CHEMWATCH

Bulletin Board

Contents

FEB. 17, 2023

(click on page numbers for links)

CONTACT US

subscribers@chemwatch.net
tel +61 3 9572 4700
fax +61 3 9572 4777

1227 Glen Huntly Rd
Glen Huntly
Victoria 3163 Australia

*** 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.**

Contents

FEB. 17, 2023

CHEMWATCH
Bulletin Board

Contents

FEB. 17, 2023

ASIA PACIFIC

Chemical added to the Inventory following issue of assessment certificate (early listing) - 9 February 2023

2023-02-09

The following industrial chemical has been added to the Australian Inventory of Industrial Chemicals under section 83 of the Industrial Chemicals Act 2019.

CAS number	1835697-72-7
Chemical name	Cyclopropanecarboxylic acid, 2-methyl-2-[[(2E)-1,2,4-trimethyl-2-penten-1-yl]oxy]propyl ester
Molecular formula	C16H28O3
Defined scope of assessment	The chemical was assessed for use by professionals and consumers as a fragrance ingredient in cosmetic, personal and household products: imported into Australia at up to 1 tonne per year imported at up to 100% concentration for reformulation of end use products at less than 1% concentrations for consumers and professional use
Listing date	7 February 2023

Chemical added to the Inventory following the issue of an assessment certificate.

Read More

AICIS, 09-02-23

https://www.industrialchemicals.gov.au/news-and-notices/chemical-added-inventory-following-issue-assessment-certificate-early-listing-9-february-2023

An Overview of New Food Related Products Application in 2022

2023-01-23

New food related products refer to new materials and additives used for food contact materials, containers, detergent, disinfector and tools/

CHEMWATCH
Bulletin Board
Regulatory Update
FEB. 17, 2023

equipment for food production and operation. In China, the application of new food related products should be submitted to National Health Commission (NHC). The final application result will be delivered after undergoing technical review and public consultation. In this article, ChemLinked summarizes the application status quo of new food contact materials and articles (FCMs) in 2022, including FCM additives, resins and materials.

Read More

Chemlinked, 23-01-23

https://food.chemlinked.com/expert-article/an-overview-of-new-food-related-products-application-in-2022

China Consults on GB 14880 National Standard for the Use of Nutritional Fortification Substances in Foods

2023-01-23

The biggest amendment to this standard is the introduction of "mass food fortification" and "voluntary food fortification". Along with the introduction of the two concepts, the amendment stipulates and revises the types and usage amounts of nutritional fortification substances that are permitted to be used in the two cases.

As revealed by a notice released on January 19, 2023, China National Center for Food Safety Risk Assessment (CFSA) is soliciting public opinions on a amendment to the currently effective GB 14880-2012 National Food Safety—Standard Standard for the Use of Nutritional Fortification Substances in Foods. Any opinions can be sent to lihuzhong@cfsa.net.cn prior to February 28, 2023.

Read More

Chemlinked, 22-01-23

https://food.chemlinked.com/news/food-news/china-consults-on-gb-14880-national-standard-for-the-use-of-nutritional-fortification-substances-in-foods

AMERICA

EPA Requires Reporting on Releases and Other Waste Management for Nine Additional PFAS

2023-01-06

Today, the U.S. Environmental Protection Agency (EPA) announced the automatic addition of nine per- and polyfluoroalkyl substances (PFAS) to the Toxics Release Inventory (TRI) list.

TRI data are reported to EPA annually by facilities in certain industry sectors and federal facilities that manufacture, process, or otherwise use TRI-listed chemicals above certain quantities. The data include quantities of such chemicals that were released into the environment or otherwise managed as waste. Information collected through TRI allows communities to learn how facilities in their area are managing listed chemicals. The data collected also helps to support informed decision-making by companies, government agencies, non-governmental organizations, and the public. The addition of these PFAS supports the Biden-Harris Administration's commitment to address the impacts of these forever chemicals, and advances EPA's PFAS Strategic Roadmap to confront the human health and environmental risks of PFAS.

"Communities have a right to know how and where PFAS are being managed, released, or recycled," said Assistant Administrator for the Office of Chemical Safety and Pollution Prevention Michal Freedhoff. "EPA continues to work to fill critical data gaps for these chemicals and ensure this data is publicly available."

These nine PFAS were added to the TRI list pursuant to the Fiscal Year 2020 National Defense Authorization Act (NDAA), which provides the framework for the automatic addition of PFAS to TRI each year in response to certain EPA activities involving such PFAS. For TRI Reporting Year 2023 (reporting forms due by July 1, 2024), reporting is required for nine additional PFAS, bringing the total PFAS subject to TRI reporting to 189.

Addition of four PFAS no longer claimed as confidential business information

Under NDAA section 7321(e), EPA must review confidential business information (CBI) claims before adding a PFAS to the TRI list if the chemical identity is subject to a claim of protection from disclosure under 5 U.S.C. 552(a). EPA previously identified four PFAS for addition to the TRI list

CHEMWATCH
Bulletin Board
Regulatory Update
FEB. 17, 2023

based on the NDAA's provision to include certain PFAS upon the NDAA's enactment. However, due to CBI claims related to their identities, these PFAS were not added to the TRI list at that time. The identities of these PFAS were subsequently declassified in an update to the TSCA Inventory in February 2022 because at least one manufacturer did not claim them as confidential during prior CDR reporting. Because they were no longer confidential, pursuant to the NDAA, the four chemicals were added to the TRI list:

- Alcohols, C8-16, γ-ω-perfluoro, reaction products with 1,6-diisocyanatohexane, glycidol and stearyl alc. (2728655-42-1)
- Acetamide, N-[3-(dimethylamino)propyl]-, 2-[(γ-ω-perfluoro-C4-20-alkyl)thio] derivs. (2738952-61-7)
- Acetic acid, 2-[(γ-ω-perfluoro-C4-20-alkyl)thio] derivs., 2-hydroxypropyl esters (2744262-09-5)
- Acetamide, N-(2-aminoethyl)-, 2-[(γ-ω-perfluoro-C4-20-alkyl) thio] derivs., polymers with N1,N1-dimethyl-1,3-propanediamine, epichlorohydrin and ethylenediamine, oxidized (2742694-36-4)

Addition of five PFAS with final toxicity values

The 2020 NDAA includes a provision that automatically adds PFAS to the TRI list upon the Agency's finalization of a toxicity value. In December 2022, EPA finalized a toxicity value for Perfluorobutanoic acid (PFBA), its anion, and its related salts. Pursuant to the NDAA, the following five chemicals have been added to the TRI:

- PFBA (375-22-4)
- Perfluorobutanoate (45048-62-2)
- Ammonium perfluorobutanoate (10495-86-0)
- Potassium perfluorobutanoate (2966-54-3)
- Sodium perfluorobutanoate (2218-54-4)

As of January 1, 2023, facilities which are subject to reporting requirements for these chemicals should start tracking their activities involving these PFAS as required by Section 313 of the Emergency Planning and Community Right-to-Know Act.

Read More

US EPA, 06-01-23

https://www.epa.gov/newsreleases/epa-requires-reporting-releases-and-other-waste-management-nine-additional-pfas

FDA allows more vitamin D fortification in cereal and bars

2023-01-12

- The FDA approved increases to the fortification levels of vitamin D in cereal products and grain-based bars in response to a petition filed by Kellogg over three years ago.
- According to the Federal Register, 560 IU per 100 grams of vitamin D3 is now allowed in cereal products, while 400 IU per 100 grams is permitted in grain-based nutrition bars.
- As consumers increasingly embrace health and wellness, formulators of foods like cereal are developing ways to increase nutrients to tout their health halos.

CPGs are continuing to look for ways to increase the nutritional aspects of their food products. For Kellogg, adding vitamin D provides a beneficial, sought-after nutrient to products like cereal, which have long been dogged by a perception of unhealthiness. The company last increased vitamin D fortification in its international cereal products in 2018.

Read More

Food Dive, 12-01-23

https://www.fooddive.com/news/vitamin-d-fortification-cereal-bars/639993/

US EPA considers new enforcement programmes on PFAS, HFCs

2023-01-12

The US EPA has announced it may undertake two new national enforcement and compliance initiatives (NECIs) in the coming years to address PFAS contamination and illegal uses of hydrochlorofluorocarbons (HFCs).

NECIs aim "to protect human health and the environment by holding polluters accountable and compelling regulated entities to return to compliance", according to a pre-publication notice in today's Federal Register. "EPA selects national initiatives every four years to focus resources on serious and widespread environmental problems where federal enforcement can make a difference."

CHEMWATCH
Bulletin Board
Regulatory Update
FEB. 17, 2023

Read More

Chemical Watch, 12-01-23

https://chemicalwatch.com/649184/us-epa-considers-new-enforcement-programmes-on-pfas-hfcs?utm_medium=social

Final rule governs air transport of lithium-ion batteries

2023-01-12

A final rule from the Pipeline and Hazardous Materials Safety Administration will regulate the transport of lithium-ion batteries shipped by air.

"The safe transport of lithium batteries by air has been an ongoing concern due to the unique challenges they pose to safety in the air transport environment," PHMSA says. "Unlike most other hazardous materials, lithium batteries have a dual hazard of chemical and electrical. This combination of hazards, when involved in a fire, has the potential to create a scenario that exceeds the fire suppression capability of an aircraft and lead to a catastrophic failure of the aircraft."

Published in the Dec. 21 Federal Register and set to take effect Jan. 20, the rule aims amends federal Hazardous Materials Regulations by:

- Prohibiting the transport of lithium-ion cells and batteries as cargo on passenger aircraft.
- Requiring that rechargeable lithium-ion cells and batteries on cargo-only aircraft be at no more than a 30% state of charge "when not packed with or contained in equipment."
- Restricting the use of alternative provisions for smaller cell or battery shipments to one package per consignment.

Read More

Safety + Health, 12-01-23

https://www.safetyandhealthmagazine.com/articles/23424-final-rule-governs-air-transport-of-lithium-ion-batteries

EUROPE

Product passports: The new trend in EU policymaking

2022-11-22

A central part of the EU's circular economy agenda rests on the introduction of so-called 'digital product passports' that will allow tracking the origin of all materials and components used in the manufacturing process of everyday consumer goods.

In this special report, EURACTIV looks at the European Commission's Ecodesign for sustainable products Regulation and how it will translate in practice for EU consumers and industry.

Read More

Euractiv, 22-11-22

https://www.euractiv.com/section/energy-environment/special_report/product-passports-the-new-trend-in-eu-policymaking/

Major PFAS ban on the horizon: This is what 53 brands think

2023-02-09

How companies view PFAS and the EU's great restriction proposal

The topic of PFAS is more relevant than ever. Due to decades of relentless use, these harmful, persistent chemicals can now be found everywhere: from otters and crayfish to drinking water and teenagers.

An ambitious and extensive EU proposal, aiming to ban the entire group of PFAS chemicals, is now – finally – about to be realised. Although the proposal is riddled with (time-limited) exceptions and the final decision is still a couple of years away, it's high time for the industry to find alternatives to "forever chemicals".

Read More

Chemsec, 09-02-23

https://chemsec.org/publication/chemicals-business/how-companies-view-pfas-and-the-eus-great-restriction-proposal/

CHEMWATCH
Bulletin Board
Regulatory Update
FEB. 17, 2023

UK REACH application for authorisation: publication of final opinion

2023-02-09

The Agency for UK REACH has produced final opinions on the below applications for authorisation.

Reference: AFA005-01

Substance:4-(1,1,3,3-tetramethylbutyl)phenol, ethoxylated (4-tert-OPnEO) (EC: 618-344-0, CAS: 9002-93-1; EC: 618-541-1, CAS: 9036-19-5)

Use:Professional use of 4-(1,1,3,3-tetramethylbutyl)phenol, ethoxylated as a surfactant in the final use of In-Vitro Diagnostic Devices (IVDs) for clinical testing using ARCHITECT, Alinity and ABBOTT PRISM automated analyser systems

HSE sent the final opinion to the Appropriate Authorities on 21 December 2022.

Reference: AFA007-01

Substances:4-(1,1,3,3-tetramethylbutyl)phenol, ethoxylated (OPEO) (EC: 618-344-0, CAS: 9002-93-1; EC: 618-541-1, CAS: 9036-19-5) and 4-Nonylphenol, branched and linear, ethoxylated (NPEO) (EC: 500-024-6, CAS: 9016-45-9)

Use: Use of 4-(1,1,3,3-tetramethylbutyl)phenol, ethoxylated and use of 4-Nonylphenol, branched and linear, ethoxylated in in-vitro diagnostic veterinary products (SNAP tests and ELISA Plate tests) as an ingredient in the wash solutions, sample diluents, control solutions, conjugate solutions, SNAP wash solutions, tissue soaking buffers and detection solutions

HSE sent the final opinion to the Appropriate Authorities on 19 December 2022.

The Defra Secretary of State (SoS) with the consent of the Appropriate Authorities have 6 months from receipt of the final opinions in which to make decisions on whether to grant the authorisations. As we have two applications listed on the bulletin the SoS will be making separate decisions.

Read More

HSE, 09-02-23

https://www.hse.gov.uk/reach/applications-for-authorisation.htm

INTERNATIONAL

Five European Nations, ECHA Propose PFAS Bans/ Restrictions

2023-02-08

As previously reported, Germany, Denmark, the Netherlands, Norway and Sweden submitted a proposal in January 2023 to the European Chemicals Agency (ECHA) to restrict per- and polyfluoroalkyl substances (PFAS) under REACH. Details of the proposal to restrict and/or ban of ~10,000 PFAS have now been published on the ECHA's website.

The proposed restrictions on the manufacture, use and placement of PFAS on the market respond to concerns over environmental exposure and accumulation, as well as potential toxicity to human health. This is due to the water solubility and mobility of PFAS.

"[The restriction] aims to reduce PFAS emissions into the environment and make products and processes safer for people," the ECHA wrote. "All PFAS in the scope of the proposal are very persistent in the environment. If their releases are not minimized, people, plants and animals will be increasingly exposed, and without a restriction, such levels will be reached that have negative effects on people's health and the environment."

Read More

Cosmetics & Toiletries, 08-02-23

https://www.cosmeticsandtoiletries.com/regulations/safety/news/22697777/five-european-nations-echa-propose-pfas-bansrestrictions

ECHA's scientific committees support limiting lead use for outdoor shooting and fishing

2022-11-30

ECHA/NR/22/20

ECHA's Committees for Socio-Economic Analysis and Risk Assessment back the proposed restriction on the use of lead in ammunition for hunting, outdoor sports shooting and in fishing. The restriction could prevent over 600 000 tonnes of lead from being released into the environment, save millions of birds from lead poisoning and protect children in hunter families.

Helsinki, 30 November 2022 – The Committee for Socio-Economic Analysis (SEAC) has adopted its final opinion on the proposed restriction covering the use of lead projectiles for hunting and outdoor sports shooting, as well as lead used in fishing sinkers and lures. The Committee for Risk Assessment (RAC) adopted its opinion on the same proposal in June 2022.

RAC considered that the use of lead in these activities poses risks to wildlife, people and the environment that are not adequately controlled. Both committees agreed that a restriction under the REACH Regulation is the most appropriate EU-wide measure to address the risks. SEAC concluded that the proposed restriction can be considered proportionate after evaluating the costs and benefits to society. It also highlighted that some of the benefits were not quantified but are likely to be significant - for example the benefits of avoiding the poisoning of predatory birds.

María Ottati, the Chair of SEAC says: "We have looked at the impacts of the restriction from many sides, not just the potential costs for shooters and fishers. We have analysed whether hunting as an activity will be affected and expect there to be no long-term drop. We have looked at the availability of shooting ranges for military training, the supply of lead ammunition for non-civilian use and at the economic impacts of installing the proposed lead containment measures at shooting ranges. Based on the available information, we consider the proposed restriction to be proportionate and the most appropriate way of addressing the risks."

RAC has also adopted a supplementary opinion on risks for human health from lead in game meat. This opinion is based on an evaluation of comments and evidence from the public submitted to ECHA during a consultation, which ran from July to October 2022. The consultation focused on data from the European Food Safety Authority (EFSA) that

REACH Update

FEB. 17, 2023

was used in the risk assessment underpinning the proposal. RAC's supplementary opinion confirms the conclusions of the original opinion.

"We have thoroughly looked at EFSA's data again and all the consultation input and consider there to be a moderate to high risk from eating lead-contaminated game meat for children in hunter families. The risks for adults are likely to be low. Overall, RAC supports a transition to more sustainable outdoor shooting and fishing to protect the environment and people's health," says Tim Bowmer, the Chair of RAC.

Both committees make recommendations to modify the conditions of the proposed restriction. Both suggest, for example, that the transition period before the restriction starts applying for lead gunshot in hunting could be shorter than the five years originally proposed. The main recommendations of the committees are available in the Q&A. The combined RAC and SEAC opinion and the RAC's supplementary opinion will be published in early 2023.

Read More

ECHA, 30-11-22

https://echa.europa.eu/-/echa-s-scientific-committees-support-limiting-lead-use-for-outdoor-shooting-and-fishing

Updated advice on testing nanomaterials

2023-02-01

We have released an updated appendix for nanomaterials, which provides guidance on how to obtain data under the new information requirements for nanoforms. This includes information on how to perform environmental testing and advice on preparation methods and testing strategies for physico-chemical testing of nanoforms.

The Partner Expert Group (PEG) members actively contributed to the update.

Read More

ECHA, 01-02-23

https://echa.europa.eu/view-article/-/journal_content/title/9109026-268

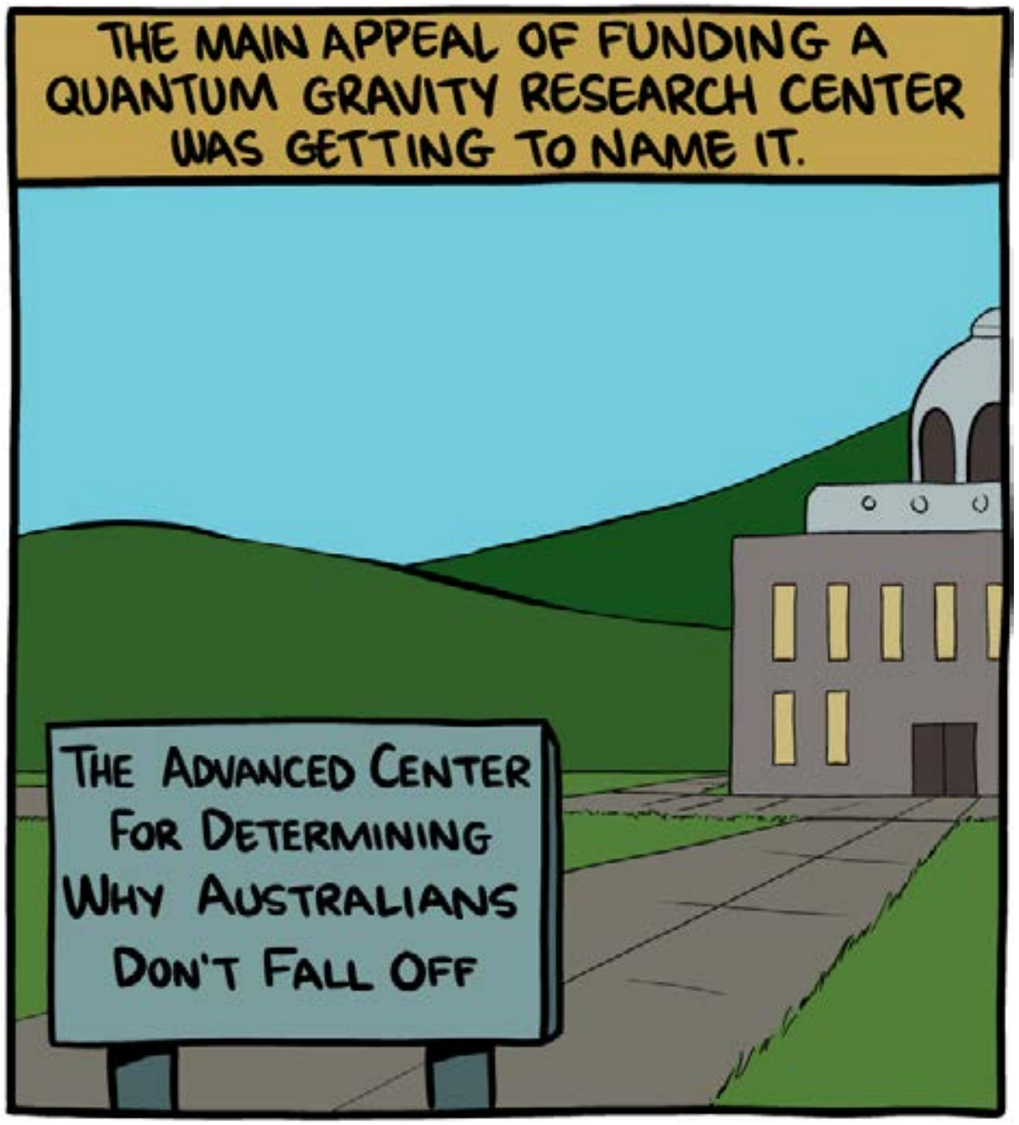
CHEMWATCH
Bulletin Board

Janet's Corner

FEB. 17, 2023

Quantum Gravity

2023-02-17



https://www.smbc-comics.com/comic/quantum-gravity

Nitrobenzene

2023-02-17

Nitrobenzene is an organic compound with the chemical formula $C_6H_5NO_2$. It is a pale yellow oil with an almond-like odour. It freezes to give greenish-yellow crystals. [1] The solid crystals melt at 6 degrees celsius and the liquid boils at 211 degrees celsius. Nitrobenzene is flammable. It dissolves only slightly in water, but mixes well with most organic (carbon-containing) solvents. Nitrobenzene is one of a group of substances known as the volatile organic compounds (VOCs). [2]

USES [1,2]

The main use of Nitrobenzene is to make the important industrial chemical Aniline, which is used in the manufacture of plastics and rubbers, dyes, agrochemicals and petrol additives. Furthermore, nitrobenzene is used in shoe and floor polishes, leather dressings, paint solvents, and other materials to mask unpleasant odours. Redistilled, as oil of mirbane, nitrobenzene has been used as an inexpensive perfume for soaps. A significant merchant market for nitrobenzene is its use in the production of the analgesic paracetamol (also known as acetaminophen).

SOURCES & ROUTES OF EXPOSURE [3]

Sources of Exposure

Exposure can occur in the workplace during its manufacture, processing, and use, or in the environment following releases to air, water, land, and groundwater. Exposure can also occur when people use nitrobenzene-containing paints and polishes.

Routes of Exposure

Nitrobenzene enters the body when people breathe air or consume food or water contaminated with nitrobenzene. It can also be absorbed through skin contact. It does not remain in the body due to its breakdown and removal.

HEALTH EFFECTS [4]

Acute Effects

Acute inhalation, oral, and dermal exposure to nitrobenzene in humans produces methemoglobinemia, in which haemoglobin (which carries

Nitrobenzene is an organic compound with the chemical formula C6H5NO2.

CHEMWATCH
Bulletin Board
Hazard Alert
FEB. 17, 2023

oxygen in the blood) is converted to methemoglobin, resulting in lowering the amount of oxygen released to the tissues of the body. This lowered oxygen capacity is associated with fatigue, weakness, dyspnea, headache, and dizziness. At higher concentrations, depressed respiration, bluish-grey skin, disturbed vision, and coma may occur. Animal studies have reported methemoglobinemia and effects on the liver, kidney, spleen, and central nervous system (CNS) from acute inhalation exposure to nitrobenzene. Tests involving acute exposure of rats have shown nitrobenzene to have moderate acute toxicity from oral exposure.

Chronic Effects

Chronic exposure to nitrobenzene in humans also results in methemoglobinemia. There is also some evidence that the human liver is damaged after chronic inhalation of nitrobenzene. Chronic, inhalation exposure to nitrobenzene in animals results in methemoglobinemia, and effects on the liver and kidney. EPA has calculated (by an alternate method) a provisional Reference Concentration (RfC) of 0.002 milligrams per cubic metre (mg/m3) for nitrobenzene based on haematological, adrenal, renal, and hepatic effects in mice. The Reference Dose (RfD) for nitrobenzene is 0.0005 milligrams per kilogram body weight per day (mg/kg/d) based on haematologic, adrenal, renal, and hepatic lesions in rats and mice.

Reproductive/Developmental Effects

No information is available on the reproductive or developmental effects of nitrobenzene in humans. Developmental effects, such as birth defects or embryotoxic effects, have not been reported in animal studies with inhalation exposure to nitrobenzene. However, reproductive effects, including a decrease in fertility, reduced testicular weights, and decreased sperm production have been noted in inhalation and oral animal studies.

Cancer Risk

EPA has classified nitrobenzene as a Group D, not classifiable as to human carcinogenicity.

ENVIRONMENT EFFECTS [2]

High-level exposure to Nitrobenzene is classed as toxic to wildlife, particularly aquatic life. However, it breaks down quickly in the environment and so only very large releases (resulting from an accidental spill for example) are likely to cause harm. Nitrobenzene is broken down

quickly in the atmosphere. In soil and water, it is readily broken down by micro-organisms. Nitrobenzene is not accumulated by fish or animals, but some plants can take it up and store it. As a VOC, Nitrobenzene may be involved in the formation of ground level ozone, which can damage crops and materials. It is not considered likely that Nitrobenzene pollution has any effects on the global environment.

SAFETY [5]

First Aid Measures

- Eye Contact: Check for and remove any contact lenses. Immediately flush eyes with running water for at least 15 minutes, keeping eyelids open. Cold water may be used. Do not use an eye ointment. Seek medical attention.
- Skin Contact: After contact with skin, wash immediately with plenty of water. Gently and thoroughly wash the contaminated skin with running water and non-abrasive soap. Be particularly careful to clean folds, crevices, creases and groin. Cover the irritated skin with an emollient. If irritation persists, seek medical attention. Wash contaminated clothing before reusing.
- Serious Skin Contact: Wash with a disinfectant soap and cover the contaminated skin with an anti-bacterial cream. Seek immediate medical attention.
- Inhalation: Allow the victim to rest in a well ventilated area. Seek immediate medical attention.
- Serious Inhalation: Evacuate the victim to a safe area as soon as possible. Loosen tight clothing such as a collar, tie, belt or waistband. If breathing is difficult, administer oxygen. If the victim is not breathing, perform mouth-to-mouth resuscitation. Seek medical attention.
- Ingestion: Do not induce vomiting. Examine the lips and mouth to ascertain whether the tissues are damaged, a possible indication that the toxic material was ingested; the absence of such signs, however, is not conclusive. Loosen tight clothing such as a collar, tie, belt or waistband. If the victim is not breathing, perform mouth-to-mouth resuscitation. Seek immediate medical attention.

Exposure Control & Personal Protection

Engineering Controls

Provide exhaust ventilation or other engineering controls to keep the airborne concentrations of vapours below their respective threshold limit

CHEMWATCH
Bulletin Board
Hazard Alert
FEB. 17, 2023

value. Ensure that eyewash stations and safety showers are proximal to the work station location.

Personal Protective Equipment

It is recommended that the following personal protective equipment be used when handling nitrobenzene:

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

Personal Protection in Case of a Large Spill:

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

REGULATION [6,7]

United States

EPA: The Environmental Protection Agency recommends that levels in lakes and streams should be limited to 17 parts of nitrobenzene per million parts of water (17 ppm) to prevent possible health effects from drinking water or eating fish contaminated with nitrobenzene. The EPA requires that discharges, spills, or accidental releases of 1,000 pounds or more of nitrobenzene must be reported to the EPA.

OSHA: The Occupational Safety and Health Administration has set a permissible exposure limit of 5 milligrams nitrobenzene per cubic metre of air (5 mg/m^3) for an 8-hour workday in a 40-hour workweek.

ACGIH & NIOSH: The American Conference of Governmental and Industrial Hygienists and the National Institute for Occupational Safety and

Health also recommend an occupational exposure limit of 5 mg/m^3 for nitrobenzene.

Australia

Safe Work Australia has established a TWA of 5mg/m^3 for nitrobenzene for an 8-hour workday.

REFERENCES

1. http://en.wikipedia.org/wiki/Nitrobenzene
2. http://apps.sepa.org.uk/spripa/Pages/SubstanceInformation.aspx?pid=76
3. http://www.epa.gov/chemfact/nitro-fs.pdf
4. http://www.epa.gov/ttn/atw/hlthef/nitroben.html
5. https://www.sciencelab.com/msds.php?msdsId=9926260
6. http://www.atsdr.cdc.gov/toxfaqs/tf.asp?id=531&tid=95
7. http://www.google.com.au/url?sa=t&rct=j&q=safe%20work%20australia%20exposure%20limits%20for%20nitrobenzene&source=web&cd=2&ved=0CC4QFjAB&url=http%3A%2F%2Fwww.safeworkaustralia.gov.au%2Fsites%2FSWA%2FAboutSafeWorkAustralia%2FWhatWeDo%2FPublications%2FDocuments%2F639%2FWorkplace_Exposure_Standards_for_Airborne_Contaminants.docx&ei=t7OFUMT-K_GhiAfqy4GwBA&usg=AFQjCNFxbRVXcwvV7kIOuJXqga2X0vwBJQ

CHEMWATCH
Bulletin Board

Clue to rising sea levels lies in DNA of 4m-year-old octopus, scientists say

2023-02-05

Deep in the DNA of an Antarctic octopus, scientists may have uncovered a major clue about the future fate of the continent's ice sheet – raising fears global heating could soon set off runaway melting.

Climate scientists have been struggling to work out if the ice sheet collapsed completely during the most recent "interglacial" period about 125,000 years ago, when global temperatures were similar to today.

The ice sheet holds enough water to raise sea levels by 3 to 4 metres with fears that global heating could soon push it towards runaway melting that would lock-in rising sea levels over centuries.

In an ingenious approach, a team of 11 scientists – including biologists, geneticists, glaciologists, computer scientists and ice-sheet modellers – looked at the genetics of Turquet's octopus – a species that has been living around the Antarctic continent for about 4m years.

Genetic samples were taken from 96 octopuses collected over three decades from around the continent.

The octopus DNA carries a memory of its past, including how and when different populations were moving and mixing together, exchanging genetic material.

The scientists say they detected clear signs that, about 125,000 years ago, some octopus populations on opposite sides of the West Antarctic Ice Sheet had mixed together, with the only likely route being a seaway between the south Weddell Sea and the Ross Sea.

"That could only have happened if the ice sheet had completely collapsed," said Dr Sally Lau, a geneticist at James Cook University who led the resarch.

The research is undergoing peer review at a journal but it has been made public, Lau said, because she wanted the scientific community to have early access and because of the urgent nature of the findings.

She said information on the changes in the DNA of the octopus can be used like a clock, allowing her to pinpoint the period when octopuses in the south Weddell Sea and the Ross Sea were mixing.

Scientists say a collapse in the ice sheet more than 100,000 years ago likely made it possible for Turquet's octopus populations to mix together by travelling between the south Weddell Sea and the Ross Sea.

Prof Nick Golledge, a co-author of the research from Victoria University of Wellington in New Zealand, said a major concern was that once the ice sheet reaches a tipping point, the melting becomes "self-sustaining" and would continue for centuries or longer.

He said the route the octopuses are thought to have used is about 1,500 to 2,000 metres below the top of the current ice sheet. That channel would have been about 1,000 metres deep, but shallower nearer the edge.

"It's a sizeable ocean segment and a significant seaway for organisms to traverse," he said.

He said over the past two decades, the rate of ice loss from west Antarctica had been increasing.

According to the most recent UN climate assessment, temperatures during the last interglacial were between 0.5C and 1.5C warmer than the period just before the industrial revolution. Sea levels were between 5 and 10 metres higher than today.

The authors of the octopus research say their findings suggest that even under global heating of 1.5C – the most ambitious goal under the global Paris climate agreement – the West Antarctic Ice Sheet could be consigned to collapse.

Prof Nathan Bindoff, an oceanographer and Antarctic expert at the University of Tasmania, said with sea levels that high scientists strongly suspect a melting West Antarctic Ice Sheet must have contributed to those rising sea levels.

Bindoff, who was not involved in the research, said using octopus DNA was "the last way I would have thought of having evidence of large sea level changes coming from the collapse of the West Antarctic Ice Sheet".

"The loss of that ice sheet would have very real consequences for the whole planet. If this [octopus research] is correct then there are sensitivities in the Earth system that lead to planetary scale sea level rise."

In the most recent UN climate report, Bindoff said one area of the greatest uncertainties on how high sea levels might get related to the West Antarctic Ice Sheet.

He said about 670 million people currently lived in low-lying areas around the world, with a further 65 million in small island states.

CHEMWATCH
Bulletin Board
Gossip
FEB. 17, 2023

He said: "This paper is another piece of evidence that reduces that uncertainty of how this ice sheet has evolved in the past and that is critical for how we think about the future."

Prof Richard Alley, a leading ice sheet expert at Penn State university, said while there was evidence the ice sheet had collapsed millions of years ago, "we still aren't sure whether the ice sheet deglaciated during the most recent interglacial".

He described the octopus research as "interesting and important" and said it strengthened arguments for the loss of the ice sheet during the last interglacial period.

The Guardian, 5 February 2023

https://theguardian.com

Butterfly wings inspire labels for better clothing recycling

2023-02-10

Labels made with inexpensive photonic fibers could improve clothing recycling, researchers report.

Less than 15% of the 92 million tons of clothing and other textiles discarded annually are recycled—in part because they are so difficult to sort.

"It's like a barcode that's woven directly into the fabric of a garment," says Max Shtein, a professor of materials science and engineering at the University of Michigan and corresponding author of the study in Advanced Materials Technologies.

"We can customize the photonic properties of the fibers to make them visible to the naked eye, readable only under near-infrared light or any combination."

Ordinary tags often don't make it to the end of a garment's life—they may be cut away or washed until illegible, and tagless information can wear off. Recycling could be more effective if a tag was woven into the fabric, invisible until it needs to be read. This is what the new fiber could do.

Recyclers already use near-infrared sorting systems that identify different materials according to their naturally occurring optical signatures—the PET plastic in a water bottle, for example, looks different under near-infrared light than the HDPE plastic in a milk jug.

Different fabrics also have different optical signatures, but those signatures are of limited use to recyclers because of the prevalence of blended fabrics, explains lead author Brian Iezzi, a postdoctoral researcher in Shtein's lab.

"For a truly circular recycling system to work, it's important to know the precise composition of a fabric—a cotton recycler doesn't want to pay for a garment that's made of 70% polyester," Iezzi says. "Natural optical signatures can't provide that level of precision, but our photonic fibers can."

To develop the technology, the team combined Iezzi and Shtein's photonic expertise—usually applied to products like displays, solar cells, and optical filters—with the advanced textile capabilities at MIT's Lincoln Lab. The lab worked to incorporate the photonic properties into a process that would be compatible with large-scale production.

They accomplished the task by starting with a preform—a plastic feedstock that comprises dozens of alternating layers. In this case, they used acrylic and polycarbonate. While each individual layer is clear, the combination of two materials bends and refracts light to create optical effects that can look like color. It's the same basic phenomenon that gives butterfly wings their shimmer.

The preform is heated and then mechanically pulled—a bit like taffy—into a hair-thin strand of fiber. While the manufacturing process method differs from the extrusion technique used to make conventional synthetic fibers like polyester, it can produce the same miles-long strands of fiber. Those strands can then be processed with the same equipment already used by textile makers.

By adjusting the mix of materials and the speed at which the preform is pulled, the researchers tuned the fiber to create the desired optical properties and ensure recyclability. While the photonic fiber is more expensive than traditional textiles, the researchers estimate that it will only result in a small increase in the cost of finished goods.

"The photonic fibers only need to make up a small percentage—as little as 1% of a finished garment," Iezzi says. "That might increase the cost of the finished product by around 25 cents—similar to the cost of those use-and-care tags we're all familiar with."

In addition to making recycling easier, the photonic labeling could be used to tell consumers where and how goods are made, and even to verify the

CHEMWATCH
Bulletin Board
Gossip
FEB. 17, 2023

authenticity of brand-name products, Shtein says. It could be a way to add important value for customers.

"As electronic devices like cell phones become more sophisticated, they could potentially have the ability to read this kind of photonic labeling," Shtein says. "So I could imagine a future where woven-in labels are a useful feature for consumers as well as recyclers."

The team has applied for patent protection and is evaluating ways to move forward with the commercialization of the technology.

The National Science Foundation and the Under Secretary of Defense for Research and Engineering funded the work.

Futurity, 10 February 2023

https://futurity.org

New Form of Carbon Discovered – "Opening Up Entirely New Possibilities"

2023-02-12

The most recognized forms of carbon are graphite and diamond, however, there exist other unique nanoscale allotropes of carbon such as graphene and fullerenes. These are sp2 hybridized carbon structures with either zero (flat-shaped) or positive (sphere-shaped) curvatures.

Meanwhile, sp2 hybridized carbon with negative curvature, called "schwarzite", has been proposed theoretically, and its discovery has been a dream of some scientists in the field of carbon materials. It has been learned that carbon can be templated into some of the periodic pores of certain zeolites via vapor deposition but the templating is incomplete due to some pores simply being too narrow. This has thwarted making carbon schwartzites by templating routes.

Recently, a team of researchers from the Center for Multidimensional Carbon Materials within the Institute for Basic Science (IBS), South Korea led by Director Rodney Ruoff and his colleagues at the University of Science and Technology of China led by Professor Yanwu Zhu, reported a discovery of a new form of carbon.

Zhu who led the USCT team said, "Professor Ruoff explained his interest in the triply periodic minimal surfaces that were described by the mathematician Schwartz, and how trivalently bonded carbon can in principle yield identical structures at the mathematical constructs. These

The team envisions potential applications of this new form of carbon in energy harvesting, conversion, and storage, catalyzing the production of chemicals, and separating molecular ions or gases.

are now referred to as "carbon schwarzite" structures, and that also can be called "negative curvature carbon". I told him years ago that this was an exciting research topic and that it might be possible to find ways to collaborate on his suggestion."

This new form of carbon was produced using C60 fullerene (buckminsterfullerene, also called "buckyball molecules") powder, as base material. The C60 was mixed with α-Li3N ("alpha lithium nitride") and then heated to moderate temperatures while holding at one atmosphere of pressure. It was learned that the α-Li3N catalyzed the breaking of some of the carbon-carbon bonds in C60, and new C-C bonds were then formed with neighboring C60 molecules through electron transfer to the C60 molecules.

Ruoff said, "In this particular effort, Prof. Zhu and team at USTC used a potent electron transfer agent (α-Li3N) to drive the formation of a new type of carbon by starting with crystalline fullerene."

Professor Zhu and team named their new carbon, 'long-range ordered porous carbon' (LOPC).

LOPC consists of 'broken C60 cages' that are connected with long-range periodicity. That is, the broken C60 cages are each still centered on the lattice sites of the face-centered cubic lattice, but they have been "opened" to a degree and formed bonds with each other. This is a somewhat unusual situation – there is still long-range periodic order of a certain type, but not every broken C60 cage is identical to its neighbors.

It was found that the formation of the LOPC occurred under narrow temperatures and carbon/Li3N ratio conditions. Heating up to 550 oC with a 5:1 ratio between carbon and Li3N causes partial destruction (breaking of some C-C bonds) of the buckyballs, which resulted in the discovery of the "broken C60 cage" structure that is found in the LOPC.

A milder temperature of 480 oC or lower level of Li3N does not damage the buckyballs, which instead join together to form a "C60 polymer crystal". This crystal decomposes back to individual buckyballs upon reheating. Meanwhile, adding too much Li3N or a harsher temperature above 600 oC resulted in the complete disintegration of the buckyballs.

This new carbon was characterized by a variety of methods, and (indeed) its characterization was not easy because of the variety of slightly different 'broken C60 cages' that nonetheless maintain their positions in a standard face-centered cubic crystal lattice. X-ray diffraction, Raman spectroscopy,

CHEMWATCH
Bulletin Board
Gossip
FEB. 17, 2023

magic-angle spinning solid-state nuclear magnetic resonance spectroscopy, aberration-corrected transmission electron microscopy, and neutron scattering were used to derive an understanding of the structure of this new form of carbon. Numerical simulations based on a neural network type of modeling, combined with the experimental methods mentioned above, show that LOPC is a metastable structure produced during the transformation from 'fullerene-type' to 'graphene-type' carbons.

The "carbon K-edge near-edge X-ray absorption fine structure" data shows a higher degree of delocalization of electrons in LOPC than in C60. The electrical conductivity is found to be $1.17 \times 10{-}2\ S\ cm{-}1$ at room temperature, and conduction at a temperature of less than 30 Kelvin seems to be a combination of metallic-like transport over short distances punctuated by carrier hopping. Knowing these electrical properties is important for elucidating what possible applications there might be for such a new type of carbon.

Ruoff notes, "While this beautiful new type of carbon has many fascinating features, it is not a carbon schwarzite, so that experimental challenge still remains on the horizon! Indeed, this carbon is something different and unique – it opens up entirely new possibilities in new directions for carbon materials."

The preparation of LOPC paves the way for the discovery of other crystalline carbons starting from C60(s) – and perhaps from other fullerenes like C70, C76, C84, and so on. Other exciting options would be including another element. This can be done by starting with the "endohedral" fullerenes such as M@ C60, where M can be an element like lanthanum or many others, which is encapsulated inside the all-carbon fullerene cage.

The team sees possible applications in harvesting, transformation, and storage of energy; in catalysis to generate chemical products; and for the separation of molecular ions or gases. An important aspect also emphasized in their Nature paper is the scalability of the synthesis. Zhu notes that it is readily scalable to a kilogram scale, and with continuous production processes, it may be possible to achieve ton-scale production.

"Yanwu invited me to join the effort after some initial success in synthesis and promising initial steps in their project, and fortunately, I was able to make some helpful suggestions about the science underway and through to completion of this study now published in Nature. Credit for the synthesis and the hands-on experimental studies is entirely due to Yanwu and his team. It was my pleasure to provide some advice on

certain topics, including some analyses to undertake and what might be learned therefrom," Ruoff notes. "Collaboration with colleagues is one of the pleasures of doing science. The topic here was a new form of carbon, perfectly aligned with the interests of our CMCM center that I direct and that is located at UNIST. So, I jumped into the collaboration with excitement, and a great eagerness to try to contribute in useful ways!"

Zhu said, "Professor Ruoff is a legendary scientist in carbon materials and also, simply in general. I was a postdoctoral fellow in his research group for 3 years and 3 months, and during those years I learned a great deal about how to do basic science from him. Indeed, my final years as a postdoc were spent in very close dialogue with him on a daily basis about work that was eventually published in Science, which happened to also be about trivalently bonded carbon based on graphene-like sheets. I and my team were very happy he joined our effort, and he contributed strongly to the science that we have described in our article published in Nature."

Sci Tech Daily, 12 February 2023

https://scitechdaily.com

Blood-filled synthetic skin spares human volunteers itchy bites

2023-02-09

In an effort to understand and help combat insect-borne diseases, many a human has sacrificed an arm in a tank full of mosquitos. Now, thanks to a new artificial skin impregnated with real blood, researchers might be able to spare humans the itchy bites, while gaining an even greater understanding of what makes mosquitoes tick.

The synthetic skin was made out of a hydrogel, the water-rich gummy-like wonder material that's being investigated to do everything from purifying water to replacing human cartilage. It was pioneered by bioengineers at Rice University and 3D-printed at Tulane University's School of Public Health and Tropical Medicine. The hydrogel patches are filled with channels that mimic blood vessels, which can be injected with a variety of liquids, including blood from humans and other species.

To test the system, researchers injected the hydrogels with warm human blood, and placed six patches of them in a plastic box filled with mosquitoes. The box was also outfitted with cameras pointing at each patch of synthetic skin. The team then used a machine-learning model to analyze the video footage and identify whether or not particular

The synthetic skin was made out of a hydrogel, the water-rich gummy-like wonder material that's being investigated to do everything from purifying water to replacing human cartilage.

CHEMWATCH
Bulletin Board
Gossip
FEB. 17, 2023

mosquitos had fed on the blood inside the hydrogels or not. The program was effective at distinguishing between the two mosquito states 92.5% of the time.

Next, the researchers coated some hydrogels in the popular repellent DEET, others in a plant-based repellent, and left some of them uncoated. They found that in the tank with uncoated patches of synthetic skin, 13.8% of the mosquitos fed on the blood. Even though this is a fairly low rate, the researchers believe it might simply be an issue of scaling up the size of the patches to encourage more feeding behavior. Another possibility they propose is heating the hydrogels in addition to the blood, as mosquitoes are attracted to warm surfaces.

In the tanks where the DEET and the plant-based repellents were used, none of the mosquitos fed.

"It's a huge game changer," said Dawn Wesson, associate professor of tropical medicine at Tulane's School of Public Health and Tropical Medicine. "If we can study how they (mosquitoes) feed, what they do in the process of feeding, we can better understand their potential for transmitting diseases and possibly do things to stop them from feeding."

The researchers say their breakthrough can allow labs to do more experiments at a reduced cost, as they won't need to hire study participants or purchase test animals. They also say the development could bring a more standardized approach to infectious disease transmission testing.

"It provides a consistent and controlled method of observation," said Omid Veiseh, the study's corresponding author and an assistant professor of bioengineering at Rice. "The hope is researchers will be able to use that to identify ways to prevent the spread of disease in the future."

Although the hydrogel and machine learning system is already in use in Wesson's lab to study the transmission of dengue, a possible future step would be using the artificial skin patches in the wild, and tuning the fluids inside the hydrogels to take a look at how mosquitoes who feed on other species behave. The team may also look at studying other mosquito species.

"All of the experiments used lab strains of mosquitoes, and the majority involved one particular species: Aedes aegypti, the vector of the yellow fever virus, dengue virus, Zika virus, and others," Wesson told Frontiers Science News. "It may take time to optimize our experimental platform and

machine learning model to study other species. Also, since the behavior of laboratory strains sometimes differs from that of mosquitoes found in the wild, it would be important to validate our results on wild mosquito populations."

"Overall, our results suggest that our experimental platform could be scaled up and adapted to screen different compounds for their effects on mosquitoes," added Veiseh.

New Atlas, 9 February 2023

https://newatlas.com

Revolutionizing the Future of Energy: Advancement in Halide Perovskite Solar Cell Technology

2023-02-11

A new type of solar technology has seemed promising in recent years. Halide perovskite solar cells are both high-performing and low-cost for producing electrical energy – two necessary ingredients for any successful solar technology of the future. But new solar cell materials should also match the stability of silicon-based solar cells, which boast more than 25 years of reliability.

In newly published research, a team led by Juan-Pablo Correa-Baena, assistant professor in the School of Materials Sciences and Engineering at Georgia Tech, shows that halide perovskite solar cells are less stable than previously thought. Their work reveals the thermal instability that happens within the cells' interface layers, but also offers a path forward toward reliability and efficiency for halide perovskite solar technology. Their research, published as the cover story for the journal Advanced Materials in December 2022, has immediate implications for both academics and industry professionals working with perovskites in photovoltaics, a field concerned with electric currents generated by sunlight.

Lead halide perovskite solar cells promise superior conversion of sunlight into electrical power. Currently, the most common strategy for coaxing high conversion efficiency out of these cells is to treat their surfaces with large positively charged ions known as cations.

These cations are too big to fit into the perovskite atomic-scale lattice, and, upon landing on the perovskite crystal, change the material's structure at the interface where they are deposited. The resulting atomic-scale defects limit the efficacy of current extraction from the solar cell. Despite

Halide perovskite solar cells are both high-performing and low-cost for producing electrical energy – two necessary ingredients for any successful solar technology of the future.

CHEMWATCH
Bulletin Board
Gossip
FEB. 17, 2023

awareness of these structural changes, research on whether the cations are stable after deposition is limited, leaving a gap in understanding of a process that could impact the long-term viability of halide perovskite solar cells.

"Our concern was that during long periods of solar cell operation the reconstruction of the interfaces would continue," said Correa-Baena. "So, we sought to understand and demonstrate how this process happens over time."

To carry out the experiment, the team created a sample solar device using typical perovskite films. The device features eight independent solar cells, which enables the researchers to experiment and generate data based on each cell's performance. They investigated how the cells would perform, both with and without the cation surface treatment, and studied the cation-modified interfaces of each cell before and after prolonged thermal stress using synchrotron-based X-ray characterization techniques.

First, the researchers exposed the pre-treated samples to 100 degrees Celsius for 40 minutes, and then measured their changes in chemical composition using X-ray photoelectron spectroscopy. They also used another type of X-ray technology to investigate precisely what type of crystal structures form on the film's surface. Combining the information from the two tools, the researchers could visualize how the cations diffuse into the lattice and how the interface structure changes when exposed to heat.

Next, to understand how the cation-induced structural changes impact solar cell performance, the researchers employed excitation correlation spectroscopy in collaboration with Carlos Silva, professor of physics and chemistry at Georgia Tech. The technique exposes the solar cell samples to very fast pulses of light and detects the intensity of light emitted from the film after each pulse to understand how energy from light is lost. The measurements allow the researchers to understand what kinds of surface defects are detrimental to performance.

Finally, the team correlated the changes in structure and optoelectronic properties with the differences in the solar cells' efficiencies. They also studied the changes induced by high temperatures in two of the most used cations and observed the differences in dynamics at their interfaces.

"Our work revealed that there is concerning instability introduced by treatment with certain cations," said Carlo Perini, a research scientist in Correa-Baena's lab and the first author of the paper. "But the good news is

that, with proper engineering of the interface layer, we will see enhanced stability of this technology in the future."

The researchers learned that the surfaces of metal halide perovskite films treated with organic cations keep evolving in structure and composition under thermal stress. They saw that the resulting atomic-scale changes at the interface can cause a meaningful loss in power conversion efficiency in solar cells. In addition, they found that the speed of these changes depends on the type of cations used, suggesting that stable interfaces might be within reach with adequate engineering of the molecules.

"We hope this work will compel researchers to test these interfaces at high temperatures and seek solutions to the problem of instability," Correa-Baena said. "This work should point scientists in the right direction, to an area where they can focus in order to build more efficient and stable solar technologies."

Sci Tech Daily, 11 February 2023

https://scitechdaily.com

Cancer Conundrum Solved: Researchers Unravel a Population of 'Cheating' Cells

2023-02-08

Scientists at the University of Connecticut Health, Yale University, and Johns Hopkins University have discovered that certain cancer cells possess the ability to evade limitations caused by oxygen deprivation, enabling the cancer cells to continue to grow.

The findings were recently published in the journal Cell Systems. The research was led by Kshitiz, an assistant professor in the Department of Biomedical Engineering, in collaboration with scientists Chi V. Dang from Johns Hopkins and Andre Levchenko from Yale.

Nearly a decade ago, the researchers observed a strange phenomenon while looking at cancer cells under hypoxia—or a lack of oxygen.

"As tumors grow and become large, they run out of oxygen and new blood vessels are created," says Kshitiz. "This results in scarcity of oxygen, called hypoxia. Under hypoxia, cells are supposed to slow down their growth, but of course, cancers continue to grow larger. This presents a conundrum, yet unsolved."

The study provides answers to multiple conundrums about cancer, while also uncovering new areas for further research.

CHEMWATCH
Bulletin Board
Gossip
FEB. 17, 2023

The researchers determined that a small number of cells were "cheating"—or rewiring their signaling to allow them to divide and grow. Solving the mystery of how the cells were cheating—and how this phenomenon applied to cancer diagnoses— soon became a focus of the researchers' work.

Under hypoxia, cells stabilize a protein called HIF-1, which is a master regulator of oxygen response in the cells. When oxygen goes down, HIF-1 signaling becomes high and takes the cells to a non-functioning state. HIF-1 directs the cell division machinery to stop working, jump-starts anaerobic respiration using a large quantity of glucose, and makes cells secrete proteins to bring blood vessels toward themselves.

In the study, the researchers noted that a small percentage of cells did not stabilize HIF-1, but instead oscillated the protein—moving it up and down. As HIF-1 oscillated and went from up to down to up again, cells could escape the HIF-1—imposed pause. In this way, these oscillating cells cheated and continue to divide, despite very low oxygen levels.

"To find cheaters within a population of cancer cells, which are themselves cheating the normal cells, is interesting at so many levels," Kshitiz says.

"We have observed oscillations in many systems, but oscillations in HIF-1 activity were not recorded before, and it is truly remarkable," Levchenko adds. "We are particularly interested in how oscillations like these can be recognized as a signal triggering specific genes."

Additionally, researchers found that the cancer cells communicate with each other, allowing cells to sense other cells' density. When HIF-1 is high because of hypoxia, cells produce energy without oxygen. A byproduct is lactate, the same molecule that gives us cramps during exercise if the muscles are not well-oxygenated. Cancers accumulate a lot of lactate in their environment. Kshitiz worked with researcher Junaid Afzal at the University of California San Francisco to work out the detailed mechanism that caused lactate to destabilize HIF-1.

"Excess lactate forces cells to undergo respiration, even when oxygen is scarce, and that caused degradation of HIF-1 in lysosomes, the recycling centers in a cell," says Afzal.

However, questions remain—are these observations under a microscope meaningful in real cases of cancer? Current technologies do not offer an effective way to test these predictions in animal subjects—let alone human subjects.

Kshitiz, along with Yasir Suhail, a postdoctoral student in Kshitiz's lab at UConn Health, used this newfound information and looked at the genetic makeup of different cancers that occur in humans.

"What we found was truly astounding," says Kshitiz. "Most genes behaved as expected, but there was a group of genes which behaved opposite to what is expected in hypoxia. It did not make much sense; why should genes which turn on in hypoxia, turn off when hypoxia is oscillating? Clearly, something is at play."

To understand further, Suhail looked at these genes in all human cancers and found a universal phenomenon. The genes that were turned off by oscillations were turned off in most cancers—showing that the oscillation in HIF-1 levels could possibly decrease tumor suppressor genes and contribute to cancer growth in most cancers.

Kshitiz says, "The most interesting aspect is the universality of the phenomenon in all cancers. It seems this effect is pan-cancer, and not just in any cancer."

The research—unraveling this unique phenomenon— answers several conundrums about cancer, while opening new lines of scientific inquiry.

"It is a large collaboration across many institutions, a testament to how deep scientific questions require the integration of many types of expertise to come together," says Kshitiz.

Sci Tech Daily, 8 February 2023

https://scitechdaily.com

"Dangerously Powerful" Laser Experiment Sets Record in University Hallway

2023-02-13

It's not at every university that laser pulses powerful enough to burn paper and skin are sent blazing down a hallway. But that's what happened in UMD's Energy Research Facility, an unremarkable looking building on the northeast corner of campus. If you visit the utilitarian white and gray hall now, it seems like any other university hall—as long as you don't peak behind a cork board and spot the metal plate covering a hole in the wall.

But for a handful of nights in 2021, UMD Physics Professor Howard Milchberg and his colleagues transformed the hallway into a laboratory: The shiny surfaces of the doors and a water fountain were covered to

Their efforts were to temporarily transfigure thin air into a fiber optic cable—or, more specifically, an air waveguide—that would guide light for tens of meters.

CHEMWATCH
Bulletin Board
Gossip
FEB. 17, 2023

avoid potentially blinding reflections; connecting hallways were blocked off with signs, caution tape, and special laser-absorbing black curtains; and scientific equipment and cables inhabited normally open walking space.

As members of the team went about their work, a snapping sound warned of the dangerously powerful path the laser blazed down the hall. Sometimes the beam's journey ended at a white ceramic block, filling the air with louder pops and a metallic tang. Each night, a researcher sat alone at a computer in the adjacent lab with a walkie-talkie and performed requested adjustments to the laser.

Their efforts were to temporarily transfigure thin air into a fiber optic cable—or, more specifically, an air waveguide—that would guide light for tens of meters. Like one of the fiber optic internet cables that provide efficient highways for streams of optical data, an air waveguide prescribes a path for light. These air waveguides have many potential applications related to collecting or transmitting light, such as detecting light emitted by atmospheric pollution, long-range laser communication or even laser weaponry. With an air waveguide, there is no need to unspool solid cable and be concerned with the constraints of gravity; instead, the cable rapidly forms unsupported in the air. In a paper accepted for publication in the journal Physical Review X the team described how they set a record by guiding light in 45-meter-long air waveguides and explained the physics behind their method.

The researchers conducted their record-setting atmospheric alchemy at night to avoid inconveniencing (or zapping) colleagues or unsuspecting students during the workday. They had to get their safety procedures approved before they could repurpose the hallway.

"It was a really unique experience," says Andrew Goffin, a UMD electrical and computer engineering graduate student who worked on the project and is a lead author on the resulting journal article. "There's a lot of work that goes into shooting lasers outside the lab that you don't have to deal with when you're in the lab—like putting up curtains for eye safety. It was definitely tiring."

All the work was to see to what lengths they could push the technique. Previously Milchberg's lab demonstrated that a similar method worked for distances of less than a meter. But the researchers hit a roadblock in extending their experiments to tens of meters: Their lab is too small and moving the laser is impractical. Thus, a hole in the wall and a hallway becoming lab space.

"There were major challenges: the huge scale-up to 50 meters forced us to reconsider the fundamental physics of air waveguide generation, plus wanting to send a high-power laser down a 50-meter-long public hallway naturally triggers major safety issues," Milchberg says. "Fortunately, we got excellent cooperation from both the physics and from the Maryland environmental safety office!"

Without fiber optic cables or waveguides, a light beam—whether from a laser or a flashlight—will continuously expand as it travels. If allowed to spread unchecked, a beam's intensity can drop to un-useful levels. Whether you are trying to recreate a science fiction laser blaster or to detect pollutant levels in the atmosphere by pumping them full of energy with a laser and capturing the released light, it pays to ensure efficient, concentrated delivery of the light.

Milchberg's potential solution to this challenge of keeping light confined is additional light—in the form of ultra-short laser pulses. This project built on previous work from 2014 in which his lab demonstrated that they could use such laser pulses to sculpt waveguides in the air.

The short pulse technique utilizes the ability of a laser to provide such a high intensity along a path, called a filament, that it creates a plasma—a phase of matter where electrons have been torn free from their atoms. This energetic path heats the air, so it expands and leaves a path of low-density air in the laser's wake. This process resembles a tiny version of lighting and thunder where the lightning bolt's energy turns the air into a plasma that explosively expands the air, creating the thunderclap; the popping sounds the researchers heard along the beam path were the tiny cousins of thunder.

But these low-density filament paths on their own weren't what the team needed to guide a laser. The researchers wanted a high-density core (the same as internet fiber optic cables). So, they created an arrangement of multiple low-density tunnels that naturally diffuse and merge into a moat surrounding a denser core of unperturbed air.

The 2014 experiments used a set arrangement of just four laser filaments, but the new experiment took advantage of a novel laser setup that automatically scales up the number of filaments depending on the laser energy; the filaments naturally distribute themselves around a ring.

The researchers showed that the technique could extend the length of the air waveguide, increasing the power they could deliver to a target at the end of the hallway. At the conclusion of the laser's journey, the waveguide

CHEMWATCH
Bulletin Board
Gossip
FEB. 17, 2023

had kept about 20% of the light that otherwise would have been lost from their target area. The distance was about 60 times farther than their record from previous experiments. The team's calculations suggest that they are not yet near the theoretical limit of the technique, and they say that much higher guiding efficiencies should be easily achievable with the method in the future.

"If we had a longer hallway, our results show that we could have adjusted the laser for a longer waveguide," says Andrew Tartaro, a UMD physics graduate student who worked on the project and is an author on the paper. "But we got our guide right for the hallway we have."

The researchers also did shorter eight-meter tests in the lab where they investigated the physics playing out in the process in more detail. For the shorter test they managed to deliver about 60% of the potentially lost light to their target.

The popping sound of the plasma formation was put to practical use in their tests. Besides being an indication of where the beam was, it also provided the researchers with data. They used a line of 64 microphones to measure the length of the waveguide and how strong the waveguide was along its length (more energy going into making the waveguide translates to a louder pop).

The team found that the waveguide lasted for just hundredths of a second before dissipating back into thin air. But that's eons for the laser bursts the researchers were sending through it: Light can traverse more than 3,000 km in that time.

Based on what the researchers learned from their experiments and simulations, the team is planning experiments to further improve the length and efficiency of their air waveguides. They also plan to guide different colors of light and to investigate if a faster filament pulse repetition rate can produce a waveguide to channel a continuous high-power beam.

"Reaching the 50-meter scale for air waveguides literally blazes the path for even longer waveguides and many applications", Milchberg says. "Based on new lasers we are soon to get, we have the recipe to extend our guides to one kilometer and beyond."

Sci Tech Daily, 13 February 2023

https://scitechdaily.com

The unexpected discovery of a mass grave of red crabs 4,000 meters below the ocean's surface is puzzling scientists—and raising questions about the ecology of the deep sea.

Millions of dead crabs ended up in the deep sea. Scientists still aren't sure why.

2023-02-10

In 2015, scientists surveying a protected area of seafloor in the Pacific Ocean's Clarion-Clipperton Zone (CCZ), a region known for its high concentration of the polymetallic nodules sought after by would-be deep-sea miners, came across an eerie sight: a mass grave of millions of red crabs. This many dead crabs in one place is shocking enough, but at a depth of 4,000 meters, it was a baffling find.

"It took us three or four days to actually realize that these are pelagic crabs"—animals that are supposed to be much nearer the surface—says Erik Simon-Lledó, the lead author of a paper documenting the find and a marine biologist at the United Kingdom's National Oceanography Centre. "It is a bit embarrassing, but it [was] so unexpected. Nobody had heard of such a massive deposition in the abyss."

While red crabs are abundant in the eastern Pacific and are noteworthy for washing up en masse on beaches in California and Baja California, Mexico, finding them at such depth in such numbers is unheard of. Even more bizarre, the grave was 1,500 kilometers offshore. This is so far from the crabs' spawning areas off the northwestern United States that it would have taken the current at least a year to push them to the point where they eventually sank.

So many crabs drifting far offshore and sinking to the seafloor would have attracted droves of hungry predators and scavengers, so the scientists aren't sure how the crabs remained relatively intact. Most creatures on the abyssal seafloor feed on the tiny bits of waste that fall from the surface, making these crabs, in comparison, a fantastic dinner. "Get your forks, mates, we have quality dinner now," says Simon-Lledó with a laugh.

The researchers suspect the sheer number of crabs involved has something to do with it. Millions of crabs descending to the seafloor are simply too many to be eaten. "Swarms can have millions and millions of crabs, especially when there are perfect conditions for their development, like algal blooms or different climatic events," explains Simon-Lledó.

The scientists can't say whether this mass "crab fall" is just a one-off coincidence or a periodic event. Masses of millions of dead crabs do wash up on beaches every couple of years, so in principle the same could be happening in the abyss but has gone unnoticed until now. That's Simon-Lledó's preferred interpretation, which is supported by the fact that there

CHEMWATCH
Bulletin Board
Gossip
FEB. 17, 2023

were two to three times more scavengers in the crab graveyard than in the rest of the scientists' survey area in the CCZ.

The researchers calculate that this single event represents one and a half times the carbon flux that the area would normally get in a whole year. The excess carbon will eventually make its way into the food web, supporting a richer ecosystem than we would typically imagine existing here—an ecosystem where deep-sea mining could do a great deal of damage.

The area where Simon-Lledó and his colleagues found the crabs is not being eyed for mining. But Amanda Ziegler, a researcher at UiT the Arctic University of Norway who was not involved in the study, says it is the same kind of habitat as other areas in the CCZ that do have claims for deep-sea mining. "So it is possible that this kind of crab fall [has] occurred somewhere that might also be a claim area, but that's hard to say since it's so difficult to assess such a big area," she says.

Trips to the deep sea are expensive, and funding bodies often prioritize mapping a new area over returning to one that is already mapped. So the research team has not been able to return to see the aftermath of the crab fall or to see whether there have been more depositions.

"Our paper shows that there is more environmental variability than we would think in abyssal areas," says Simon-Lledó. "It also shows how little we know about this environment that we will potentially be mining in a few years."

Popular Science, 10 February 2023

https://popsci.com

AI supports doctors' hard decisions on cardiac arrest

2023-02-13

One of these decision support tools (SCARS-1), now published, is downloadable free of charge from the Gothenburg Cardiac Arrest Machine Learning Studies website. However, results from the algorithm need to be interpreted by people with the right skills. AI-based decision support is expanding strongly in many areas of health care, and extensive discussions are underway on how care services and patients alike can benefit most from it.

The app accesses data from the Swedish Cardiopulmonary Resuscitation Register on tens of thousands of patient cases. The University of Gothenburg researchers have used an advanced form of machine learning

When patients receive care after cardiac arrest, doctors can now -- by entering patient data in a web-based app -- find out how thousands of similar patients have fared.

to teach clinical prediction models to recognize various factors that have affected previous outcomes. The algorithms take into account numerous factors relating, for example, to the cardiac arrest, treatment provided, previous ill-health, medication, and socioeconomic status.

New evidence-based methods

It will be a few years before official recommendations for cardiac arrest are likely to include AI-based decision support, but doctors are free to use these prediction models and other new, evidence-based methods. The research group working on decision support for cardiac arrest is headed by Araz Rawshani, a researcher at the University's Sahlgrenska Academy and resident physician in cardiology at Sahlgrenska University Hospital.

"Both I and several of my colleagues who treat emergency patients with cardiac arrest have already started using the prediction models as part of our process for deciding on the level of care. The answer from these tools often means we get confirmation of views we've already arrived at. Still, it helps us not to subject patients to painful treatment that is very unlikely to be of benefit to the patient, while saving care resources," Rawshani says.

Highly accurate

To date, the research group has published two decision support tools. One clinical prediction model, known as SCARS-1, is presented in The Lancet's eBioMedicine journal. This model indicates whether a new patient case resembles other, previous cases where, 30 days after their cardiac arrest, patients had survived or died. The model's accuracy is unusually high. Based on the ten most significant factors alone, the model has a sensitivity of 95 percent and a specificity of 89 percent. The "AUC-ROC value" (ROC being the receiver operating characteristic curve for the model and AUC the area under the ROC curve) for this model is 0.97. The highest possible AUC-ROC value is 1.0 and the threshold for a clinically relevant model is 0.7.

One piece of the puzzle

This decision support was developed by Fredrik Hessulf, a doctoral student at Sahlgrenska Academy, University of Gothenburg, and anesthesiologist at Sahlgrenska University Hospital/Mölndal.

"This decision support is one of several pieces in a big puzzle: the doctor's overall assessment of a patient. We have many different factors to consider in deciding whether to go ahead with cardiopulmonary resuscitation. It's a highly demanding treatment that we should give only to patients who will

CHEMWATCH
Bulletin Board
Gossip
FEB. 17, 2023

benefit from it and be able, after their hospital stay, to lead a life of value to themselves," Hessulf says.

This form of support is based on 393 factors affecting patients' chances of surviving their cardiac arrest for 30 days after the event. The model's high accuracy may be explained by the huge number of patient cases (roughly 55,000) on which the algorithm is based and the fact that ten of the nearly 400 factors have been found to impact heavily on survival. By far the most important factor was whether the heart regained a viable cardiac rhythm again after the patient's admission to the emergency department.

Risk of new cardiac arrest

The second decision support tool published has been presented in the journal Resuscitation. This tool is based on data from patients who survived their out-of-hospital cardiac arrest until they were discharged from hospital. The predictive models are based on 886 factors in 5098 patient cases from the Swedish Cardiopulmonary Resuscitation Register. This tool is partly aimed at helping doctors identify which patients are at risk of another cardiac arrest or death within a year of discharge from hospital following their cardiac arrest. It also aims to highlight which factors are important for long-term survival after cardiac arrest -- an aspect of the subject area that has not been well studied.

"The accuracy of this tool is reasonably good. It can predict with about 70 percent reliability whether the patient will die, or will have had another cardiac arrest, within a year. Like Fredrik's tool, this one has the advantage that just a few factors can predict outcome almost as well as the model with several hundred variables," says Gustaf Hellsén, the research doctor who developed this decision support tool.

"We hope," he continues, "to succeed in developing this prediction model, so as to enhance its precision. Today, it can already serve as support for doctors in identifying factors with an important bearing on survival among cardiac arrest patients who are to be discharged from hospital."

Science Daily, 13 February 2023

https://sciencedaily.com

Creating 3D objects with sound

2023-02-13

Additive manufacturing or3D printing enables the fabrication of complex parts from functional or biological materials. Conventional 3D printing

Scientists assemble matter in 3D using sound waves for 3D printing.

can be a slow process, where objects are constructed one line or one layer at a time. Researchers in Heidelberg and Tübingen now demonstrate how to form a 3D object from smaller building blocks in just a single step. "We were able to assemble microparticles into a three-dimensional object within a single shot using shaped ultrasound," says Kai Melde, postdoc in the group and first author of the study. "This can be very useful for bioprinting. The cells used there are particularly sensitive to the environment during the process," adds Peer Fischer, Professor at Heidelberg University.

Sound waves exert forces on matter -- a fact that is known to any concert goer who experiences the pressure waves from a loudspeaker. Using high-frequency ultrasound, which is inaudible to the human ear, the wavelengths can be pushed below a millimeter into the microscopic realm, which is used by the researcher to manipulate very small building blocks, like biological cells.

In their previous studies Peer Fischer and colleagues showed how to form ultrasound using acoustic holograms -- 3D-printed plates, which are made to encode a specific sound field. Those sound fields, they demonstrated, can be used to assemble materials into two-dimensional patterns. Based on this the scientists devised a fabrication concept.

Acoustic field catches particles

With their new study the team was able to take their concept a step further. They capture particles and cells freely floating in water and assemble them into three-dimensional shapes. On top of that, the new method works with a variety of materials including glass or hydrogel beads and biological cells. First author Kai Melde says that "the crucial idea was to use multiple acoustic holograms together and form a combined field that can catch the particles." Heiner Kremer, who wrote the algorithm to optimize the hologram fields, adds: "The digitization of an entire 3D object into ultrasound hologram fields is computationally very demanding and required us to come up with a new computation routine."

The scientists believe that their technology is a promising platform for the formation of cell cultures and tissues in 3D. The advantage of ultrasound is that it is gentle for using biological cells and that it can travel deep into

CHEMWATCH
Bulletin Board
Gossip
FEB. 17, 2023

tissue. This way it can be used to remotely manipulate and push cells without harm.

Science Daily, 13 February 2023

https://sciencedaily.com

Are reusable takeout boxes worth the resources needed to make them?

2023-02-10

Since 2019, customers of almost 150 participating restaurants across New York City have had the option of receiving their takeout and delivery orders in returnable, reusable food containers thanks to DeliverZero. The third-party delivery service intends to reduce plastic waste, one reusable container at a time.

The convenience of takeaway food in today's fast-paced, modern lifestyles might explain why the global market is estimated to reach $120.43 billion this year. However, as the founder of DeliverZero realized, the increasing reliance on to-go meals is not good for the environment. Plastic bags, food containers, cutlery, and other take-out items dominate global litter in most major aquatic environments around the globe.

In some cases, consumers are encouraged to bring reusable alternatives to minimize the waste generated by single-use takeaway containers. But the manufacture of reusable alternatives, because they need to be durable enough to withstand multiple uses, may use more energy and generate more greenhouse gasses (GHG) than the production of single-use ones.

That comparison—whether reusable takeout containers are always more sustainable than single-use ones—is answered by a new study. Reusable containers generally have lower impacts across most metrics than comparable single-use containers, according to a recent Resources, Conservation, and Recycling report. This research quantified environmental performance across different metrics, such as end-of-life waste, greenhouse gas (GHG) emissions, primary energy usage, and water consumption.

"From a waste perspective, reusable containers are more environmentally preferable even when containers are used only four times," says Christian Hitt, a graduate student from the University of Michigan and Center for Sustainable Systems research assistant who was an author of the study. However, it doesn't just come down to the number of times you reuse the container. Many factors need to be considered when assessing whether a product is environmentally preferable over an alternative, he adds.

Transportation, washing, and other elements

Customer behavior can influence how sustainable a container is. For example, if only 5 percent of customers travel to the restaurant solely to return used containers, then the reusable system would have higher life cycle GHG emissions and primary energy use than single-use containers, the study found.

Multiple-use containers aren't automatically the more sustainable option.

It was also common for customers to wash the container to some extent before returning it to the restaurant, the authors observed. This can be excessive since restaurants must still wash the container themselves before reusing it, says Hitt. If all customers ran the reusable container through the dishwasher before returning it, the life cycle energy impacts could be equal to or more than that of a single-use container. The washing method, water heater type, and electricity grid of the customer all factor in.

Individuals are recommended to follow the best practices with washing and transportation, says Hitt. For example, it's better to scrape or rinse the reusable container with minimal cold water, as opposed to hand- or machine-washing. Returning the container with low-impact transportation, or only returning it when purchasing another meal or when the drop-off is along an already planned route, is also advisable, he adds.

The material composition of a takeout container is crucial, too. The authors considered the material type, like polypropylene (PP), polylactic acid (PLA), and aluminum, in their study. "PLA containers require high water consumption relative to other containers," says Hitt. Containers also vary in GHG emissions due to differences in their production and disposal, he adds.

A 2019 Journal of Cleaner Production study similarly conducted a life-cycle assessment of four different takeout containers: single-use aluminum, expanded polystyrene (EPS), PP, and reusable PP. The authors found that single-use EPS containers are the best option when compared to reusable PP takeaway containers, because their manufacture uses fewer materials and less electricity. Reusable PP takeaway containers and "Tupperware" food savers would have to be reused three to 39 times and 16 to 208 times, respectively, to become a better option than EPS containers.

The number of reuses matters because it determines how many single-use containers were displaced over the life of the reusable container, says Alejandro Gallego Schmid, senior lecturer in Circular Economy and Life Cycle Sustainability Assessment at the University of Manchester, who was involved in the 2019 study. But single-use EPS containers have a major flaw: They are not usually recycled, because it is costly to do so, he adds, which means they cannot be considered a sustainable option.

Rules for restaurants and patrons

People who are conscious about making sustainable choices may reuse their own containers, but that's not the same for all consumers. Therefore, says Gallego Schmid, restaurants and policymakers must make it easier for everyone to reuse and return containers.

Hitt agrees. "Restaurants should look into implementing reusable systems as this can reduce their environmental impact as well as foodware costs," he says. "Implementing incentives such as discounts when returning containers could increase participation."

The restaurant chain Just Salad currently has two reusable bowl programs. In the first one, MyBowl, you can purchase a reusable bowl and receive a free topping every time you reuse it for in-store orders. With the second program, BringBack, you may opt to receive your meal in a green reusable bowl that you can return to participating drop-off locations. For the whole month of February, they are offering salads at a discounted price across all locations for customers who reuse their bowls for in-store purchases.

Meanwhile, lawmakers can ban or tax the use of single-use plastics and also provide grant money to fund reusable container programs. One way to allocate money this way is through a solid waste disposable tax (which is collected per ton of trash delivered to a dump) that could fund circular economy programs, says Hitt.

Outlawing certain carryout items can be effective, too. At least eight states have a ban on single-use plastic bags. Vermont goes even further with a more comprehensive plastics ban, which includes plastic straws, plastic stirrers, and EPS food and beverage containers.

Exploring alternatives to common takeaway containers is crucial, especially given the plastic crisis, says Gallego Schmid. A rigorous analysis of the environmental impacts of different takeout container materials is necessary, he adds, so consumers can be informed of what they use as they eat.

Popular Science, 10 February 2023

https://popsci.com

CHEMWATCH
Bulletin Board
Curiosities
FEB. 17, 2023

Cockatoos know to bring along multiple tools when they fish for cashews

2023-02-10

Goffin's cockatoos have been added to the short list of non-human animals that use and transport toolsets. In a study publishing in the journal Current Biology on February 10, researchers show that the cockatoos carry multiple tools to their worksite when the job calls for it. This behavior has only been previously reported in chimpanzees, our closest relatives.

Goffin's cockatoos are small white parrots that hail from the Tanimbar Islands archipelago in Indonesia. Captive Goffin's cockatoos use and manufacture tools, and a previous study of wild-caught cockatoos reported that they can use up to three different tools to extract seeds from a particular fruit. Up until now, though, it wasn't clear whether the cockatoos considered these tools as a "set"; it's possible that what may look like a toolset is instead nothing more than a chain of single tool uses, with the need for each new tool appearing to the animal as the task evolves.

Now, a team of researchers have used controlled experiments to clarify that the cockatoos do indeed recognize when a job requires more than one tool. "With this experiment we can say that, like chimpanzees, Goffin's cockatoos not only appear to be to using toolsets, but they know that they are using toolsets," says first author Antonio Osuna-Mascaró, an evolutionary biologist at the University of Veterinary Medicine Vienna. "Their flexibility of behavior is stunning."

Osuna-Mascaró was inspired by the termite-fishing Goualougo Triangle chimpanzees of northern Congo, the only other known non-human animal to use toolsets. These chimpanzees fish for termites via a two-step process: first, they use a blunt stick to break holes in the termite mound, and then they insert a long, flexible probe to "fish" the termites out of the holes. In this study, Osuna-Mascaró's team tasked the cockatoos with fishing for cashews instead of termites.

To mimic the termite-fishing set-up, the researchers presented the cockatoos with a box containing a cashew behind a transparent paper membrane. To reach the cashew, the cockatoos had to punch through the membrane and then "fish" the cashew out. They were provided with a short, pointy stick for punching holes and a vertically halved plastic straw for fishing.

"With this experiment we can say that, like chimpanzees, Goffin's cockatoos not only appear to be to using toolsets, but they know that they are using toolsets."

Seven of the ten cockatoos tested taught themselves to extract cashews successfully by punching through the membrane, and two of the cockatoos (Figaro and Fini) completed the task within 35 seconds on their first attempt. The cockatoos don't have an equivalent foraging behavior in the wild, so there was no chance that their tool use was based on innate behaviors, and each cockatoo used a slightly different technique.

Next, the team tested the cockatoos' ability to change their tool use in a flexible manner depending on the situation. To do this, they presented each cockatoo with two different types of box: one with a membrane and one without. The cockatoos were given the same two tools, but they only needed the pointy stick when a membrane was in the way. "The cockatoos had to act according to the problem; sometimes the toolset was needed, and sometimes only one tool was enough," says Osuna-Mascaró.

All of the cockatoos mastered the test in a very short period of time and were able to recognize when a single tool was sufficient. However, the birds engaged in an interesting behavior during this choosing phase. "When making the choice between which tool to use first, they were picking one up, releasing it, then picking up the other one, releasing it, returning to the first one, and so on," says Osuna-Mascaró. The researchers found that when cockatoos did this switching, they performed better on the tests.

Next, the team tested the cockatoos' ability to transport the tools as a set on an as-needed basis. They put the cockatoos through a series of increasingly challenging trials to reach the boxes: first they had to climb a short ladder while carrying their tools; then they had to fly horizontally with them; and in the final test, they had to carry the tools while flying vertically. As before, the birds were only sometimes presented with a box with a membrane barrier, so they had to decide whether the problem required one or both tools.

Some cockatoos learned to carry the two tools together—by inserting the short punching stick into the groove of the halved straw—when they were presented with a box that required both. This meant they only had to make one trip, albeit while carrying a heavier toolset. Most of the cockatoos transported the toolset on an as-needed basis, further indicating that they knew ahead of time when two tools were required, though some made two trips when necessary. One cockatoo, Figaro, decided not to waste time thinking and instead carried both tools in almost every trial.

CHEMWATCH
Bulletin Board
Curiosities
FEB. 17, 2023

"We really did not know whether the cockatoos would transport two objects together," says Alice Auersperg, senior author on the study and a cognitive biologist at the University of Veterinary Medicine Vienna. "It was a little bit of a gamble because I have seen birds combining objects playfully, but they very rarely transport more than one object together in their normal behavior."

There's a lot more to be learned about cockatoo tool use, the researchers say. "We feel that, in terms of technical cognition and tool use, parrots have been underestimated and understudied," says Auersperg.

"We've learned how dexterous the cockatoos are when using a toolset, and we have a lot of things to follow-up on," says Osuna-Mascaró. "The switching behavior is very interesting to us, and we are definitely going to use it to explore their decision making and their metacognition—their ability to recognize their own knowledge."

Phys Org, date

https://phys.org

Saturn's Rings Are Acting Strange – Hubble Captures Mysterious "Spokes"

2023-02-10

New images of Saturn from NASA's Hubble Space Telescope herald the start of the planet's "spoke season" surrounding its equinox, when enigmatic features appear across its rings. The cause of the spokes, as well as their seasonal variability, has yet to be fully explained by planetary scientists.

Like Earth, Saturn is tilted on its axis and therefore has four seasons, though because of Saturn's much larger orbit, each season lasts approximately seven Earth years. Equinox occurs when the rings are tilted edge-on to the Sun. The spokes disappear when it is near summer or winter solstice on Saturn. (When the Sun appears to reach either its highest or lowest latitude in the northern or southern hemisphere of a planet.) As the autumnal equinox of Saturn's northern hemisphere on May 6, 2025, draws near, the spokes are expected to become increasingly prominent and observable.

The suspected culprit for the spokes is the planet's variable magnetic field. Planetary magnetic fields interact with the solar wind, creating an electrically charged environment (on Earth, when those charged particles

Since their discovery by NASA's Voyager mission in the 1980s, temporary "spoke" features across Saturn's rings have fascinated scientists, yet eluded explanation.

hit the atmosphere this is visible in the northern hemisphere as the aurora borealis, or northern lights). Scientists think that the smallest, dust-sized icy ring particles can become charged as well, which temporarily levitates those particles above the rest of the larger icy particles and boulders in the rings.

The ring spokes were first observed by NASA's Voyager mission in the early 1980s. The transient, mysterious features can appear dark or light depending on the illumination and viewing angles.

"Thanks to Hubble's OPAL program, which is building an archive of data on the outer solar system planets, we will have longer dedicated time to study Saturn's spokes this season than ever before," said NASA senior planetary scientist Amy Simon, head of the Hubble Outer Planet Atmospheres Legacy (OPAL) program.

Saturn's last equinox occurred in 2009, while NASA's Cassini spacecraft was orbiting the gas giant planet for close-up reconnaissance. With Cassini's mission completed in 2017, and the Voyager spacecrafts long gone, Hubble is continuing the work of long-term monitoring of changes on Saturn and the other outer planets.

"Despite years of excellent observations by the Cassini mission, the precise beginning and duration of the spoke season is still unpredictable, rather like predicting the first storm during hurricane season," Simon said.

While our solar system's other three gas giant planets also have ring systems, nothing compares to Saturn's prominent rings, making them a laboratory for studying spoke phenomena. Whether spokes could or do occur at other ringed planets is currently unknown. "It's a fascinating magic trick of nature we only see on Saturn —for now at least," Simon said.

Hubble's OPAL program will add both visual and spectroscopic data, in wavelengths of light from ultraviolet to near-infrared, to the archive of Cassini observations. Scientists are anticipating putting these pieces together to get a more complete picture of the spoke phenomenon, and what it reveals about ring physics in general.

Sci Tech Daily, 10 February 2023

https://scitechdaily.com

CHEMWATCH
Bulletin Board
Curiosities
FEB. 17, 2023

Why don't identical twins have the same fingerprints? New study provides clues

2023-02-09

No two fingerprints are exactly the same. That's what makes them so useful for police and smartphones to positively identify people. Previous research has shown genes play a role in how the complex pattern of grooves and bumps on our fingertips form, so why don't identical twins have identical fingerprints? A new study reveals that three families of signaling molecules—along with slight differences in the shape of the finger and the timing of skin growth—all interact to create our unique variations.

"It is a great example of how minor fluctuations … can generate endless variations in a pattern," says Roel Nusse, a developmental biologist at Stanford Medicine who was not involved in the research.

The uneven surfaces of fingers improve grip and are found in humans and climbing species, such as koalas and chimpanzees. They also help us feel the difference between textures. Fingerprints form relatively early in fetal development, starting around the 13th week of gestation with the formation of indentations in the fingertips called primary ridges. These ridges develop into three main patterns: symmetrical, circular arrangements called "whorls"; longer, curved patterns called "loops"; and triangular ridges known as "arches." Scientists have identified several genes that influence which patterns end up in a person's fingerprint, but the biochemical mechanisms that drive the formation of these ridges have proved elusive.

To shed light on this mystery, Denis Headon, a geneticist at the University of Edinburgh, and colleagues sequenced the RNA inside the nuclei of human embryonic fingertip cells to identify the genes being expressed during development. (The embryonic tissue came from people who terminated their pregnancies in the United Kingdom.) Those genes unearthed three different signaling pathways—families of proteins that carry instructions between cells—that each play a role in directing the growth of skin on the fingertips. Genes involved in two of these signaling pathways, known as WNT and BMP, are expressed in alternating stripes of cells in the developing fingertips, creating what will ultimately become the grooves and bumps of the fingerprint. A third factor, EDAR, is expressed alongside WNT in the developing grooves.

Waves of chemical signals spread across developing fingers, creating one-of-a-kind patterns of ridges.

Mice also have simple ridge patterns on their digits. When researchers artificially suppressed the signaling pathways in mice, they found the WNT and BMP signals work in opposing ways. WNT appears to stimulate cell growth to create raised bumps in the outer layer of the skin, whereas BMP suppresses cell growth to form grooves. EDAR signals help determine the size and spacing of the ridges. For example, when researchers knocked out the WNT pathway, their digits formed no ridges at all, whereas knocking out the BMP pathway made the ridges wider. And in mice carrying a mutation that silenced EDAR activity, a polka dot pattern of ridges grew on their digits rather than stripes.

Ultimately, these three signaling pathways work together to control the formation of primary ridges that grow into the corrugated structure of fingerprints, the team reports this week in Cell.

The opposing relationship between WNT and BMP in human fingertips is characteristic of Turing patterns—in which different, overlapping chemical activities give rise to complex patterns—which are widespread in nature and give rise to the stripes and spots seen in animal fur and tropical fish skin. "The individual uniqueness [of fingerprints] comes from minute elements of the pattern," Headon says, such as long ridges that stop, ridges that split in two, or short ridges called islands. "Turing patterns readily produce this type of fine-scale pattern," he explains.

But the overall shape of the fingerprint pattern—whether the fingerprint ends up as a whorl, a loop, or an arch—depends on the anatomy of the finger and the exact timing of ridge formation. In the human embryonic tissues, the researchers found primary ridges start to form in up to three locations: the center of the fetal finger's soft raised pad, the end of the finger under the nail, and the crease at the joint where the finger bends. From these three sites, the ridges spread out across the fingertip like "waves … each ridge serving to define the position of the next one out," Headon says. The finger's anatomy helps direct the pattern of finger cell growth. If the pads are large and symmetrical and ridges begin to form there early, they tend to produce a whorl. If the pads are longer and asymmetrical, they result in a loop. If ridges simply fail to form on the pad, or if they begin to form there late in development, then the ridges from the crease and the fingernail will meet in the middle, producing an arch.

The researchers also found that the same chemical signals—WNT, BMP, and EDAR—cause cells elsewhere in the body to develop into hair follicles. But our fingertips remain hair-free because the follicle formation on the palms of our hands halts early. This suggests different structures in the

CHEMWATCH
Bulletin Board
Curiosities
FEB. 17, 2023

skin all start down the same early developmental path before diverging into specialized roles. "It may be that all of the structures formed by our largest organ, the skin—including hair, glands, fingerprints—are all fundamentally generated by the same mechanism," Nusse says.

Science, 9 February 2023

https://science.org

The Benefits of Polygamy: How Birds Avoid Harmful Mutations

2023-02-10

The majority of birds form a bond with a solitary mate each mating season, while certain species like swans or geese mate for life.

In contrast, some bird species are polygamous, having several partners per breeding season, however, it is unclear why they have evolved a different mating system.

An international team of scientists led by Bath analyzed the genomes of 150 bird species, spanning all the major bird families and from locations across the world, including six species that were sequenced for the first time.

By counting differences between the genes inherited from the individual's mother and father (termed the heterozygosity), they were able to estimate the level of genetic diversity across each species.

They also looked at the frequency of gene mutations in each species and whether they changed the sequence of proteins for which they coded or were "silent". The former, called non-synonymous polymorphisms, are often detrimental to the individual, whereas silent mutations are generally harmless.

Contrary to their expectations, they found that polygamous species on the whole were no more diverse than monogamous ones, although the small number of species with polygamous females did have higher than expected genetic diversity.

They also found that, relative to the number of silent mutations, the polygamous species had significantly fewer potentially damaging mutations that changed the protein sequence.

When the team sequenced the genome of polygamous Red-necked phalaropes for the first time, they found they carried fewer harmful mutations.

Kees Wanders, a Ph.D. student in the University of Bath's Department of Life Sciences is funded by the NERC GW4+ Doctoral Training Partnership and is the first author of the paper.

He said: "Species evolve through natural selection, where harmful mutations are removed from the population in the long term because individuals with the mutation don't survive long enough to breed, or individuals with beneficial adaptations survive for longer.

"However, species also evolve through sexual selection, where evolution is shaped by individuals competing for access to mates so that only the most desirable characteristics are successfully passed down to offspring.

"This research suggests that sexual selection aligns with natural selection in birds so that harmful mutations are removed more efficiently in polygamous populations, where sexual selection is particularly strong.

"We still don't know exactly why some bird species are polygamous when most pair up for a breeding season or even for life.

"There are many different theories about why polygamy evolved in these species, but we've found the first evidence that it increases the efficiency of natural selection by rooting out harmful mutations and avoiding the effects of inbreeding.

"It's been previously observed by others in the lab in fruit flies, but this is the first time it's been observed in wild populations of birds."

Dr. Araxi Urrutia, Senior Lecturer at the Milner Centre for Evolution at the University of Bath and last author of the paper, said: "I had a hypothesis that in polygamous species, where individuals can't easily find a mate and have to travel further to find a breeding partner, that this would mean that there would be more genetic diversity in these species.

"However, we were surprised to find there was no evidence for this – instead we found that these species had fewer harmful mutations.

"Despite this apparent evolutionary advantage, most birds tend to stick together to raise their chicks because it gives their offspring a better chance of survival."

Sci Tech Daily, 10 February 2023

https://scitechdaily.com

CHEMWATCH
Bulletin Board
Curiosities
FEB. 17, 2023

Recovering "Hidden Knowledge" – How an Asthma Medication Could Restore Memories

2023-02-09

Students often sacrifice sleep to study for exams, but lack of sleep can negatively impact memory. Now, University of Groningen neuroscientist Robbert Havekes has found that sleep deprivation hinders recall, not retention of information. Havekes and his team used optogenetics and the drug roflumilast to make "hidden knowledge" obtained while sleep-deprived accessible again days later. Their findings were recently published in the journal Current Biology.

Havekes, associate professor of Neuroscience of Memory and Sleep at the University of Groningen, the Netherlands, and his team have extensively studied how sleep deprivation affects memory processes. "We previously focused on finding ways to support memory processes during a sleep deprivation episode", says Havekes.

However, in his latest study, his team examined whether amnesia as a result of sleep deprivation was a direct result of information loss, or merely caused by difficulties retrieving information.

"Sleep deprivation undermines memory processes, but every student knows that an answer that eluded them during the exam might pop up hours afterward. In that case, the information was, in fact, stored in the brain, but just difficult to retrieve."

Hippocampus

To address this question, Havekes and his team used an optogenetic approach: using genetic techniques, they caused a light-sensitive protein (channelrhodopsin) to be produced selectively in neurons that are activated during a learning experience. This made it possible to recall a specific experience by shining light on these cells. 'In our sleep deprivation studies, we applied this approach to neurons in the hippocampus, the area in the brain where spatial information and factual knowledge are stored', says Havekes.

First, the genetically engineered mice were given a spatial learning task in which they had to learn the location of individual objects, a process that heavily relies on neurons in the hippocampus. The mice then had to perform this same task days later, but this time with one object moved to a novel location. The mice that were deprived of sleep for a few hours before

The molecular pathway set off during the [memory] reactivation is also targeted by the drug roflumilast, which is used by patients with asthma or COPD.

the first session failed to detect this spatial change, which suggests that they cannot recall the original object locations.

"However, when we reintroduced them to the task after reactivating the hippocampal neurons that initially stored this information with light, they did successfully remember the original locations," says Havekes. "This shows that the information was stored in the hippocampus during sleep deprivation, but couldn't be retrieved without the stimulation."

Memory problems

The molecular pathway set off during the reactivation is also targeted by the drug roflumilast, which is used by patients with asthma or COPD. Havekes: "When we gave mice that were trained while being sleep-deprived roflumilast just before the second test, they remembered, exactly as happened with the direct stimulation of the neurons."

As roflumilast is already clinically approved for use in humans and is known to enter the brain, these findings open up avenues to test whether it can be applied to restore access to "lost" memories in humans.

The discovery that more information is present in the brain than we previously anticipated, and that these 'hidden' memories can be made accessible again – at least in mice – opens up all kinds of exciting possibilities.

"It might be possible to stimulate the memory accessibility in people with age-induced memory problems or early-stage Alzheimer's disease with roflumilast," says Havekes. "And maybe we could reactivate specific memories to make them permanently retrievable again, as we successfully did in mice." If a subject's neurons are stimulated with the drug while they try and 'relive' a memory, or revise information for an exam, this information might be reconsolidated more firmly in the brain. "For now, this is all speculation of course, but time will tell."

At this time, Havekes is not directly involved in such studies in humans. "My interest lies in unraveling the molecular mechanisms that underlie all these processes," he explains. "What makes memories accessible or inaccessible? How does roflumilast restore access to these 'hidden' memories? As always with science, by addressing one question you get many new questions for free."

Sci Tech Daily, 9 February 2023

https://scitechdaily.com

CHEMWATCH
Bulletin Board
Curiosities
FEB. 17, 2023

What is vinyl chloride, the chemical released from the East Palestine train cars?

2023-02-08

From the time that Beaver County Emergency Services opened a dedicated phone line Monday afternoon until that midnight, it received more than 250 calls, some from as far as Philadelphia, asking when the black cloud would be coming their way.

The calls began shortly after Norfolk Southern released vinyl chloride from five derailed train cars carrying the chemical in East Palestine, Ohio. Following a severe temperature fluctuation inside the train cars, officials decided to poke holes in the tankers and set the chemical inside afire, preventing an explosion that could have sent fumes and shrapnel a mile outward.

About 5:30 p.m., images of a fire billowing a thick black cloud captured the attention of the entire region, and beyond. Soon, the cloud established a horizontal presence in the sky that appeared to hover over the site.

The plume drifted into northern Beaver County, clipping a portion of Lawrence County. By the time it was no longer detectable, about 7:30 p.m., it had traveled about five miles from the derailment site, according to radar data from the National Weather Service in Pittsburgh. Bill Modzelewski, a meteorologist with the agency, said the plume rose to about 3,000 feet.

Ohio Environmental Protection Agency Office of Emergency Response representative Mike Eberle addresses reporters at East Palestine Elementary School on Tuesday, Feb. 7, 2023, in East Palestine, Ohio. About 50 cars, including 10 carry hazardous materials, derailed in a fiery crash Friday night. Ohio and Pennsylvania residents living close to the wreckage were forced to evacuate the area and aren't being allowed into their homes, authorities said Tuesday.

Officials of several Ohio counties urged some residents to shelter in place, citing noxious odors. In Beaver County, residents within a mile evacuated. Gov. Josh Shapiro had cautioned people within that radius that they risked permanent lung damage within a matter of hours or days. Everyone else was told the air was safe.

On Tuesday evening, the U.S. Environmental Protection Agency released the results of its air monitoring before and after the controlled release, showing elevated levels of particulate matter, but otherwise no alarming

The National Cancer Institute says inhalation of vinyl chloride gas can lead to an increased risk of liver, brain and lung cancers, as well as lymphoma.

readings for some of the most worrying byproducts of the burn: hydrochloric acid and a poisonous gas called phosgene. Both can be created when vinyl chloride burns.

What is vinyl chloride?

Vinyl chloride is a colorless gas and liquid mainly used in the manufacture of plastic materials such as polyvinyl chloride, used in industrial settings and plastics such as PVC pipe.

According to the Occupational Safety and Health Administration, it has a "pleasant odor" at high concentrations. When burned, it decomposes into various gasses, potentially including hydrogen chloride and trace amounts of phosgene.

The National Cancer Institute says inhalation of vinyl chloride gas can lead to an increased risk of liver, brain and lung cancers, as well as lymphoma.

There is no federal standard for how much vinyl chloride is safe in the air. For workers, OSHA's exposure limits are 1 part per million over eight to 10 hours, and no more than 5 parts per million during a 15-minute period. One part per million is equivalent to putting one drop of a liquid from an eyedropper into 10 gallons of water.

Inhaling a lot all at once can lead to dizziness, headaches and confusion and can cause death by respiratory and nervous system depression, according to the Environmental Protection Agency and relevant literature on the chemical.

Norfolk Southern said Monday that it had success burning off the chemical. Authorities said they would continue to monitor the scene for contaminants.

According to the Agency for Toxic Substances and Disease Registry, "vinyl chloride in the air breaks down in a few days, resulting in the formation of several other chemicals including hydrochloric acid, formaldehyde, and carbon dioxide."

But it's not just venting into the air.

"The cloud that was really being produced was not vinyl chloride but what it was being turned into — the combustion product," said James Fabisiak, director of the Center for Healthy Environments & Communities at the University of Pittsburgh's School of Public Health.

CHEMWATCH
Bulletin Board
Curiosities
FEB. 17, 2023

He was especially concerned about phosgene, a gas that was used as a weapon in World War I, because it can cause lung damage after acute exposure.

Mr. Fabisiak said that once it's in the sky, phosgene disperses, so he's not worried about long-term exposure. Rather, he said, it was the people who were near the burn and the plume when it was close to the ground who should monitor their respiratory symptoms for a few days, paying attention to a new or aggravated cough, trouble breathing or a sore throat.

EPA's data showed that readings at monitors during and after the release, including 10 in Pennsylvania, showed no detectable concentration of phosgene. The readings did pick up some hydrochloric acid in the air but the levels were below what the EPA considers to be dangerous. The monitors also detected hydrogen cyanide — an acid that's used as rodent poison and in industrial manufacturing and is hazardous to humans — but also at levels below federal exposure guidelines.

On Wednesday, the EPA posted an update that volatile organic compound counts rose downwind of the derailment the night before, but were below levels considered problematic. Particulate matter remained high.

Are these chemicals toxic?

Vinyl chloride gas, hydrogen chloride and phosgene are toxic. Phosgene is colorless and, according to the Centers for Disease Control and Prevention, has a "suffocating odor." Exposure could cause coughing, burning in the throat and eyes, vomiting, chest pain and difficulty breathing.

Hydrogen chloride is "corrosive to any tissue it contacts," according to Agency for Toxic Substances and Disease Registry. Those exposed briefly to low levels can expect throat irritation, but at high levels, a person is at risk of lung damage and suffocation. Some may also develop a type of asthma called reactive airways dysfunction syndrome from exposure. When hydrogen chloride reacts with water in the air, it forms hydrochloric acid, which is irritating and can also cause suffocation at certain levels.

"When you burn vinyl chloride, you can make a variety of different products, but we don't know in this instance," said Chris Reddy, a scientist at Woods Hole Oceanographic Institute who studies chemical spills. In other words, it is not a guarantee that phosgene was produced at high enough levels to sicken people.

"Fire is its own beast," said Mr. Reddy. Many environmental factors, like wind and temperature, can affect the outcome of a chemical spill, and because the vinyl chloride burned, that means it's harder to study.

But he said wind should dilute airborne chemicals.

"This is a very potent, short-lived and hazardous chemical, but it doesn't last long. It's very reactive, but it's not going to build up in water or food," he said. "You will not have to sell your house because it's contaminated. This is a short, unfortunate punch in the face, and we'll just have to get through it."

People also have to be in the path of the toxic chemical to become sick. "Things have to be unfortunately aligned," said Mr. Reddy. "The dose makes the poison."

Both vinyl chloride and phosgene are heavier than air and would remain closer to the ground than other chemicals, Mr. Fabisiak said. That's one reason that plume modeling, which was conducted by federal and state environmental agencies to determine an evacuation radius before Monday's burn, is difficult when the plume involves different organic chemicals.

Some will rise when emitted, and others will linger near the ground, he said.

Is the air safe to breathe?

According to the EPA, while its monitors detected particulate matter from the fire on Monday and Tuesday, the agency said it "did not detect chemical contaminants of concern in the hours following the controlled burn."

It also warned on Tuesday that "residents in the area and tens of miles away may smell odors coming from the site."

"This is because the byproducts of the controlled burn have a low odor threshold. This means people may smell these contaminants at levels much lower than what is considered hazardous."

On Tuesday morning, the EPA deployed a plane with air-monitoring equipment to collect information on what chemical compounds were in the air column below it.

CHEMWATCH
Bulletin Board
Curiosities
FEB. 17, 2023

The aircraft had been deployed in the past to categorize pollution from the Deepwater Horizon oil spill and natural disasters such as hurricanes. It can also detect radiation exposure.

A fact sheet about the plane says it can provide near real-time data, which had not been made available publicly.

Pittsburgh Post-Gazette, 8 February 2023

https://post-gazette.com

Fatty Liver Disease: A Hidden Danger to Your Brain?

2023-02-08

A study conducted by the Roger Williams Institute of Hepatology, affiliated with King's College London and the University of Lausanne, found a connection between non-alcoholic fatty liver disease (NAFLD) and brain dysfunction. The accumulation of fat in the liver reduces oxygen flow to the brain and causes inflammation, both of which have been linked to the development of severe brain diseases.

Around 25% of the general population and over 80% of severely obese individuals are affected by NAFLD. While prior studies have shown the harm that an unhealthy diet and obesity can inflict on brain function, this study is believed to be the first to clearly associate NAFLD with brain decline and identify a potential therapeutic target.

The research, conducted in collaboration with Inserm (the French National Institute of Health and Medical Research) and the University of Poitiers in France, involved feeding two different diets to mice. Half of the mice consumed a diet with no more than 10% fat in their calorie intake, while the other half's calorie intake contained 55% fat; intended to resemble a diet of processed foods and sugary drinks.

After 16 weeks researchers conducted a series of tests to compare the effects of these diets on the body and more specifically, on the liver and the brain. They found that all mice consuming the higher levels of fat were considered obese, and developed NAFLD, insulin resistance, and brain dysfunction.

The study which was funded by the University of Lausanne and the Foundation for Liver Research also showed that the brain of mice with NAFLD suffered from lower oxygen levels. This is because the disease affects the number and thickness of the brain blood vessels, which deliver less oxygen to the tissue, but also due to specific cells consuming more

Fatty liver disease is a condition where excess fat accumulates in the liver cells, leading to inflammation and scarring. This can impair liver function and potentially progress to more serious health problems.

oxygen while the brain is becoming inflamed. These mice were also more anxious and showed signs of depression.

By comparison, the mice consuming the healthy diet did not develop NAFLD or insulin resistance, they behaved normally, and their brain was completely healthy.

"It is very concerning to see the effect that fat accumulation in the liver can have on the brain, especially because it often starts off mild and can exist silently for many years without people knowing they have it," said lead author Dr. Anna Hadjihambi, sub-team lead in the Liver-Brain Axis group at the Roger Williams Institute of Hepatology and honorary lecturer at King's College London.

To try and combat the dangerous effect that NAFLD has on the brain, the scientists bred mice with lower levels of a whole-body protein known as Monocarboxylate Transporter 1 (MCT1) – a protein specialized in the transport of energy substrates used by various cells for their normal function.

When these mice were fed the same unhealthy fat- and sugar-rich diet as those in the initial experiment, they had no fat accumulation in the liver and exhibited no sign of brain dysfunction – they were protected from both ailments.

"Identifying MCT1 as a key element in the development of both NAFLD and its associated brain dysfunction opens interesting perspectives," said Professor Luc Pellerin, director of the Inserm U1313 research unit at the University of Poitiers in France and senior researcher in the study. "It highlights potential mechanisms at play within the liver-brain axis and points to a possible therapeutic target."

Dr. Hadjihambi added: "This research emphasizes that cutting down the amount of sugar and fat in our diets is not only important for tackling obesity, but also for protecting the liver to maintain brain health and minimize the risk of developing conditions like depression and dementia during aging, when our brain becomes even more fragile.

Sci Tech Daily, 8 Feburary 2023

https://scitechdaily.com

CHEMWATCH
Bulletin Board
Curiosities
FEB. 17, 2023

Scientists Explain: Why Are Card Games So Addictive?

2023-02-11

A jerk is a measurement of a sudden acceleration change and is commonly used in fields such as engineering, sports science, manufacturing, and more. Researchers have now proposed that examining the impact of jerks can also offer deeper insights into gameplay. The game refinement theory posits that acceleration, or the rate at which information speed changes, represents the balance between certainty and uncertainty in a game. This balance is referred to as the game refinement value (GR) and serves as an indicator of a player's level of engagement.

A new perspective, the motion-in-mind model, measures the uncertainty of progress in a game relative to two physical measures—velocity, which represents the win rate, and mass, which represents how hard it is to win. These physical values can be translated into psychological reactions. A jerk—denoted as AD, an abbreviation for addictive—can thus be interpreted as unpredictability or surprise. Games with a higher AD value are highly unpredictable and full of surprises, making them addictive.

Recently, a group of researchers led by Assistant Professor Mohd. Nor Akmal Khalid from the School of Information Science, Japan Advanced Institute of Science and Technology (JAIST), has investigated the influence of jerks on game addiction through several popular card games—these included suits-irrelevant (Wakeng and Doudizhu) and suits-relevant (Winner, Big Two, and Tien Len) games. The study, which was co-authored by Professor Hiroyuki Iida of JAIST, was recently published in the journal IEEE Access.

Prof. Khalid discusses the motivation behind the research. "Card games are typical incomplete information games. Short, repeatable rounds, chances, and strategizing make them among the most entertaining, even addictive, games. We wanted to understand why this was so."

The researchers first explored the rules, designs, and complexities of these games, using game refinement and the motion-in-mind model. Next, they performed two simulations with self-playing artificial intelligence (AI) agents. In the first experiment, the AI mimicked a fixed game played by contestants with different skill levels (weak, fair, and strong). In contrast, the second experiment comprised games of various sophistications played by a fixed AI level. The differences between two parameters were observed—first, the odds of winning (as seen in games with deterministic versus random odds), and second, the difficulty level (as seen in simple

The researchers employed game refinement, the motion-in-mind model, and AI simulations to assess the impact of sudden movements in card games with incomplete information.

versus complex games). These analyses enabled researchers to compare the different card games.

The results demonstrate that skill and sophistication must match for reasonable GR (correlated with attractiveness) and AD (correlated with surprise) values. In addition, the games must also be balanced and fair enough, so that winning is not interpreted as just good luck. Take Doudizhu for example, which has nearly equal GR and AD values. This balance between uncertainty and unpredictability leads to a fast-paced game with frequent rewards and surprises. As a result, people want to play repeatedly, making Doudizhu the most popular and addictive card game.

Through the above investigation, the researchers discerned the principles of play for addictive entertainment. The four measures of the game progress model—game length, velocity, acceleration, and jerk—correspond respectively to reward cost, reward frequency, uncertainty, and unpredictability. Further, they determine game fairness, reinforcement, attractiveness, and surprise, respectively.

"These components highlight the potential of GR and AD measures as powerful tools to understand gameplay. They will prove useful in making games more attractive and educational. Not just games, the findings of this study can be extended to help make any normal and mundane activity engaging, enjoyable, surprising, and even addictive. In essence, the boundary between work and play can get blurred, leading to an ultimate sense of achievement and passion," concludes Prof. Khalid.

Sci Tech Daily, 11 February 2023

https://scitechdaily.com

Can hearing loss be reversed? Research reveals clues that could regrow the cells that help us hear

2023-02-13

Just like your future body will thank you for the apple, your future ears (specifically your cochlear hair cells) will thank you for protecting them. The most common cause of hearing loss is progressive because these hair cells -- the primary cells to detect sound waves -- cannot regenerate if damaged or lost. People who have repeated exposure to loud noises, like military personnel, construction workers, and musicians, are most at risk for this type of hearing loss. But, it can happen to anyone over time (even concert goers).

CHEMWATCH
Bulletin Board
Curiosities
FEB. 17, 2023

On the other hand, birds and fish can regenerate these hair cells, and now researchers at the Del Monte Institute for Neuroscience are getting closer to identifying the mechanisms that may promote this type of regeneration in mammals, as explained in research recently published in Frontiers in Cellular Neuroscience.

"We know from our previous work that expression of an active growth gene, called ERBB2, was able to activate the growth of new hair cells (in mammals), but we didn't fully understand why," said Patricia White, PhD, professor of Neuroscience and Otolaryngology at the University of Rochester Medical Center. The 2018 study led by Jingyuan Zhang, PhD, a postdoctoral fellow in the White lab at the time, found that activating the growth gene ERBB2 pathway triggered a cascading series of cellular events by which cochlear support cells began to multiply and activate other neighboring stem cells to become new sensory hair cells.

"This new study tells us how that activation is happening -- a significant advance toward the ultimate goal of generating new cochlear hair cells in mammals," said White.

Using single-cell RNA sequencing in mice, researchers compared cells with an overactive growth gene (ERBB2 signaling) with similar cells that lacked such signaling. They found the growth gene -- ERBB2 -- promoted stem cell-like development by initiating the expression of multiple proteins -- including SPP1, a protein that signals through the CD44 receptor. The CD44 receptor is known to be present in cochlear-supporting cells. This increase in cellular response promoted mitosis in the supporting cells, a key event for regeneration.

"When we checked this process in adult mice, we were able to show that ERBB2 expression drove the protein expression of SPP1 that is necessary to activate CD44 and grow new hair cells," said Dorota Piekna-Przybylska, PhD, a staff scientist in the White Lab and first author of the study. "This discovery has made it clear that regeneration is not only restricted to the early stages of development. We believe we can use these findings to drive regeneration in adults."

"We plan to further investigation of this phenomenon from a mechanistic perspective to determine whether it can improve auditory function after damage in mammals. That is the ultimate goal," said White.

Additional authors include Daxiang Na, Cameron Baker, and John Ashton, PhD, at the University of Rochester and Medical Center. The research was supported by the U.S. Army Medical Research Mechanism, the National

The most common cause of hearing loss is progressive because hair cells -- the primary cells to detect sound waves -- cannot regenerate if damaged or lost.

Curiosities

FEB. 17, 2023

Institute on Deafness and Other Communication Disorders, UR Ventures, and the Schmitt Program on Integrative Neuroscience.

Sci Tech Daily, 13 February 2023

https://scitechdaily.com

CHEMWATCH
Bulletin Board

Technical Notes

FEB. 17, 2023

(NOTE: OPEN YOUR WEB BROWSER AND CLICK ON HEADING TO LINK TO SECTION)

CHEMICAL EFFECTS

Toxicity of the 3,4-Methylenedioxymethamphetamine and Its Enantiomers to Daphnia magna after Isolation by Semipreparative Chromatography

Recent advances in nanomaterials based sustainable approaches for mitigation of emerging organic pollutants

Phytotoxicity and genotoxicity of agro-industrial digested sludge hydrochar: The role of heavy metals

ENVIRONMENTAL RESEARCH

Extruded polystyrene microplastics as a source of brominated flame retardant additives in the marine environment: long-term field and laboratory experiments

Traffic-Related Air Pollution and Ground-Level Ozone Associated Global DNA Hypomethylation and Bulky DNA Adduct Formation

PHARAMACEUTICAL/TOXICOLOGY

Harmonized human biomonitoring in European children, teenagers and adults: EU-wide exposure data of 11 chemical substance groups from the HBM4EU Aligned Studies (2014-2021)

Climate Toxicity: an increasingly relevant clinical issue in Cancer Care

OCCUPATIONAL

Integration of proteomic and metabolomic analyses: New insights for mapping informal workers exposed to potentially toxic elements

Pleural plaques and the role of exposure to mineral particles in the Asbestos Post-Exposure Survey

Helmet-Mounted Real-Time Toxic Gas Monitoring and Prevention System for Workers in Confined Places