub> to hydrocarbons (methane, ethylene, ethane) and formic acid. All these products are potential energy sources and industrially important chemicals. With a view to sustainable, carbon-neutral bioproduction, the team wanted to know: How well can the



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enzymes discriminate between CO<sub>2</sub> and N<sub>2</sub>? And do microorganisms that grow on N<sub>2</sub> also reduce CO<sub>2</sub> under normal, physiological conditions?

### Two isoenzymes

To answer these questions, the researchers focused on the photosynthetic bacterium *Rhodobacter capsulatus*, which harbors two isoenzymes: the molybdenum (Mo) nitrogenase and the iron (Fe) nitrogenase, which the bacterium needs as a reserve in the event of molybdenum deficiency. The researchers isolated both nitrogenases and compared their CO<sub>2</sub> reduction using biochemical tests. They found that the Fe nitrogenase actually reduces CO<sub>2</sub> three times more efficiently than its molybdenum containing counterpart and produces formic acid and methane at atmospheric CO<sub>2</sub> concentrations.

When both enzymes were offered CO<sub>2</sub> and N<sub>2</sub> at the same time, another important difference became apparent: while Mo-nitrogenase selectively reduces N<sub>2</sub>, Fe-nitrogenase tends to choose CO<sub>2</sub> as a substrate. "Normally, a higher reaction speed in enzymes comes at the expense of accuracy. Interestingly, Mo-nitrogenase is both faster and more selective, showing its advantage in N<sub>2</sub> reduction. The lower specificity of Fe nitrogenase and its preference for CO<sub>2</sub> make it a promising starting point for the development of novel CO<sub>2</sub> reductases," says Frederik Schmidt, PhD student in Johannes Rebelein's lab and co-author of the study.

### Wide-spread CO<sub>2</sub> reduction in nature?

The low selectivity was not the only surprise. "We analyzed which fraction of electrons ended up in which product and found that methane and high concentrations of formic acid derived from CO<sub>2</sub> conversion by Fe nitrogenase were secreted by the bacteria even when no additional CO<sub>2</sub> was added to the culture: the metabolically derived CO<sub>2</sub> was sufficient to drive this process. This finding suggests that Fe nitrogenase-catalyzed CO<sub>2</sub> reduction may indeed be widespread in nature," says Niels Oehlmann, co-first author of the study. This also means that the availability and exchange of one-carbon substrates is likely to influence microbial communities in different environments.

The work challenges the traditional view of nitrogenases as true nitrogen-converting enzymes. Photosynthetic bacteria such as *R. capsulatus*, which use light energy to stimulate nitrogenases to convert the greenhouse gas CO<sub>2</sub>, could play a key role not only in their environmental impact, but also in the societal shift towards a sustainable circular economy, says Johannes Rebelein. "The idea is that we can store the energy from the

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sunlight captured by the microorganism's photosynthetic apparatus in the hydrocarbons produced by nitrogenase. In the future, we want to further develop the iron nitrogenase in order to use it for CO<sub>2</sub> fixation and utilization.

Science Daily, 14 August 2024

<https://sciencedaily.com>

### Hydrogen bonding helps to maintain tear film stability

2024-08-16

Hydrogen bonding increases the stability of tear film, new research shows.<sup>1</sup> The findings could help illuminate the origins of dry eye syndrome and lead to new strategies for treating the condition.

Eyes are important organs that require protection from debris and bacteria. Located between the mucosal and meibomian layers, tear film is an aqueous layer that provides protection by covering the cornea's surface. But when the tear film is discontinuous and unstable, dry spots can form leading to dry eye syndrome – a problem that affects millions worldwide.

While ocular mucins are understood to stabilise and lubricate tear film, and an oily substance called meibum prevents evaporation, the role of electrolytes within tear film is unclear. Now, a research team surrounding Suraj Borkar of Stanford University in the US has investigated how these solutes effect film stability.

The study used white light interferometry to compare how solutions of sodium chloride and Hank's buffer – which contains sodium, chloride, potassium and phosphate ions and glucose – responded when applied to a silica glass dome that mimicked the curvature of the cornea.

With the sodium chloride solution, the team saw salt crystals and dry spots form on the dome. But with Hank's buffer solution – which the team used to represent tear film – these crystals were absent. Instead, there was a delay in evaporation and a local thickening of the film.

It is 'surprising that it doesn't take much buffer salt to really prevent' the formation of salt crystals, comments Richard Braun, a mathematician who develops models to study tear film stability at the University of Delaware in the US.



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Borkar and colleagues ascertained that the sodium chloride in Hank's buffer contributes to the local thickening. It increases the surface tension of the film and subsequently creates a surface tension differential between the edges of the dome and the centre, leading to an influx of fluid towards the centre.

'We saw something very fascinating when we had a buffered solution that is very close in its composition [to the tear film],' notes Borkar – patterns known as viscous fingers, which were absent in the sodium chloride experiments. They deduced that hydrogen bonding from the hydroxyl groups in Hank's buffer solution increases the viscosity of the film. The team linked this to Saffman–Taylor instability, when low viscosity fluid pushes against a high viscosity film results in viscous fingers. This observation paired with the local thickening resulted in increased film stability in the buffer solution compared with the sodium chloride solution.

The team hopes that better understanding the fundamentals behind tear film stability will advance treatments for dry eye syndrome.

Chemistry World, 16 August 2024

<https://chemistryworld.com>

### New Study: A Daily Multivitamin Could Slow Brain Aging by Almost 60%

2024-06-30

If you've heard multivitamins are pointless, Harvard-affiliated researchers suggest you think again thanks to fresh findings from longitudinal research.

The population is aging, with one in four Americans projected to be 65 years or older by 2060. This presents challenges across healthcare, and one particular concern is that this stage of life is when the greatest incidence of cognitive decline, dementia, and Alzheimer's disease are diagnosed.

Lifestyle choices and clinical interventions are continually being studied and tested for their roles in preventing issues with cognition. One such study has just published a final paper in a series that suggests a daily multivitamin might have a protective effect for individuals who are most likely to experience cognitive issues. In fact, at least one of the analyses saw an almost 60% slowdown in cognitive aging with the daily use of multivitamins.

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COSMOS, which stands for the COcoa Supplement and Multivitamin Outcomes Study, was a series of studies led by researchers from Brigham and Women's Hospital, a teaching hospital of Harvard Medical School, and the Fred Hutchinson Cancer Research Center in Seattle. This research involved more than 20,000 Americans aged 60 years and older to analyze the benefits of cocoa extract and multivitamins on heart disease, cancer, and other health issues.

The third study in the series was published on January 18, 2024, in *The American Journal of Clinical Nutrition*. It took the previous research into account and added a study that included over 500 participants assigned to taking either a multivitamin or a placebo.

Examining the effects from over a two-year period, the final study found "that a daily multivitamin improved memory and slowed cognitive aging in three separate placebo-controlled studies," said JoAnn Manson, MD, MPH, DrPH, a leader of the study and chief of the Division of Preventive Medicine at Brigham and Women's Hospital.

In a press release, researchers were impressed by the findings. "Cognitive decline is among the top health concerns for most older adults, and a daily supplement of multivitamins has the potential as an appealing and accessible approach to slow cognitive aging," said the study's first author, Chirag Vyas, MBBS, MPH, an instructor at Massachusetts General Hospital and a founding member of the Mass General Brigham healthcare system.

The final study's finding on the role of a multivitamin supported two others in COSMOS, all of which showed that a multivitamin outperformed a placebo for cognitive protection. It provided "strong and consistent evidence that taking a daily multivitamin, containing more than 20 essential micronutrients, helps prevent memory loss and slow down cognitive aging," Vyas commented.

If you're looking to add a daily multivitamin, talk to your healthcare provider about which one is right for your needs.

The Healthy, 30 June 2024

<https://thehealthy.com>



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