CHEMWATCH

Bulletin Board

Contents

NOV. 25, 2022

(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.**

CHEMWATCH
Bulletin Board
Contents
NOV. 25, 2022

ASIA PACIFIC

Plastic items and materials for phase out: tranche 2 and 3

2022-11-17

Descriptions of hard-to-recycle and single-use plastics to be phased out in mid-2023 (tranche 2) and mid-2025 (tranche 3). This information is indicative only and subject to change.

The information below reflects the decisions Cabinet has made for proposed regulations. These decisions are still subject to refinement as we develop the proposed regulations, and subject to final Cabinet decisions on the wording of those regulations.

More information on the proposed regulations will be available from late-2022.

Read More

New Zealand Ministry for the Environment, 17-11-22

https://environment.govt.nz/what-government-is-doing/areas-of-work/waste/plastic-phase-out/plastic-items-and-materials-for-phase-out/

Inventory Update: Australia Adds 8 Chemicals in to AIIC and Revokes CBI Approval of 1 Chemical

2022-11-17

On November 16, 2022, the Australian Government issued two notices to declare some updates of the Australian Inventory of Industrial Chemicals (AIIC).

According to Notice I, 8 chemicals have been added to AIIC in accordance with Section 82 of the Industrial Chemical Act 2019. Five years have passed since the assessment certificates were issued. Below are the details of the 8 chemicals.

CAS Number	Chemical Name
590374-68-8	2-Propenoic acid, 2-methyl-, 2-hydroxyethyl ester, polymer with ethenylbenzene, 2-ethylhexyl 2-propenoate and 2-propenenitrile

CHEMWATCH
Bulletin Board
Regulatory Update
NOV. 25, 2022

CAS Number	Chemical Name
203874-34-4	Cyclotetrasiloxane, 2,4,6,8-tetramethyl-, reaction products with 1,1′-(methylethylidene)bis[4-(2-propen-1-yloxy)benzene]
872182-46-2	Propanedioic acid, 2-[(4-hydroxy-3,5-dimethoxyphenyl)methyl]-, 1,3-bis(2-ethylhexyl) ester
2055490-70-3	Fatty acids, C18-unsatd., dimers, di-Me esters, hydrogenated, polymers with 1,4-butanediol, 1,6-diisocyanatohexane and 2-hydroxyethyl-terminated hydrogenated polybutadiene, stearyl alc.-blocked
144820-27-9	Neodecanoic acid, ethenyl ester, polymer with butyl 2-propenoate and ethenyl acetate
2844332-35-8	1,2-Cyclohexanedicarboxylic acid, 1-[2-[(2-methyl-1-oxo-2-propen-1-yl) oxy]ethyl] ester, polymer with butyl 2-propenoate, ethenylbenzene, 2-hydroxyethyl 2-methyl-2-propenoate and methyl 2-methyl-2-propenoate, 2,2′-(1,2-diazenediyl) bis[2-methylpropanenitrile]-initiated
2844332-31-4	2-Propenoic acid, 2-methyl-, polymer with ethenylbenzene, 2-hydroxyethyl 2-methyl-2-propenoate, 2-hydroxyethyl 2-propenoate, methyl 2-methyl-2-propenoate and 2-methylpropyl 2-methyl-2-propenoate, tert-Bu 2-ethylhexaneperoxoate- and 2,2′-(1,2-diazenediyl)bis[2-methylpropanenitrile]-initiated
1708937-98-7	Humic acids, polymers with acrylic acid, N,N-dimethyl-2-propenamide and 2-methyl-2-[(1-oxo-2-propen-1-yl)amino]-1-propanesulfonic acid, sodium salt, peroxydisulfuric acid ([(HO)S(O)2]2O2) sodium salt (1:2)-initiated

According to Notice II, the Australian Government revoked the CBI

approval for the proper name of 1 industrial chemical in the AIIC. This industrial chemical is:

CAS Number	Chemical Name
2093197-30-7	1,3-Benzenedicarboxylic acid, polymer with (2E)-2-butenedioic acid, 2,2-dimethyl-1,3-propanediol, 2-ethyl-2-(hydroxymethyl)-1,3-propanediol and hexanedioic acid, (octahydro-4,7-methano-1H-indenyl)methyl ester

The last update to the AIIC was made on October 25, 2022, click here to learn more.

Chemical substances that are listed in the AIIC can be introduced by any registered introducers (importers or manufactures). According to the Industrial Chemical Act 2019, introducers shall apply for registration before introducing an industrial chemical to Australia during a registration year (goes from September 1 to August 31). For chemicals not listed in AIIC, introducers shall apply to the Executive Director for an assessment certificate for the introduction of such industrial chemicals.

Read More

Chemlinked, 17-11-22

https://chemical.chemlinked.com/news/chemical-news/inventory-update-australia-adds-8-chemicals-in-to-aiic-and-revokes-cbi-approval-of-1-chemical

No More Papers—China to Require Compact Disc Submission for All Drug Registration Applications

2022-11-10

On Nov. 4, China National Medical Products Administration (NMPA) released a series of draft regulations on electronic drug registration application, requiring application dossiers to be submitted in compact discs instead of paper.1 Public advice and comments are welcomed to be sent to zhongwch@cde.org.cn before Nov. 20, 2022.

The draft regulations include:

1. Announcement on Electronic Drug Registration Applications

CHEMWATCH
Bulletin Board
Regulatory Update
NOV. 25, 2022

2. Announcement on the Requirements for Electronic Drug Registration Applications
3. Technical Requirements for Compact Discs Containing Application Dossiers
4. Document Structure of Electronic Drug Registration Applications
5. Commitment Letter

Compact Disc Submission

According to Draft 1 Announcement on Electronic Drug Registration Applications, drug registration applications as well as supplemental documents during the review shall be submitted in compact discs from Dec. 1, 2022. For applications submitted in paper before Dec. 1, 2022, supplemental documents submitted during the review can still be in paper. The submission process stays the same as before.

For drug applications submitted in Electronic Common Technical Documents (eCTD) format, the paper documents, previously required by the Announcement on Adopting the eCTD Submission for Drug Registration Applications, will no longer be required. Other requirements in the announcement will still be effective.

Format Review of the Application Dossiers

Draft 2 Announcement on the Requirements for Electronic Drug Registration Applications notes that Center for Drug Evaluation (CDE) will review the application dossier's format within 5 workdays upon receiving the compact discs.

If the application is accepted, CDE will upload the acceptance letter to the "Drug Affair Application System" and the "Drug eCTD Registration System". The applicants will be reminded through SMS and can download the letter directly. CDE will NOT send the acceptance letter to the applicant in paper.

Read More

Chemlinked, 10-11-22

https://baipharm.chemlinked.com/news/no-more-paperschina-to-require-compact-disc-submission-for-all-drug-registration-applications

New rules propose that permission from the Minister will not be required for the transport of dangerous goods with a mass over 400 kg in a certain container exempted from examination.

Japan to Align Maritime Transport Rules for Dangerous Goods with IMDG Code 2022 Edition

2022-11-17

Japan's Ministry of Land, Infrastructure, Transport and Tourism (MLITT) is consulting on the proposed updates of the Regulations for Transport and Storage of Dangerous Goods by Ships (hereinafter referred to as the Regulations) and the Standards Concerning the Transport of Dangerous Goods by Ships (hereinafter referred to as the Standards), aiming to align Japan's rules for transport of dangerous goods (TDG) by ships with the international rules - International Maritime Dangerous Goods Code (IMDG Code)*. The consultation will end on November 28, 2022. Once approved, they are expected to be officially released in late December 2022 and take effect from January 2023.

Read More

Chemlinked, 17-11-22

https://chemical.chemlinked.com/news/chemical-news/japan-to-align-maritime-transport-rules-for-dangerous-goods-with-imdg-code-2022-edition

AMERICA

CDC to conduct health study at polluted former Army base

2022-11-10

Federal health officials are conducting a new study to determine whether veterans once stationed at a now-shuttered California military base were exposed to dangerously high levels of cancer-causing toxins.

The decision by the Centers for Disease Control and Prevention comes nine months after an Associated Press investigation found that drinking water at Fort Ord contained toxic chemicals and that hundreds of veterans who lived at the central California coast base in the 1980s and 1990s later developed rare and terminal blood cancers.

In a letter last Friday to Rep. Katie Porter, D-Calif., the director of the CDC's Agency for Toxic Substances and Disease Registry, Patrick Breysse, wrote that "there are sufficient data and scientific reasons for ATSDR to re-evaluate health risks related to historical drinking water exposures at Fort

CHEMWATCH
Bulletin Board
Regulatory Update
NOV. 25, 2022

Ord." Porter had asked for a new study in February, two days after the AP published its story.

Read More

AP News, 10-11-22

https://apnews.com/article/health-california-veterans-cancer-centers-for-disease-control-and-prevention-89c8cac493f633dfe2757db8b8f49a82

ESA WORKPLAN UPDATE: Nontarget Species Mitigation for Registration Review and Other FIFRA Actions

2022-11-17

EPA's Pesticide Program faces the decades-long challenge of meeting its Endangered Species Act (ESA) obligations for the large number of actions taken annually under the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA).

To address this challenge, EPA has taken several crucial steps in the last year alone. In January 2022, the Agency committed to fully complying with the ESA before registering any new conventional pesticides. And in April 2022, the Agency released a workplan on how it will address this challenge, including by incorporating protections for ESA listed species earlier in its FIFRA process.

EPA is now releasing this first update to the workplan, which describes the Agency's efforts to reduce pesticide exposure to nontarget organisms, including listed species, during the FIFRA registration review process and through other FIFRA actions. Taken together, these steps will move EPA toward fulfilling its ESA obligations and making final registration review decisions by providing earlier protections for listed species, while increasing regulatory certainty for growers and pesticide registrants. The workplan update thus reflects a major milestone in EPA's journey to fully comply with the ESA in ways that are protective, implementable, and transparent. For most pesticides, registration review is the most important opportunity for EPA to include mitigation for listed species.

On 15-year intervals, EPA must assess each existing pesticide active ingredient to ensure it continues to meet the FIFRA standard of causing no unreasonable adverse effects. Because most pesticides were registered without a formal ESA review, the initial registration review is the Agency's first major opportunity to incorporate mitigation for listed species and many other nontarget wildlife.

Further, registration review triggers ESA requirements as courts have repeatedly made clear. EPA's inability to fully meet the ESA requirements has created a growing number of lawsuits against the Agency. Existing court-enforceable deadlines, combined with ongoing litigation and settlement discussions, will require EPA to complete ESA reviews for over 50 pesticides, thus filling the Agency's ESA workload well beyond 2030. Yet these cases represent less than 5% of EPA's future pesticide actions that trigger ESA obligations. Unless EPA makes substantial progress on ESA compliance, it is likely to face more litigation. The workplan update represents a major step in this process by proposing a large menu of ecological mitigation measures that EPA will begin including in registration review actions. This outcome is a win for wildlife in need of protections, and a win for growers who seek legal certainty about the status of the pesticides they rely on.

Read More

US EPA, 17-11-2022

https://www.epa.gov/system/files/documents/2022-11/esa-workplan-update.pdf

Food Safety: FDA Oversight of Substances Used in Manufacturing, Packaging, and Transporting Food Could Be Strengthened

2022-11-08

Food processing and packaging can introduce non-food substances, such as those used to greaseproof paper takeout containers, into food. Some of these substances may pose health risks.

FDA reviews information on the safety of such substances before their first use. As new information becomes available that suggests a substance may pose a health risk, FDA will occasionally reevaluate it based on the new information. But, FDA doesn't have specific authority to require companies to provide the information that the agency may need for such reviews—so re-evaluation may not be possible.

We recommended that FDA request this authority from Congress.

What GAO Found

The Department of Health and Human Services' Food and Drug Administration (FDA) has primary responsibility for reviewing the safety

CHEMWATCH
Bulletin Board
Regulatory Update
NOV. 25, 2022

of food contact substances before and after they enter the market. These substances come into contact with food during processes such as manufacturing, packaging, and transporting food (see fig.). Such substances may migrate into food, where they could pose a risk to human health. FDA conducts premarket reviews of the safety of substances largely by reviewing companies' submissions of supporting evidence before substances enter the market. FDA bases its postmarket reviews on safety information, including new information published since the substance's initial approval for use.

Read More

US GAO, 8-11-22

https://www.gao.gov/products/gao-23-104434

EPA Announces the Addition of Chitosan to the List of Active Ingredients Eligible for Risk Pesticide Exemption

2022-11-15

On November 8, 2022, the U.S. Environmental Protection Agency (EPA) issued a final rule adding chitosan (Poly-D-Glucosamine), a naturally occurring substance found in the cell walls of all crustaceans, many fungi, and the exoskeletons of most insects, to its minimum risk pesticide exemption list. 87 Fed. Reg. 67364. EPA states that the listing also includes those chitosan salts that can be formed when chitosan is mixed with the acids that are listed as active or inert ingredients eligible for use in minimum risk pesticide products.

According to EPA's announcement of the final rule, the purpose of the exemption list is to eliminate the need for EPA to expend significant resources to regulate products deemed to be of minimum risk to human health and the environment. Under the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) Section 25(b) minimum risk exemption, products that contain only those active and inert ingredients allowed by the exemption and that meet certain requirements are exempt from the normal FIFRA registration requirements. Approximately a decade has passed since a substance was added to the list of ingredients eligible for the minimum risk pesticide exemption.

Chitosan is currently registered with EPA under FIFRA as a fungicide, antimicrobial agent, and plant growth regulator that boosts the ability of plants to defend against fungal infections. EPA's decision was based on a review of an October 10, 2018, petition requesting that chitosan be

added to the list of active ingredients allowed in exempted minimum risk pesticide products. In November 2020, EPA requested public comment on the proposed rule to add chitosan to the list of active ingredients eligible for the exemption. Additionally, in November 2021, EPA requested information from the petitioner on chitosan salts and their potential effect on the environment.

EPA states that after reviewing the latest available science and comments on the proposed rule and the Notice of Data Availability, it has determined to add chitosan to its list of active ingredients eligible for EPA's minimum risk pesticide exemption. EPA's analysis of the available data suggests that chitosan and chitosan salts are of low toxicity to humans and that no environmental risks of concern have been identified. As a result of this final rule, products that contain chitosan and that comply with all the other requirements applicable to minimum risk pesticides will no longer need to be registered under FIFRA. Products containing chitosan that cannot meet all minimum risk pesticide requirements may still require registration.

Read More

FIFRA Blog, 15-11-22

https://pesticideblog.lawbc.com/entry/epa-announces-the-addition-of-chitosan-to-the-list-of-active-ingredients-el

EUROPE

Businesses to be given UK product marking flexibility

2022-11-14

Businesses given 2 additional years to apply new product safety marking.

- Government to continue to recognise the CE product marking in Great Britain for a further 2 years, allowing business to use either UKCA or CE markings
- move will cut costs for businesses and remove potential disruption
- future product marking plans to be reviewed to minimise costs and burdens for business in the longer term

Businesses will be given an additional 2 years to apply new product safety marking, giving thousands of businesses the freedom to focus on growth, Business Secretary Grant Shapps has announced today (Monday 14 November).

CHEMWATCH
Bulletin Board
Regulatory Update
NOV. 25, 2022

The UK Conformity Assessed (UKCA) marking has been introduced as part of the UK's own robust regulatory framework. It shows that products comply with our product safety regulations which are designed to protect consumers.

However, given the difficult economic conditions created by post-pandemic shifts in demand and supply, alongside Putin's war in Ukraine and the associated high energy prices, the government does not want to burden business with the requirement to meet the original (31 December 2022) deadline.

The government will continue to recognise the CE marking for 2 years, therefore allowing businesses until 31 December 2024 to prepare for the UKCA marking. Businesses can also use the UKCA marking, giving them flexibility to choose which marking to apply.

Business Secretary Grant Shapps said:

The government is determined to remove barriers to businesses so they can get on with their top priorities, like providing quality customer service, enabling growth and supporting their staff.

This move will give businesses the breathing space and flexibility they need at this crucial time and ensure that our future system for product safety marking is fit for purpose, providing the highest standard for consumers without harming businesses.

Read More

Gov.uk, 14-11-22

https://www.gov.uk/government/news/businesses-to-be-given-uk-product-marking-flexibility

Request for information on substances proposed as Persistent Organic Pollutants (POPs) 2022

2022-10-31

Requesting information to feed into draft Risk Profiles and draft Risk Management Evaluations for 3 chemical substances proposed as POPs to the UN's POP Review Committee

The UK is a party to the Stockholm Convention on persistent organic pollutants (POPs), which are substances that persist in the environment,

accumulate in living organisms and pose a risk to our health and the environment.

They can be transported by air, water or migratory species across international borders, reaching regions where they have never been produced or used.

The POPs Review Committee (POPRC) has requested additional information relating to the following:

- adverse effects resulting from the long-range transport of chlorpyrifos, to inform revisions to the draft Risk Profile for chlorpyrifos (Annex E of the Stockholm Convention)
- socio-economic considerations for long-chain perfluorocarboxylic acids, their salts and related compounds, to assist the drafting of a Risk Management Evaluation (Annex F of the Stockholm Convention)
- socio-economic considerations for chlorinated paraffins with carbon chain lengths in the range C14 to17 and with chlorination levels at or exceeding 45 percent chlorine by weight, to assist the drafting of a Risk Management Evaluation (Annex F of the Stockholm Convention)

This information will help determine the need for any specific exemptions and acceptable purposes. These substances have been proposed for listing as POPs under the Stockholm Convention.

Read More

Gov.uk, 31-10-22

https://www.gov.uk/government/publications/request-for-information-on-substances-proposed-as-persistent-organic-pollutants-pops-2022

On the Razor's edge: how to deal with the threat of Asbestos

2022-11-14

After the general ban on asbestos, which finally had to be implemented in all EU member states in 2005, the asbestos issue became quiet – too quiet. For a long time, almost all actors overlooked the fact that asbestos is still present in millions of public and private buildings built before the ban and in parts of the infrastructure.

The trade unions were as well also quiet about the asbestos issue. Then, in 2009, a debate started in the European Federation of Building and Woodworkers (EFBWW), inspired by Scandinavian colleagues. This debate

CHEMWATCH
Bulletin Board
Regulatory Update
NOV. 25, 2022

led to the EFBWW campaign "Europe 2023- Asbestos free". The focus of the campaign was and is to create national action plans within the framework of a European initiative to eliminate all remaining asbestos. This goal is also to be supported by legislative initiatives in the EU's areas of competence.

The EU's climate targets and the related "Renovation Wave" are now acting like a burning glass on the asbestos problem. A large number of occupational groups will be carrying out work on roofs, heating systems, windows, bathrooms, etc. (in addition to the specialised asbestos removal companies). They will all potentially come into contact with asbestos-contaminated materials. There is thus a risk that the currently very high number of annual asbestos victims will once again skyrocket (the Commission assumes a figure of about 70,000 deaths caused by occupational asbestos exposure in Europe).

In this context, the Commission's proposals on asbestos, presented on 28 September 2022, come late, but they can still curtail the foreseeable catastrophe that will occur if Renovation Wave workers are not well trained and cannot carry out the work in safe conditions and properly. In particular, the Commission has presented a proposal for the revision of the Asbestos Directive (2022/489) and a Communication (2022/488) proposing further asbestos-related measures and initiatives in other policy areas.

The background for the Commission's initiative is not least the European Parliament's own-initiative legislative report, which was adopted in October 2021. It is based on a holistic approach and has spelled out which initiatives and legal changes are necessary to increase protection against asbestos exposure and to implement the current state of scientific and technical knowledge in this area. Thus, the parliamentary report is very much in line with the demands that the EFBWW is pursuing with its asbestos campaign.

Read More

Euractiv, 14-11-22

https://www.euractiv.com/section/energy-environment/opinion/asbestos-still-a-killer/

One in four substances recovered from waste non-compliant with REACH

2022-11-09

ECHA/NR/22/17

Results from a Forum pilot enforcement project on substances recovered from waste reveal that 26 % of checked substances are in breach of REACH.

Helsinki, 8 November 2022 – Inspectors checked 46 cases to find out if substances recovered from waste met the conditions for exemption from REACH registration. Firstly, they examined if the recovered and registered substances are the same and secondly if information on safe use was available.

Inspectors also confirmed that safety data sheets (SDSs) were provided with recovered substances and mixtures in 96 % of the cases. When SDSs were lacking information, the main concern was unclear substance identity. 37 % of the inspected cases did not meet the main CLP Regulation requirements on classification, labelling and packaging.

The non-compliances found during the pilot project led to written advice, fines and administrative orders.

The cooperation between the national REACH and waste inspectors and other national inspectorates was a key element in this project, with collaboration such as joint inspections in 70 % of cases.

Recommendations

- Waste operators placing recovered substances on the market should contact national authorities and helpdesks to gain knowledge about their substances. They should also be aware how the substances will be used by their customers.
- National authorities enforcing REACH and the Waste Framework Directive should strengthen cooperation so they can jointly monitor the situation of recovered substances placed on the market and improve safety for humans and the environment.
- The Enforcement Forum should pursue this subject and consider including it in the scope of an EU-wide enforcement project in the future.
- ECHA should look into revising the current Guidance on waste and recovered substances.

CHEMWATCH
Bulletin Board
REACH Update
NOV. 25, 2022

- The legal text would benefit from a revision to mitigate the shortcomings identified during the project. The European Commission should also work on harmonising the EU's end of waste criteria.

Background

This pilot project assessed the compliance of recovered materials against REACH Article 2(7)(d). It was the first time the Enforcement Forum explored the interface between REACH and the Waste Framework Directive. The pilot project ran in 11 Member States.

Read More

ECHA, 09-11-22

https://echa.europa.eu/-/one-in-four-substances-recovered-from-waste-non-compliant-with-reach

Restriction proposals for bisphenols and creosote available

2022-11-09

We have published restriction proposals for:

- 4,4'-isopropylidenediphenol (bisphenol A) as well as other bisphenols and bisphenol derivatives with endocrine-disrupting properties for the environment, prepared by Germany; and
- creosote and related substances prepared by France.

The proposals will be evaluated by ECHA's scientific Committees for Risk Assessment (RAC) and Socio-Economic Analysis (SEAC). Consultations will be opened after the committees agree that the proposals conform with the legal requirements for a REACH restriction proposal. The conformity check will take place during the November/December meetings of the committees.

All restrictions under REACH are decided by the European Commission together with the EU Member States.

Read More

ECHA, 09-11-22

https://echa.europa.eu/restrictions-under-consideration

Assessment of regulatory needs reports published

2022-11-09

A report for the paraben acid, salts and esters group of substances is now available.

You can filter the list with the group name to get a full list of the substances in the group and access the report.

Read More

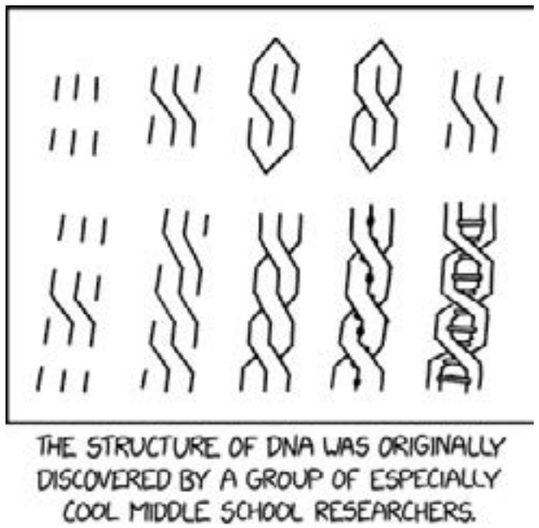
ECHA, 09-11-22

https://echa.europa.eu/assessment-regulatory-needs

CHEMWATCH
Bulletin Board

Cool S

2022-11-25



https://xkcd.com/2690/

Nitrogen Dioxide

2022-11-25

Nitrogen dioxide is the chemical compound with the formula NO_2. It is one of several nitrogen oxides. [1] Nitrogen dioxide is non-flammable and colourless to brown at room temperature. It has a strong, harsh odour and is a liquid at room temperature, becoming a reddish-brown gas above 70F. [2] NO_2 is an intermediate in the industrial synthesis of nitric acid. [1] Some nitrogen dioxide is formed naturally in the atmosphere by lightning and plants, soil and water produce some. However, only about 1% of the total amount of nitrogen dioxide found in our cities' air is formed this way. Nitrogen dioxide is an important air pollutant because it contributes to the formation of photochemical smog, which can have significant impacts on human health. [3]

USES [4]

Nitrogen dioxide has been used as a catalyst in certain oxidation reactions; as an inhibitor to prevent polymerisation of acrylates during distillation; as a nitrating agent for organic compounds; as an oxidising agent; as a rocket fuel; as a flour-bleaching agent and in increasing the wet strength of paper.

SOURCES & ROUTES OF EXPOSURE

Sources of Exposure [3]

The major source of nitrogen dioxide in Australia is the burning of fossil fuels: coal, oil and gas. Most of the nitrogen dioxide in cities comes from motor vehicle exhaust (about 80%). Other sources of nitrogen dioxide are petrol and metal refining, electricity generation from coal-fired power stations, other manufacturing industries and food processing. Unflued gas heaters and cookers are the major sources of nitrogen dioxide in Australian homes.

Routes of Exposure [2]

- The general population is primarily exposed to nitrogen dioxide by breathing in air. People who live near combustion sources such as coal burning power plants or areas with heavy motor vehicle use may be exposed to higher levels of nitrogen dioxide.

Nitrogen dioxide is the chemical compound with the formula NO2.

CHEMWATCH
Bulletin Board
Hazard Alert
NOV. 25, 2022

- Households that burn a lot of wood or use kerosene heaters and gas stoves tend to have higher levels of nitrogen dioxides in them when compared to houses without these appliances.
- Nitrogen dioxide is found in tobacco smoke, so people who smoke or breathe in second-hand smoke may be exposed to it.
- Workers employed in facilities that produce nitric acid or certain explosives like dynamite and trinitrotoluene (TNT), as well as workers involved in the welding of metals may breathe in nitrogen dioxide during their work.

HEALTH EFFECTS [5]

Acute Effects

- Contact can irritate and burn skin and eyes with possible eye damage.
- Breathing nitrogen dioxide can irritate the throat and nose.
- Breathing nitrogen dioxide can irritate the lungs causing coughing and/or a shortness of breath. Higher exposures can cause a build-up of fluid in the lungs (pulmonary oedema), a medical emergency, with severe shortness of breath.
- High levels can interfere with the ability of the blood to carry oxygen causing headache, fatigue, dizziness, and a blue colour to the skin and lips (methemoglobinemia).
- Higher levels can cause trouble breathing, collapse and even death.

Chronic Hazard

- Repeated exposure to high levels may lead to permanent lung damage.

Cancer Hazard

- Nitrogen dioxide may cause mutations (genetic changes).
- There is no evidence that nitrogen dioxide causes cancer in animals.

Reporductive Hazard

- There is limited evidence that nitrogen dioxide may damage the developing foetus; and
- Decrease fertility in females.

SAFETY [6]

First Aid Measures

- If inhaled: If breathed in, move person into fresh air. If not breathing, give artificial respiration. Consult a physician.
- In case of skin contact: Take off contaminated clothing and shoes immediately. Wash off with soap and plenty of water. Take victim immediately to hospital. Consult a physician.
- In case of eye contact: Rinse thoroughly with plenty of water for at least 15 minutes and consult a physician.
- If swallowed: Do NOT induce vomiting. Never give anything by mouth to an unconscious person. Rinse mouth with water. Consult a physician.

Exposure Controls & Personal Protection

Engineering Controls

- Avoid contact with skin, eyes and clothing.
- Wash hands before breaks and immediately after handling the product.

Personal Protective Equipment

The following personal protective equipment is recommended when handling nitrogen dioxide:

Eye/face protection

- Tightly fitting safety goggles.
- Faceshield (8-inch minimum).
- Use equipment for eye protection tested and approved under appropriate government standards such as NIOSH (US) or EN 166(EU).

Skin protection

- Handle with gloves.
- Gloves must be inspected prior to use.
- Use proper glove removal technique (without touching gloves' outer surface) to avoid skin contact with this product.
- Dispose of contaminated gloves after use in accordance with applicable laws and good laboratory practices.
- Wash and dry hands.

CHEMWATCH
Bulletin Board
Hazard Alert
NOV. 25, 2022

- The selected protective gloves have to satisfy the specifications of EU Directive 89/686/EEC and the standard EN 374 derived from it.

Body Protection

- Complete suit protecting against chemicals.
- The type of protective equipment must be selected according to the concentration and amount of the dangerous substance at the specific workplace.

Respiratory Protection

- Where risk assessment shows air-purifying respirators are appropriate use a full-face respirator with multi-purpose combination (US) or type AXBEK (EN 14387) respirator cartridges as a backup to engineering controls.
- If the respirator is the sole means of protection, use a full-face supplied air respirator.
- Use respirators and components tested and approved under appropriate government standards such as NIOSH (US) or CEN (EU).

REGULATION

United States [7]

Exposure Limit	Limit Values	HE Codes	Health Factors and Target Organs
OSHA Permissible Exposure Limit (PEL)-General Industry	5 ppm (9 mg/m^3) Ceiling	HE10	Chronic bronchitis, emphysema
		HE15	Eye, nose, and upper respiratory irritation
OSHA PEL-Construction Industry	5 ppm (9 mg/m^3) Ceiling	HE10	Chronic bronchitis, emphysema
		HE15	Eye, nose, and upper respiratory irritation

Exposure Limit	Limit Values	HE Codes	Health Factors and Target Organs
OSHA PEL-Shipyard Employment	5 ppm (9 mg/m^3) Ceiling	HE10	Chronic bronchitis, emphysema
		HE15	Eye, nose, and upper respiratory irritation
National Institute for Occupational Safety and Health (NIOSH) Recommended Exposure Limit (REL)	1 ppm (1.8 mg/m^3) STEL	HE7	Mild headache
		HE10	Bronchiolitis obliterans
		HE11	Acute pulmonary oedema; lower respiratory irritation (cough, dyspnea)
		HE15	Eyes, nose, and throat irritation
American Conference of Governmental Industrial Hygienists (ACGIH) Threshold Limit Value (TLV) (2012)	0.2 ppm (0.38 mg/m^3) TWA A4	HE11	Lower respiratory irritation
CAL/OSHA PEL	1 ppm (1.8 mg/m^3) STEL		

Australia [8]

Safe Work Australia

Chemical name	CAS No.	TWA (ppm)	TWA (mg/m^3)	STEL (ppm)	STEL (mg/m^3)	advisory carcino-gen category
Nitrogen dioxide	10102-44-0	3	5.6	5	91	Carc. 2

CHEMWATCH
Bulletin Board
Hazard Alert
NOV. 25, 2022

References

1. https://en.wikipedia.org/wiki/Nitrogen_dioxide
2. http://www.atsdr.cdc.gov/toxfaqs/tf.asp?id=396&tid=69
3. http://www.environment.gov.au/protection/publications/factsheet-nitrogen-dioxide-no2
4. http://www.c-f-c.com/specgas_products/nitrogen-dioxide.htm
5. http://nj.gov/health/eoh/rtkweb/documents/fs/1376.pdf
6. http://www.sigmaaldrich.com/MSDS/MSDS/DisplayMSDSPage.do?country=AU&language=en&productNumber=295582&brand=ALDRICH&PageToGoToURL=http%3A%2F%2Fwww.sigmaaldrich.com%2Fcatalog%2Fproduct%2Faldrich%2F295582%3Flang%3Den
7. https://www.osha.gov/dts/chemicalsampling/data/CH_257400.html
8. http://www.safeworkaustralia.gov.au/sites/swa/about/Publications/Documents/772/Workplace-exposure-standards-for-airborne-contaminants.docx

Balloon labor induction safer for babies, researchers find

2022-11-11

Melbourne researchers have found that one of two common methods to induce labor is safer for babies, although both were as safe for the mother and neither led to more cesarean births.

The findings could help inform the growing number of inductions conducted globally each year—now around 14 million—when the risks of continued pregnancy outweigh the benefits.

Published in The Lancet, the Monash Health and Monash University-led study found clear evidence that a balloon catheter leads to an improved safety profile for newborns than vaginal hormones.

This included fewer adverse events such as acidosis (a build-up of acid in the bloodstream), poor condition after birth, or neonatal intensive care unit admission. There was no difference in maternal adverse events or cesarean rates between the two methods.

Labor induction is one of the most common obstetric interventions and rates have significantly increased over the past decade, from 25 to 35% in Australia alone.

Most commonly, the cervix is "ripened" either mechanically, by inserting a water-filled balloon catheter which exerts pressure on the cervix over several hours and guides it open, or hormonally, with medications that replicate prostaglandin, a hormone which also softens and opens the cervix.

The international data meta-analysis concluded that while both methods were effective, balloon catheters were safer for newborns and using them could considerably reduce adverse birth events.

Investigators of 12 high-quality trials contributed data, resulting in 5,460 women who were randomized in original trials for either balloon catheter or vaginal prostaglandins.

First author Dr. Madeleine Jones, a Monash Health/Monash Women's Registrar and Monash University Department of Obstetrics and Gynecology Ph.D. candidate, said previous research had demonstrated that balloon catheters were likely as effective as vaginal prostaglandin.

This included fewer adverse events such as acidosis (a build-up of acid in the bloodstream), poor condition after birth, or neonatal intensive care unit admission.

CHEMWATCH
Bulletin Board
Gossip
NOV. 25, 2022

"However, it was unclear if one method was safer than the other, as there is a limited ability to measure these with either single clinical trials or analysis of summary data from multiple trials," Dr. Jones said.

"We established an international collaborative that was led by our research group at Monash University and Monash Health to address this knowledge gap. This enabled us to achieve some clear and important results."

Senior author Dr. Wentao Li, a Monash University School of Clinical Sciences Department of Obstetrics and Gynecology Research Fellow, said the results were significant.

"For the first time, we identified clear evidence that a balloon catheter over vaginal prostaglandins leads to an improved safety profile for newborns, including fewer adverse events such as acidosis, poor condition after birth, or admission to a neonatal intensive care unit," Dr. Li said.

"Maternal adverse events did not show any difference between the two methods, nor was there a significant difference in the rates of cesarean section.

"What all this means is perinatal safety should be carefully assessed in shared decision-making and policymaking around choices of labor induction methods."

Medical Xpress, 11 November 2022

https://medicalxpress.com

New Medication Highly Effective in Treating Eczema

2022-11-14

Researchers involved in a new multi-site international phase III study led by Northwestern Medicine found that dupilumab was highly effective in reducing the signs and symptoms of moderate-to-severe eczema. This is the first study to treat moderate-to-severe eczema in infants and children 6 months to 5 years of age with a biologic drug (monoclonal antibody) instead of immune-suppressing medications.

More than half the children saw at least a 75% decrease in signs of eczema, highly significant reductions in itching, and better sleep after a 16-week course of dupilumab, a medication that targets a critical immune pathway in allergies.

This is the first large, random, placebo-controlled study of a monoclonal antibody for any skin condition, including eczema, in children as young as

More than half of the children treated saw a greater than 75% reduction in symptoms.

six months. The research, which included 31 sites throughout Europe and North America, was recently published in the journal The Lancet.

"Preschoolers who are constantly scratching, awake multiple times a night with their parents, irritable and markedly curtailed in their ability to do what other children their ages can do improved to the extent that they sleep through the night, change their personalities and have a normal life — as babies and children should," said lead study author Dr. Amy Paller, chair of dermatology at Northwestern University Feinberg School of Medicine and an attending physician at Ann & Robert H. Lurie Children's Hospital of Chicago.

Eczema, also known as atopic dermatitis, is a chronic inflammatory skin condition that causes itching and red, dry, often oozing, skin. It can have a significant impact on the life of both the patient and their family.

About one-fifth of all children under the age of six are thought to have eczema and 85 to 90% of those who have the condition as a whole experience its onset in the first five years of life.

The children's debilitating itch causes sleep problems, poor neurocognitive development, and, on average, a full night of missed sleep per week.

"The ability to take this drug will significantly improve the quality of life for infants and young children who suffer tremendously with this disease," Paller said. "Atopic dermatitis or eczema is so much more than just itchy skin. It is a devastating disease. The quality of life of severe eczema — not only for the child but also parents — is equivalent to many life-threatening diseases."

As a result of this study, this medication is now available to infants and preschoolers as young as 6 months of age. It has "an outstanding safety profile" and does not even require any laboratory tests before starting the medication, Paller said.

Although one-half to two-thirds of young children with eczema have mild symptoms, which can be handled with steroid ointment and moisturizers, the other one-third or more have moderate-to-severe disease and require more aggressive management.

"Up to now, all we have had to treat more severe eczema is immune-suppressing medications, such as oral steroids, which we try to avoid in children because they are associated with so many side effects and thus are not a preferred treatment for a chronic skin disease," Paller said. "The

CHEMWATCH
Bulletin Board
Gossip
NOV. 25, 2022

potential long-term impact on the development of the immune system in young children is also of concern with these immunosuppressants."

During the past few years, a new medication has become available called dupilumab, which is the first "biologic" drug to treat eczema in a targeted manner, meaning a narrow attack on just what scientists have found is causing the manifestations of the disease in the skin. This medication was found to be effective and safe in studies with adults, then adolescents, then other school-aged children.

"But the group in whom we worry the most about safety — those under 5 — had not been tested and were unable to get this medication," Paller said.

The parent or a health care provider gives the child a monthly shot to administer the medication.

"The effect for most of these younger children is dramatic and at least as good as we've seen with the risky immunosuppressant medications," Paller said.

Potential added benefit by treating associated allergies

This medication has also been shown to be effective for treating asthma, gastrointestinal manifestations of allergy, and other allergy-mediated problems but is not yet approved for these indications in infants and young children.

In fact, 66% of children in this trial had developed their eczema during the first six months of life and, by the time of initiating the dupilumab, more than 80% had already developed at least one allergic disorder, such as asthma or food allergy.

"By treating more aggressively to calm the immune system activation in these young children with early, severe eczema, we may also reduce the risk of their developing a range of allergic problems, changing their life beyond improving eczema," Paller said. "These associated allergic issues most often begin after eczema starts."

Children were randomized to receive either a placebo injection or the dupilumab (weight-based dosing) every four weeks for 16 weeks. Only children who were not responding adequately to topical medications were allowed to enroll, and they had to be of high severity, even with the topical medications.

As a result of the study, Paller said, scientists and physicians can start to better understand the relationships between eczema and a variety of allergic disorders and can consider the possibility of using this medication for other disorders that affect these very young children.

Sci Tech Daily, 14 November 2022

https://scitechdaily.com

New "Artificial Photosynthesis" System Produces Methane With 10x Efficiency

2022-11-13

Humans have relied on fossil fuels for concentrated energy for the past two centuries. Our society has been taking advantage of the convenient, energy-dense substances packed with the proceeds from hundreds of millions of years of photosynthesis. However, that supply is finite, and fossil fuel consumption has an enormous negative impact on Earth's climate.

"The biggest challenge many people don't realize is that even nature has no solution for the amount of energy we use," said University of Chicago chemist Wenbin Lin. Not even photosynthesis is that good, he said: "We will have to do better than nature, and that's scary."

"Artificial photosynthesis" is one possible option scientists are exploring. This entails reworking a plant's system to make our own kinds of fuels. However, the chemical equipment in a single leaf is incredibly complex, and not so easy to turn to our own purposes.

Now, an innovative new system for artificial photosynthesis that is more productive than previous artificial systems by an order of magnitude is presented in a study published in the journal Nature Catalysis on November 10 by six chemists at the University of Chicago. Unlike regular photosynthesis, which produces carbohydrates from carbon dioxide and water, artificial photosynthesis could produce ethanol, methane, or other fuels.

Although it still has a long way to go before it can become a way for you to fuel your car every day, the method gives scientists a new direction to explore. Plus, in the shorter term, it may be useful for the production of other chemicals.

"This is a huge improvement on existing systems, but just as importantly, we were able to lay out a very clear understanding of how this artificial

CHEMWATCH
Bulletin Board
Gossip
NOV. 25, 2022

University of Chicago breakthrough creates methane fuel from sun, carbon dioxide, and water.

system works at the molecular level, which has not been accomplished before," said Lin, who is the James Franck Professor of Chemistry at the University of Chicago and senior author of the study.

'We will need something else'

"Without natural photosynthesis, we would not be here. It made the oxygen we breathe on Earth and it makes the food we eat," said Lin. "But it will never be efficient enough to supply fuel for us to drive cars; so we will need something else."

The trouble is that photosynthesis is built to create carbohydrates, which are great for fueling us, but not our cars, which need much more concentrated energy. So researchers looking to create alternates to fossil fuels have to re-engineer the process to create more energy-dense fuels, such as ethanol or methane.

In nature, photosynthesis is performed by several very complex assemblies of proteins and pigments. They take in water and carbon dioxide, break the molecules apart, and rearrange the atoms to make carbohydrates—a long string of hydrogen-oxygen-carbon compounds. Scientists, however, need to rework the reactions to instead produce a different arrangement with just hydrogen surrounding a juicy carbon core—CH4, also known as methane.

This re-engineering is much trickier than it sounds; people have been tinkering with it for decades, trying to get closer to the efficiency of nature.

Lin and his lab team thought that they might try adding something that artificial photosynthesis systems to date haven't included: amino acids.

The team started with a type of material called a metal-organic framework or MOF, a class of compounds made up of metal ions held together by an organic linking molecule. Then they designed the MOFs as a single layer, in order to provide the maximum surface area for chemical reactions, and submerged everything in a solution that included a cobalt compound to ferry electrons around. Finally, they added amino acids to the MOFs, and experimented to find out which worked best.

They were able to make improvements to both halves of the reaction: the process that breaks apart water and the one that adds electrons and protons to carbon dioxide. In both cases, the amino acids helped the reaction go more efficiently.

Even with the significantly improved performance, however, artificial photosynthesis has a long way to go before it can produce enough fuel to be relevant for widespread use. "Where we are now, it would need to scale up by many orders of magnitude to make a sufficient amount of methane for our consumption," Lin said.

The breakthrough could also be applied widely to other chemical reactions; you need to make a lot of fuel for it to have an impact, but much smaller quantities of some molecules, such as the starting materials to make pharmaceutical drugs and nylons, among others, could be very useful.

"So many of these fundamental processes are the same," said Lin. "If you develop good chemistries, they can be plugged into many systems."

The scientists used resources at the Advanced Photon Source, a synchrotron located at the U.S. Department of Energy's Argonne National Laboratory, to characterize the materials.

The co-first authors of the paper were Guangxu Lan (PhD'20, now with Peking University), graduate student Yingjie Fan, and Wenjie Shi (Visiting student, now with Tianjin University of Technology. The other authors of the paper were Eric You (BS'20, now a graduate student at MIT) and Samuel Veroneau (BS'20, now a PhD student at Harvard University).

Sci Tech Daily, 13 November 2022

https://scitechdaily.com

A new analysis shows a "crisis" of male reproductive health

2022-11-15

For years, scientists across the world have gathered evidence showing declines in sperm quality. Now, new research compiling the results of those studies has found that sperm count has dropped dramatically around the world, and the rate of decline is accelerating.

In a new analysis, researchers at Mount Sinai Medical Center, the University of Copenhagen, and the Hebrew University of Jerusalem, among others, found that sperm count globally dropped by more than half between 1973 and 2018, and that the decline is accelerating: Since 1972, sperm count has dropped by about 1% each year. Since 2000, the annual decrease has been, on average, more than 2.6%.

Global average sperm count is declining at a quicker pace than previously known, chemical exposure is a suspected culprit.

CHEMWATCH
Bulletin Board
Gossip
NOV. 25, 2022

The findings raise concerns that an increasing number of people will need assistance to reproduce, as well as concerns about the overall health of human society, since low sperm count is linked to higher rates of some diseases. And while scientists are still trying to tease out the reasons for the drop, chemical exposures, especially to pesticides, are a likely factor — and climate change may even play a role. Researchers are calling for urgent action to bolster more research into sperm count, determine the causes of the decline, and prevent further deterioration of male reproductive health.

"We have clear evidence that there is a crisis in male reproduction," Hagai Levine, lead author on the study and an epidemiologist at the Hebrew University of Jerusalem, told EHN.

An "alarming" decline

The study builds on the team's previous research, which showed a decline in sperm count in North America, Europe, Australia, and parts of Asia of 28.5% between 1973 and 2011. Adding data from 38 studies to the new analysis has made the case for sperm decline stronger, Shanna Swan, an author on the paper and a leading reproductive epidemiologist at Mount Sinai, told EHN. "It's really alarming," said Swan, who is also an adjunct scientist with Environmental Health Sciences, which publishes EHN.org

Swan authored the book Count Down: How Our Modern World Is Threatening Sperm Counts, Altering Male and Female Reproductive Development, and Imperiling the Future of the Human Race.

The research found that the average global sperm count in 2018 was 49 million per milliliter of semen. When a man's sperm count drops below about 45 million per milliliter, his ability to cause a pregnancy starts dropping dramatically, said Swan. She said the results could mean that in the coming decades, large swaths of the global population of men could be subfertile or infertile, or could require assisted reproduction techniques, like in vitro fertilization (IVF), hormone treatment, or a technique called intracytoplasmic sperm injection (ICSI), in which sperm are directly injected into an egg.

In addition to the drop in average sperm count, Levine said it was surprising that the rate of decline was accelerating, rather than slowing down. "Is there a tipping point, that once you cross, you get an even worse situation?" he said. "That's something to really pay attention to."

Overall, said Levine, the results indicate that "something is very wrong with our global modern environment."

Sperm count is not only a reproductive concern, but an indicator for other health problems in men, and is used as a predictor for male longevity. Men with poor sperm count tend to have higher rates of cardiovascular disease, certain cancers and even death, Michael Eisenberg, a professor of urology at Stanford University who was not involved in the research, told EHN. "This decline in sperm count could also suggest other health concerns," he said.

A 2016 study authored by Eisenberg found that diabetes and other diseases were associated with lower reproductive health. However, said Eisenberg, the reason why overall health is linked to sperm quality is still unknown.

Eisenberg said the new study on sperm count decline is a "powerful addition" to previous evidence that sperm count across the globe has declined.

Reasons for the trend

Though the reasons for the drop were not discussed in the paper, scientists have known for decades that certain environmental factors, like exposures to pesticides (such as atrazine, alachlor, and diazinon) and other endocrine-disrupting chemicals, like phthalates, and polychlorinated biphenyls (PCBs), can have impacts on reproductive health. Nearly 20 years ago, for example, Swan and other researchers published an analysis of research into links between pesticide exposure and sperm quality, and found that 79% of studies indicated a decrease in sperm quality among those exposed to the chemicals. Diet, activity level, and stress may also play a role.

Swan and Levine said exposures to chemicals in the environment and other factors likely all play a substantial role in the sperm count trend. And, the risk factors are related; for example, obesity is a risk factor for lower quality sperm, but certain endocrine-disrupting chemicals — which interfere with how hormones work — are thought to contribute to obesity, as well. Diet is hard to decouple from chemical exposures, too, since pesticide residues linger on much of the food we eat.

Additionally, both Swan and Levine said climate change could be a factor, both due to climate-related stress and actual fluctuations in temperature, since heat waves are linked to decreases in sperm quality.

CHEMWATCH
Bulletin Board
Gossip
NOV. 25, 2022

Prenatal exposure may be a contributor, too. Chemical exposures during the male "programming window," when reproductive traits are formed in utero, have an outsized effect on sperm quality later in life, said Swan. For example, she said, when a man smokes — a known endocrine-disrupting activity — he lowers his sperm count by about 20%. When a male is born to a woman who smokes, his sperm count is reduced by about 50%. Those effects may last for generations before subsequent children and grandchildren return to normal sperm counts.

Protecting reproductive health

Levine is optimistic that scientists and policymakers can reverse the trend if they can determine the causes. Swan pointed to the sharp drop in cigarette smoking in the past 50 years as evidence that widespread lifestyle changes are possible, and said that any large-scale adoption of healthier habits, like better diets and more physical activity, can help improve reproductive health.

Making individual lifestyle changes like choosing organic, pesticide-free produce and staying away from certain plastics and chemical products can help lower a person's exposure to endocrine-disrupting chemicals, too. However, doing so can be difficult, especially for disadvantaged populations with less access to fresh foods, higher environmental exposures, and fewer means to purchase safer, non-toxic household goods.

To truly tackle the problem, though, much more research is needed, said Swan. One thing she'd like to see would be better tracking of sperm count, similar to how the U.S. Centers for Disease Control and Prevention tracks obesity. Levine also said better surveillance tools will be crucial to understanding the problem more deeply.

Once humankind "defines a problem and puts our resources and mind into it, we find solutions that we could not have thought about when we started," said Levine. "It's always theoretically reversible."

Environmental Health News, 15 November 2022

https://ehn.org

Coming Soon: A Pollution Map That's As Easy to Access As a Weather Forecast

2022-11-15

North Texas environmental health advocates and scientists from Texas A&M University have received funding to create a system that will allow the public to track air pollution similar to how they follow the weather forecast.

Texas A&M and the nonprofit Downwinders at Risk were last week awarded a $250,000 grant to pay for a computer model that can predict air pollution across the region down to the hour. The money comes from Google's Environmental Justice Data Fund, which has a goal to fund programs that help improve the air quality of neighborhoods near industry.

It's an extension of the SharedAirDFW Network, an existing partnership with the University of Texas at Dallas, Paul Quinn College, the city of Plano, and Dallas County. That program started with eight strategically-placed air monitors that track air quality across neighborhoods in southern Dallas, Mesquite, Richardson, Fort Worth, and Plano. There are now more than 100 situated across North Texas.

The new initiative takes those goals to the next level. It involves mounting a "super-powered" gas analyzer to a vehicle that will drive through neighborhoods similar to how Google collects its Street View media. This so-called "mobile laboratory" will report back data to combine with the scientists' modeling, delivering the public a mapped reading of dozens of pollutants found each day in communities in real time.

By 2024, the researchers hope to produce a five-to-seven-day air forecast as well as an hourly pollutant concentration map for the entire region. A forecast map with hourly information about air quality would be the first in Texas. A prototype version of the system was built in Houston, but the Dallas initiative's ambitions for daily and weekly projections set it apart.

"It used to be large corporations or government agencies that could do this kind of thing," said Jim Schermbeck, the director of Downwinders at Risk. "We are very excited about having the potential to do this because we think it will be a great way to identify new hotspots, new pollution hotspots, and possible new nonattainment areas for pollutants."

He hopes that tracking air pollution in real-time, and by offering predictions, could shape environmental legislation within local and state

North Texas environmental health advocates and Texas A&M University scientists have received a $250,000 grant to track pollution in real time. They hope it will shape policy and affect everyday behavior.

CHEMWATCH
Bulletin Board
Gossip
NOV. 25, 2022

governments. The organizers believe tracking the data is key to addressing environmental justice efforts for Black and Brown neighborhoods that have disproportionately been subjected to industrial polluters.

It will pair nicely with research from Paul Quinn College that mapped Dallas' largest polluters and the city of Dallas' investment in mobile air monitors, which have been placed near some industrial operators. Schermbeck sees the new system functioning as a critical piece of information in a fight against "racist zoning patterns that are still at play today." Many studies have tied particulate matter air pollution to illnesses and diseases ranging from asthma to autism.

"We're excited to build this new high-tech tool to map the accumulation of pollution many frontline residents know they're breathing," said Evelyn Mayo, the chair of Downwinders and the Urban Research Initiative Fellow at Paul Quinn. "This is a tool that'll show who's in harm's way."

Building the model is Dr. Qi Ying, a Texas A&M associate professor of civil and environmental engineering. He will use the U.S. Environmental Protection Agency's modeling template as a baseline to estimate the concentration of 31 different forms of pollutants in the air. Dr. Natalie Johnson, an A&M associate professor and environmental toxicologist, will take the "mobile laboratory" on the road to calibrate the projection model's accuracy in real time.

"This closes some of the giant gaps related to environmental justice issues with disparities in air quality," Johnson said. "We will be able to work with fence-line communities to provide extremely detailed maps. And in the future, we will be able to look at how this is related to health and what it means in terms of informing the intervention around improved zoning and neighborhood planning."

It will likely take two years before the system will be ready to use. It comes at an important time for local environmental policy. The city of Dallas is overhauling its land use plan, which advocates like Downwinders are pushing to include measures that will prevent industry from operating near homes and schools.

But Schermbeck also sees a more intimate way to use the technology: allow North Texas residents to make the healthiest choices for their families each day.

"There are all kinds of applications for this project," Schermbeck said. "Like the monitoring, you don't really see all of them when you start doing

it. But they become clearer over time as people use the tool and the information becomes more relevant to people's lives."

D Magazine, 15 November 2022

https://dmagazine.com

Stem cells (and mini brains) grown from critically endangered rhinos

2022-11-14

The Sumatran rhino is critically endangered and difficult to breed. But now, researchers have created induced pluripotent stem cells (iPSCs) from the genetic material of a male, potentially providing new ways to help conservation efforts. They even used them to grow mini rhino brains in the lab.

Once widespread across southeast Asia, there are now fewer than 80 individual Sumatran rhinos left on Earth. Habitat loss and poaching for its horn are the main threats to its existence, and conservation efforts haven't been as successful as hoped because the animals don't thrive in captivity, and struggle to breed.

To give them a much needed leg up, scientists at the Max-Delbrück-Center for Molecular Medicine (MDC) have turned to lab-based tools. Mature cells can be reprogrammed to become iPSCs, which can in turn become almost any other cell in the body – and in this study, the team generated iPSCs out of skin cells taken from Kertam, the last male Sumatran rhino in Malaysia, who died in 2019.

These iPSCs were found to successfully produce cells from the three germ layers – the endoderm, mesoderm and ectoderm – which in turn can give rise to all of an animal's tissues and organs. Next, the researchers used the stem cells to grow cerebral organoids – essentially, miniature rhino brains – in lab dishes. All neural markers tested for were detected, indicating the potential of these cells to produce complex organs.

But of course, the most important implication from this work is that iPSCs could be used to help improve the success of breeding Sumatran rhinos and increase their genetic diversity. Kertam's legacy could live on long past his death.

"We conserved his genetic information and created an opportunity to produce viable spermatozoa for breeding purposes in the future," said Vera Zywitza, first author of the study. "As the quality of semen collected

Once widespread across southeast Asia, there are now fewer than 80 individual Sumatran rhinos left on Earth.

CHEMWATCH
Bulletin Board
Gossip
NOV. 25, 2022

from Sumatran rhinos is poor directly after retrieval and even worse after cryopreservation and thawing, in vitro-generated spermatozoa offer a great alternative for assisted breeding of Sumatran rhinos in general."

The research was published in the journal iScience.

New Atlas, 14 November 2022

https://newatlas.com

A New, Better Way to Desalinate Water

2022-11-14

A team led by King Abdullah University of Science & Technology (KAUST) has shown how ultrathin polymer-based ordered membranes can efficiently remove salt from brine and seawater, offering a potential alternative for current desalination systems.

"Water desalination membranes should simultaneously exhibit high water flux and high salt rejection," says Yu Han, who led the study. Carbon nanomaterials, such as carbon nanotubes and graphene, are projected to match these requirements because of their unique surface chemistry and tendency to stack into channels with diameters less than one nanometer. However, the challenges of channel alignment and stacking prevent their large-scale use in membranes.

"One way to address these limitations is through two-dimensional porous carbonaceous membranes with regular and uniformly distributed subnanometer-sized molecular transport channels," says first author Jie Shen, a postdoc in Han's group. However, these membranes are typically synthesized in solution, which promotes the random growth of a disordered three-dimensional structure with poorly defined micropores.

Using chemical vapor deposition, Yu Han, Vincent Tung, Ingo Pinnau, and Lance Li, a former researcher at KAUST who is now affiliated with the University of Hong Kong, have developed a technique that helps control the growth of two-dimensional conjugated polymer frameworks into ultrathin carbon films.

The researchers deposited the monomer triethynylbenzene on atomically flat single-crystalline copper substrates in the presence of an organic base that acts as a catalyst. Triethynylbenzene bears three reactive groups that serve as anchor points for additional monomers. These groups show a 120-degree angle with respect to each other, generating organized

Novel membranes can remove salt from water.

arrays of well-defined cyclic structures that stack into subnanometer-sized rhombic hydrophobic channels.

The membrane displayed excellent water desalination performance in forward and reverse osmosis configurations, surpassing those containing advanced materials such as carbon nanotubes and graphene. It also showed strong rejection for divalent ions, as well as small charged and neutral molecules.

The researchers discovered that the water molecules formed a three-dimensional network inside the membrane instead of moving through the membrane along vertical triangular channels as one-dimensional chains. This explains the fast water transport through the membrane. "This unexpected result revealed that the seemingly discrete vertical channels are actually interconnected by short horizontal channels that can be easily overlooked in the projected structural model," Han says.

The team is now working on improving the antifouling property, mechanical strength, and long-term chemical stability of the membrane for future practical applications. They are also fine-tuning its surface-charge properties and channel sizes. "Our ultimate goal is to provide a versatile multifunctional platform that meets the needs of various applications, such as ion sieving, single-molecule sensing, and neural interfaces," Han says.

Sci Tech Daily, 14 November 2022

https://scitechdaily.com

Neurotoxicological hazard assessment without animal testing

2022-11-15

The development of our nervous system in the womb and during the first years of life is a highly complicated process: Nerve cells proliferate by cell division, specialize, change their position in the tissue and interconnect to form networks of innumerable cells.

However, this complexity also makes the development of the nervous system vulnerable, for example, to the harmful effects of environmental toxicants. The negative consequences often only become apparent much later—in childhood or adulthood.

It is therefore all the more surprising that fewer than 200 substances worldwide have been tested for their developmental neurotoxicity (DNT) in accordance with the official guidelines of the Organization for Economic Cooperation and Development (OECD)—despite the high relevance of such data for consumer safety. Obvious reasons for this include the enormous cost of at least one million euros per substance for DNT studies conducted in animals.

Fewer than 200 substances worldwide have been tested for their developmental neurotoxicity (DNT) in accordance with the official guidelines of the OECD.

An alternative to animal testing

In order to reduce the effort required for hazard assessment while maintaining or even increasing reliability, an international research team led by Marcel Leist (University of Konstanz) and Ellen Fritsche (Heinrich Heine University Düsseldorf and IUF) developed an animal-free testing battery to detect DNT and used it to test 120 substances.

"Among them were some substances known to be toxic to the nervous system, such as certain pesticides or flame retardants, as well as substances considered to be harmless to serve as negative controls," explains Fritsche, professor at the IUF–Leibniz Research Institute for Environmental Medicine (IUF) in Düsseldorf.

The results of this extensive study have just been published in the journal Chemosphere and are extremely promising: They show that the carefully compiled testing battery is technically feasible and already has a measurement sensitivity that is on a par with animal experiments. The battery provided alerts for more than 80% of the known toxicants among the tested substances and for none of the harmless substances used as negative controls.

"However, we also discovered 'gaps' in our testing battery. Thus, in the article we also mention possibilities which test procedures could be added to the battery to close them," says Jonathan Blum, lead author of the study and a member of the Leist research group at the Department of Biology at the University of Konstanz.

Higher relevance for humans

All test procedures included in the battery are based on cell cultures. This means that they are not carried out on living organisms, but "in the test tube" (in vitro). Even more importantly, human cells are used for all tests. "Ideally, this increases the conclusiveness of the test procedures compared to animal testing, since the respective results do not have to be transferred from an animal model, such as mice or rats, to the processes relevant for humans," Fritsche describes one of the potential advantages of using human cells.

Such in vitro methods as well as all other alternative methods to classical animal testing in toxicology are referred to as "new approach methods" (NAMs). Further general advantages of NAMs are the comparatively low costs and the possibility of testing significantly more substances for their toxicity in high-throughput procedures than would be possible in animal testing in the same period of time. Consequently, NAMs are an important part of current concepts of next generation risk assessment—by both scientific and regulatory bodies.

This is particularly relevant in view of the thousands of industrial chemicals that have not yet been tested, but nevertheless are produced at a rate of more than 1,000 tons per year. The findings obtained in the current study play a very important role in this, confirms Andrea Terron, who works for the European Food Safety Authority (EFSA) in Parma and was involved in the study: "The study was a cornerstone of our strategy at EFSA to obtain and use DNT data from human relevant in vitro tests for risk assessment."

Application in the regulatory context

A first concrete application for the testing battery could be screening the large number of pesticides and substances in the living and working environments for which currently only insufficient or no DNT data are available. In fact, key international organizations, including the OECD, are taking the first steps toward implementing the testing battery and using it for regulatory purposes. "This study has been extensively discussed by OECD member countries and formed the basis of a draft guidance on how to interpret data from the DNT in vitro battery," says Magdalini Sachana of the OECD.

For example, when a pesticide is re-approved in the EU, the testing battery could provide hazard data for the substance to be evaluated, which in the best case would already allow a final assessment with regard to DNT. "If the data are not finally conclusive, follow-up tests could be carried out, such as the extensions we have proposed for our testing battery," Blum says, explaining one possible approach.

A new alliance of the study authors with other European partners to further develop the testing battery has planned work that will also include input from the U.S. Environmental Protection Agency. In order to make the

CHEMWATCH
Bulletin Board
Gossip
NOV. 25, 2022

tests available to end users, such as the pesticide industry, Ellen Fritsche's team recently founded the start-up DNTOX.

Phys Org, 15 November 2022

https://phys.org

Smoke Residue Can Trigger Skin Diseases

2022-11-18

Thirdhand smoke (THS) refers to the residual pollutants from tobacco smoke that linger on surfaces and in dust after the tobacco has been smoked. It may remain on indoor surfaces indefinitely, subjecting both smokers and non-smokers to potentially dangerous exposure.

According to a group of scientists at the University of California, Riverside, acute skin exposure to THS raises biomarkers linked to the onset of skin diseases such as contact dermatitis and psoriasis.

The study discovered that acute thirdhand smoke exposure increased urine biomarkers of oxidative damage to DNA, lipids, and proteins and that these biomarkers remained elevated after the exposure ended.

"We found exposure of human skin to THS initiates mechanisms of inflammatory skin disease and elevates urinary biomarkers of oxidative harm, which could lead to other diseases, such as cancer, heart disease, and atherosclerosis," said Shane Sakamaki-Ching, a former graduate student at UC Riverside who graduated with a doctoral degree in cell, molecular, and developmental biology in March 2022. "Alarmingly, acute dermal exposure to THS mimics the harmful effects of cigarette smoking."

The study is the first to be conducted on people who have been exposed to THS dermally, and it was recently published in the journal eBioMedicine.

Ten healthy, non-smokers between the ages of 22 and 45 participated in the clinical study, which was conducted at the University of California, San Francisco. Per participant wore clothing impregnated with THS for three hours and either walked or ran on a treadmill for at least 15 minutes each hour to induce perspiration and enhance THS absorption through the skin. Participants were unaware that the clothes contained THS. The subjects' blood and urine samples were then taken on a regular basis to check for protein changes and indications of oxidative stress brought on by the THS. Participants in the control exposure wore clean clothes.

"We found acute THS exposure caused elevation of urinary biomarkers of oxidative damage to DNA, lipids, and proteins, and these biomarkers remained high after the exposure stopped," said Sakamaki-Ching, now a research scientist at Kite Pharma in California, where he leads a stem cell team. "Cigarette smokers show the same elevation in these biomarkers.

Our findings can help physicians in diagnosing patients exposed to THS and help develop regulatory policies dealing with remediation of indoor environments contaminated with THS."

Prue Talbot, a professor of cell biology in whose lab Sakamaki-Ching worked, explained that skin is the largest organ to contact THS and may thus receive the greatest exposure.

"There is a general lack of knowledge of human health responses to THS exposure," said Talbot, the paper's corresponding author. "If you buy a used car previously owned by a smoker, you are putting yourself at some health risk. If you go to a casino that allows smoking, you are exposing your skin to THS. The same applies to staying in a hotel room that was previously occupied by a smoker."

The THS exposures that the 10 participants were subjected to were relatively brief and did not cause visible changes in the skin. Nevertheless, the molecular biomarkers in blood that are associated with early-stage activation of contact dermatitis, psoriasis, and other skin conditions were elevated.

"This underscores the idea that dermal exposure to THS could lead to molecular initiation of inflammation-induced skin diseases," Sakamaki-Ching said.

Next, the researchers plan to evaluate residues left by electronic cigarettes that can come into contact with human skin. They also plan to evaluate larger populations exposed to longer periods of dermal THS.

Sci Tech Daily, 18 November 2022

https://website

All-perovskite tandem solar cell boasts high efficiency, record voltage

2022-11-15

Engineers have developed a new solar cell with a record voltage and (arguably) a record efficiency for its kind. The all-perovskite tandem solar cell uses two layers of perovskite that tap into different wavelengths of light, plus a special surface treatment that reduces wasted energy.

In the field of photovoltaics, perovskite is a particularly promising material that's gunning for silicon's crown. Not only is it great at absorbing energy

The material's thickness and chemical composition can be tweaked to allow it to tap into different parts of the solar spectrum.

CHEMWATCH
Bulletin Board
Gossip
NOV. 25, 2022

from sunlight, but it's thinner, lighter, more flexible, and easier and cheaper to manufacture.

Efficiency-wise, perovskite has shot up drastically in a little over a decade, from under 4% in 2009 to over 25% in 2021, now rivaling silicon. It works even better in so-called tandem cells, where multiple layers of materials are stacked on top of each other to harvest different wavelengths of light from the Sun. Perovskite-silicon tandem solar cells, for instance, recently passed the 30% efficiency milestone.

In the new study, a team of engineers has created and tested an all-perovskite tandem solar cell. How can a solar cell be all-perovskite but still tandem? The material's thickness and chemical composition can be tweaked to allow it to tap into different parts of the solar spectrum, so two different versions of the material can be combined in one device.

"In our cell, the top perovskite layer has a wider band gap, which absorbs well in the ultraviolet part of the spectrum, as well as some visible light," said Chongwen Li, co-lead author of the study. "The bottom layer has a narrow band gap, which is tuned more toward the infrared part of the spectrum. Between the two, we cover more of the spectrum than would be possible with silicon."

Using this design, the team reported that a solar cell measuring 1 cm2 (0.15 in2) had a maximum efficiency of 27.4%, which would be a record for its type and impressive for any kind of solar cell. However, the team stops short at claiming the title, since an independent certification by NREL recorded an efficiency of 26.3% – just 0.1% short of the current official record-holder.

Where the cell did achieve a new record is in its voltage. The team measured an open-circuit voltage of 2.19 electron volts, the highest of any all-perovskite tandem solar cell.

Both of these impressive stats came thanks to tweaks made at the interface between the perovskite light-absorbing layer and the layer that carries electrons away. The team found that the electric field wasn't consistent across the surface of the perovskite, meaning some electrons would be lost to the circuit. So the team added a thin coat of what's called 1,3-propanediammonium (PDA), which evens out the charge of the surface.

The team says that future work will focus on boosting the solar cell's efficiency by making the cell more stable, increasing the current, and expanding the size of the cell.

The research was published in the journal Nature.

New Atlas, 15 November 2022

https://newatlas.com

Rats can bop to the beat – a trait once thought to be exclusively human

2022-11-14

Naturally recognising a beat in a song – known as beat synchronicity – is something that humans are naturally good at. Even if you've never heard a song in your life, the ability to bop your head or tap your feet at the right time is a trait that we take for granted.

But research has found that it's not just a human trait. First it was Snowball, a pet sulphur-crested cockatoo, who went viral a decade ago for his headbanging and ended up the star of a paper in Current Biology.

Now, researchers have published a paper in Science Advances showing that rats also have the ability to recognise beats, and the finding might help scientists understand the mechanism behind how this occurs in humans.

"Rats displayed innate — that is, without any training or prior exposure to music — beat synchronisation most distinctly within 120-140 bpm (beats per minute), to which humans also exhibit the clearest beat synchronisation," explained biomedical engineer Associate Professor Hirokazu Takahashi from the University of Tokyo.

"The auditory cortex, the region of our brain that processes sound, was also tuned to 120-140 bpm, which we were able to explain using our mathematical model of brain adaptation."

The researchers attached an accelerometer to the head of 10 rats, and then played music for them. The rats listened to 60 second excerpts of 'Sonata for Two Pianos' in D major, by Mozart.

They played at four different tempos — 99 BPM (which is 75% of the original), 132 BPM (normal speed), 264 BPM (twice the original), and 528 BPM (four times the original).

The accelerometers allowed the researchers to measure the slightest head movements in the rats. They also did the research in 20 human participants, with accelerometers attached to headphones.

The team found that just like humans, the 132 BPM version was the one that the beat was most understood, and the rats' beat synchronicity was clearest.

The team found that just like humans, the 132 BPM version was the one that the beat was most understood, and the rats' beat synchronicity was clearest.

This is a little surprising, as rats are generally a lot 'faster' than humans. Their heartbeat, breathing rate, circulation time and lifespan are all shorter, and so the team thought that maybe the ideal tempo would be faster as well.

Instead, the similar BPM result means that maybe the speed is determined by something called the brain 'time constant', suggesting that our ability to keep the beat has been conserved in the brain waves of both humans and rats.

"After conducting our research with 20 human participants and 10 rats, our results suggest that the optimal tempo for beat synchronization depends on the time constant in the brain," said Takahashi.

"This demonstrates that the animal brain can be useful in elucidating the perceptual mechanisms of music."

Although this might just seem like a cute, unimportant experiment, understanding why only some animals – including rats – seem to be able to understand beats will help us get to the bottom of why music is so important to us… and Snowball the cockatoo.

Cosmos, 11 November 2022

https://cosmosmagazine

Forever Young: Scientists Reveal the Secret to a Strange Animal's Eternal Youth

2022-11-14

Sea anemones are seemingly immortal animals. They seem to be immune to aging and the negative impacts that humans experience over time. However, the exact reasons for their eternal youth are not completely understood.

The genetic fingerprint of the sea anemone Nematostella vectensis reveals that members of this incredibly ancient animal phylum employ the same gene cascades for neural cell differentiation as more complex organisms. These genes are also in charge of maintaining the balance of all cells in the organism during the anemone's lifetime. These findings were recently published in the journal Cell Reports by a group of developmental biologists headed by Ulrich Technau of the University of Vienna.

Almost all animal organisms are made up of millions, if not billions, of cells that join together in intricate ways to create specific tissues and organs,

CHEMWATCH
Bulletin Board
Curiosities
NOV. 25, 2022

which are made up of a range of cell types, such as a variety of neurons and gland cells. However, it is unclear how this critical balance of diverse cell types emerges, how it is regulated, and if the different cell types of different animal organisms have a common origin.

Single-cell fingerprint leads to common ancestors

The research group, led by evolutionary developmental biologist Ulrich Technau, who is also head of the Single Cell Regulation of Stem Cells (SinCeReSt) research platform at the University of Vienna, has deciphered the diversity and evolution of all nerve and gland cell types and their developmental origins in the sea anemone Nematostella vectensis.

In order to achieve this, they used single cell transcriptomics, a method that has revolutionized biomedicine and evolutionary biology over the past decade.

"With this, entire organisms can be resolved into single cells – and the entirety of all currently expressed genes in each individual cell can be decoded. Different cell types fundamentally differ in the genes they express. Therefore, single cell transcriptomics can be used to determine the molecular fingerprint of each individual cell," explains Julia Steger, the first author of the current publication.

In the study, cells with an overlapping fingerprint were grouped. This allowed the scientists to distinguish defined cell types or cells in transitional stages of development, each with unique expression combinations. It also allowed the researchers to identify the common progenitor and stem cell populations of the different tissues.

To their surprise, they found that contrary to earlier assumptions, neurons, glandular cells, and other sensory cells originate from one common progenitor population, which could be verified by genetic labeling in living animals. Since some gland cells with neuronal functions are also known in vertebrates, this could indicate a very old evolutionary relationship between gland cells and neurons.

Ancient genes in constant use

One gene plays a special role in the development of these common ancestor cells. SoxC is expressed in all precursor cells of neurons, gland cells, and cnidocytes and is essential for the formation of all these cell types, as the authors were additionally able to show in knockout experiments.

In sea anemones, highly conserved genes guarantee the lifelong differentiation of neurons and glandular cells.

"Interestingly, this gene is no stranger: It also plays an important role in the formation of the nervous system in humans and many other animals, which, together with other data, shows that these key regulatory mechanisms of nerve cell differentiation seem to be conserved across the animal kingdom," says Technau.

By comparing different life stages, the authors also found that in sea anemones, the genetic processes of neuron development are maintained from the embryo to the adult organism, therefore contributing to the balance of neurons throughout the life of Nematostella Vectensis.

This is remarkable because, unlike humans, sea anemones can replace missing or damaged neurons throughout their lives. For future research, this raises the question of how the sea anemone manages to maintain these mechanisms, which in more complex organisms only occur in the embryonic stage, into the adult organism in a controlled manner.

Sci Tech Daily, 14 November 2022

https://scitechdaily.com

Why you should throw away your non-stick pan the second it cracks

2022-11-14

Non-stick cookware is often a kitchen favorite because food doesn't stick to its surface—making it easy to whip up dinner without a huge cleaning hassle. The kitchen essential has grown in popularity since scientists created the first non-stick cooking pan in 1954, but the COVID-19 pandemic drove a surge. The market demand for non-stick cookware reached 206.1 million units worldwide in 2020 and is expected to increase even more due to the growing preference for it.

The non-stick coating is made of a synthetic fluoropolymer called polytetrafluoroethylene (PTFE), more commonly known under the brand name Teflon. A 2022 report from the non-profit organization Ecology Center shows that 79 percent of non-stick cooking pans and 20 percent of non-stick baking pans were coated with PTFE.

In a new Science of The Total Environment study, the authors simulated the cooking process with different non-stick pots and pans using turners made of different materials, like steel or wood. They found that non-stick cookware mainly coated with Teflon may release about 9100 plastic particles during the cooking process if it has a surface crack. Should

One surface crack on a PTFE-coated pan releases about 9,100 plastic particles.

CHEMWATCH
Bulletin Board
Curiosities
NOV. 25, 2022

something break the coating, around 2,300,000 microplastics and nanoplastics may be released and potentially find their way into food.

These cracks are a problem because PTFE falls under per- and polyfluorinated substances (PFAS), a group of chemicals that don't break down in the environment, contaminate soil and water and build up in the bodies of living creatures. Once millions of PFAS plastic particles are released, they will circulate in the ecosystem for a long time, which explains why they are commonly dubbed "forever chemicals." Its widespread occurrence in the environment may increase human exposure to PFAS, potentially leading to health impacts like altered metabolism, increased risk of being overweight or obese, and reduced ability to fight infections.

The authors quantified the release of plastic particles from non-stick cookware by scanning the surfaces of different non-stick pots to generate data. The data was then converted to an image using three algorithms to visualize the microplastics and nanoplastics directly, says Cheng Fang, senior research fellow in the Global Centre for Environmental Remediation (GCER) at the University of Newcastle in Australia, who was involved in the study.

"PFAS are a class of chemicals that are characterized by extremely long environmental persistence," says Graham Peaslee, professor of physics at the University of Notre Dame who was not involved in the study. "The smaller PFAS don't break down from exposure to sunlight, microorganisms, or anything else routinely, which means they can last for hundreds of years or longer in the environment once created."

To avoid contaminating food or the environment with plastic particles from PTFE cookware, at-home chefs must use soft turners or non-sharp utensils that don't scratch the surface during the cooking and cleaning process. Should there be any scratches on the cookware, replacement is recommended, says Fang.

Still, cracked surfaces aren't the only thing to consider when cooking with Teflon. The coating can also release toxic chemicals into the air when it reaches extreme temperatures. There are several cases of individuals experiencing temporary, flu-like symptoms from polymer fume fever—as a result.

Peaslee says re-evaluating the necessity of Teflon-coated cookware may reduce our exposure to PFAS. He adds that it may have been marketed as a great new technology in the 1950s, but cast iron always worked just

as well. Fluoropolymers are concerning for environmental and human health because they emit PFAS during production, processing, use, and end-of-life treatment. There are reasonable alternatives that will do less harm to the environment and not support the fluoropolymer industry, like ceramics or stainless steel, says Peaslee.

Although much is yet to be known about the impacts of microplastic pollution on the environment, reducing the use of plastics and improving the recycling process should be paramount, says Fang.

"In our daily lives, we have lots of plastic items surrounding us," he adds. "Most of them can gradually release microplastics and nanoplastics in their lifetimes, as tested and confirmed in this study."

Popular Science, 14 November 2022

https://popsci.com

The Green Steel of the 21st Century

2022-11-14

About four stories up a gleaming tower block in downtown Hong Kong, a shirtless figure clambers horizontally across the building's facade, fastens a knot and then leaps down a level like a real-life Spider-Man.

But rather than relying on hyper-elastic webs to transport himself, the young man has his own kind of miracle material: bamboo. Vast lattices of it cover the building and countless others across the bustling Asian metropolis.

"I think that bamboo may be the future," says Wallace Chang, a professor in the University of Hong Kong's Department of Architecture. "From a material point of view, bamboo is very sustainable. It's relatively cheap. It's a phenomenon."

Throughout Chinese history, bamboo has been widely used in construction as well as everything from basket weaving to concocting sugary juice, according to Chang, who wrote Bamboo Theatre, a book tracing the culture of Hong Kong's bamboo opera, including the spectator stands made of bamboo and the masters producing them.

In Hong Kong, the material is closely intertwined with the craft and apprenticeships of scaffolding and construction, and it's common to see 50-story skyscrapers like the Bank of China wrapped in it. Skilled armies of scaffolders — today the city has 2,479 registered experts — can erect

Cheap, strong and plentiful, bamboo has been used in Hong Kong for ages as an ultra-sustainable building material. Other countries are catching on.

CHEMWATCH
Bulletin Board
Curiosities
NOV. 25, 2022

enough bamboo to cover a building in a day, using techniques that are thousands of years old. "In mainland China, Taiwan and Macau, bamboo is diminishing, and it is being replaced," says Chang. "But in Hong Kong, it's been passed from generation to generation by masters."

The ubiquitous bamboo scaffolding of Hong Kong showcases the material's strengths — and how, like reconstituted wood, it could also be adapted to build high rises themselves. Bamboo is flexible, strong and cheaper than steel or aluminum. It is one of the fastest-growing plants in the world — while traditional hardwood lumber can take 70 years to reach maturity, bamboo can be harvested in a few years, growing in some cases 60 centimeters a day.

"It has the potential to be the most affordable structural material on the planet," says David Sands, founder of Rizome, a company engineering bamboo products. "And the potential it has to cut our emissions is absolutely enormous."

Today, buildings and construction are responsible for about two fifths of all global carbon emissions. Such emissions hit their highest-ever level in 2019, according to the Global Status Report for Buildings and Construction, increasing to 9.95 gigatons of CO2. Bamboo's potential to mitigate this is far from immaterial — concrete and steel alone account for around 15 percent of global annual greenhouse gasses. And the world is set to add two trillion square feet of buildings by 2060 — double the current amount, and the equivalent of constructing one New York City every month for the next 40 years.

As this global construction boom gets underway, a spurt of interest in bamboo has provided green shoots of optimism. Renowned Vietnamese architect Vo Trong Nghia, for one, has described bamboo as "the green steel of the 21st century," and his firm, Vo Trong Nghia Architects, is leading the way when it comes to building with green and natural materials.

"Whenever I have the option to use bamboo, I use it," says Nghia, who grew up in a village where bamboo furniture and tools were common. "It's natural, it can reduce our environmental impact and it can reduce energy use. It can help a lot."

As an architect, Nghia first incorporated bamboo into his designs in 2006 for the Wind and Water Cafe, a magnificent thatched bamboo dome in Vietnam's Binh Duong province, which is one of the earliest examples of bamboo in contemporary architecture. Currently, he's developing an

ambitious 3,600-square-meter bamboo meditation hall in north Vietnam, which would be one of the largest such structures in the world.

"From Indonesia to Thailand and Latin America, many architects are now seeing the value of using bamboo," says Nghia.

One company in the Philippines, for example, is set to house 10,000 workers and their families by 2023 in a modular housing system made from bamboo known as Cubo, providing an affordable alternative to slum housing in Manila. Indonesian firm Ibuk, meanwhile, is experimenting with ambitious designs such as The Arc in Bali, which has a self-supporting roof of 14-meter-high arches made from bamboo.

Others are working to develop bamboo itself. Alireza Javadian, head of research for sustainable construction at Germany's Karlsruhe Institute of Technology, studied the most common species from Africa, Asia and Latin America, and found that Giant Guadua bamboo was best suited to develop a powerful "composite material."

Giant Guadua bamboo, native to Latin America and commonly grown for lumber in Colombia, can grow up to 20 feet in five years, according to Javadian. The culms, or stems, have thick walls with a large inner cell structure and thick growth joints, which provide elasticity and help prevent mold and insect damage. "It's an amazing material," he says. "It has a mechanical property and grows very fast."

For now, supply is ramping up. Rizome aims to plant 10 million bamboo clumps of Guadua, a noninvasive species, by 2030, both in the Philippines and in Florida, where it believes bamboo could become a cash crop for the flagging citrus industry.

Rizome is currently producing hardwood replacements, but it needs to develop softwood replacements to do the job of concrete and steel, which will take time. But the gains could be huge: The company claims that 12 percent of global construction could shift to bamboo — and in doing so, one third of global emissions could be wiped out through avoided emissions and carbon sequestered by bamboo plantations.

But according to Chang, the two main challenges facing wider, long-term adoption of bamboo are, firstly, the support of architects and companies, which he says is already beginning to shift, secondly, and the development of a regulation framework.

CHEMWATCH
Bulletin Board
Curiosities
NOV. 25, 2022

"It requires more substantial support from material science and from the regulating authority," he says. "Regulations shouldn't be an afterthought, they should be developed in parallel."

Javadin, whose team carried out market research with construction companies in Singapore and Zurich, agrees. "Convincing the larger players is difficult," he says. "The problem is that bamboo is either seen as a poor man's timber or that it is creative, fancy and something nice to have. Neither is true."

Back on the busy streets of Hong Kong, the use of bamboo everywhere from old crumbling shacks to cutting-edge apartments is evidence that the naturally grown material can, and perhaps must, have a place in the modern world.

"We need to be growing bamboo at the scale of millions of hectares," says Sands. "And it needs to happen quickly."

Reasons to be Cheerful, 14 November 2022

https://reasonstobecheerful.world

Puzzling study finds bee lifespans are now 50% shorter than 50 years ago

2022-11-14

Striking research from a pair of entomologists at the University of Maryland suggests the lifespan of honey bees kept in controlled laboratory conditions is 50% shorter than what was seen in the 1970s. The researchers hypothesize genetic changes in bees may be responsible for the shorter lifespans.

Studying the lifespan of honey bees can be challenging. In real-world conditions the lifespan of a worker bee can vary depending on the dynamics of its specific colony. Our general understanding of bee longevity stem from several key studies conducted in the 1950s, with scientists tagging bees before returning them to wild colonies for observation.

Around 50 years ago scientists began to conduct more controlled bee studies, tracking lifespans in caged laboratory environments. While these experiments don't correlate with real-world experiences they can serve as valuable standardized insights into bee lifespans, not confounded by other environmental variables.

Researchers found caged bees are only living half the time as their counterparts in similar conditions 50 years ago.

The new research began when entomologists Anthony Nearman and Dennis van Engelsdorp were conducting a study looking at how sugar in water affected the lifespan of caged bees. The researchers noticed the median lifespan of bees in their studies was half of what was reported in similar studies from the 1970s.

The researchers replicated all the protocols from older studies. Bee pupae was collected from hives before they emerged and then kept in similar caged conditions as adults. But their modern bees were only living a median of 17.7 days compared to the 34.3 day lifespan reported in the older studies.

"When I plotted the lifespans over time, I realized, wow, there's actually this huge time effect going on," said Nearman. "Standardized protocols for rearing honey bees in the lab weren't really formalized until the 2000s, so you would think that lifespans would be longer or unchanged, because we're getting better at this, right? Instead, we saw a doubling of mortality rate."

The researchers do indicate there is a recent body of study indicating bee lifespans have decreased over the past few decades. However, that research has primarily focused on real-world conditions, encompassing environmental stressors such as disease and pesticide exposure. This new research is the first to eliminate all those variables and suggest there could be a decline in honey bee lifespan independent of environmental factors.

"We're isolating bees from the colony life just before they emerge as adults, so whatever is reducing their lifespan is happening before that point," said Nearman. "This introduces the idea of a genetic component. If this hypothesis is right, it also points to a possible solution. If we can isolate some genetic factors, then maybe we can breed for longer-lived honey bees."

University of Sussex biologist Dave Goulson called this new study "fascinating" but points out a number of caveats making its conclusions far from definitive. He suggests comparing current experiments to historical data from up to 50 years ago is difficult as there is no guarantee lab conditions are similar between such disparate eras. Goulson also speculates its possible pesticides have infiltrated the pollen being fed to larvae, affecting the bees' lifespan from this early point.

Nevertheless, Goulson does indicate these results need to be taken seriously because if they are correct, "something really worrying is going

CHEMWATCH
Bulletin Board
Curiosities
NOV. 25, 2022

on." He notes similar examples of natural selection favoring shorter lifespans may be occurring in other species.

"Artificial (by beekeepers) or natural selection may favor bees with shorter lifespans," Goulson writes in The Conversation. "Scientists are seeing this happen in other species. For example, cod now mature earlier and when they are smaller in size because overfishing means fish rarely survive long enough to grow large. Perhaps stressors in the modern world, such as pesticides and disease, mean honey bees rarely survive for a long time. So their evolution might favor a live-fast-die-young lifestyle."

Nearman and van Engelsdorp are very aware their hypothesis honey bees are experiencing shorter lifespans due to genetic changes is still incredibly speculative. It's even possible that beekeepers have inadvertently simply favored colonies with shorter lifespans due to a perception of better health.

So the next step for the researchers is to widen their scope and look at honey bee lifespans in different geographical regions. If they still detect consistent patterns of decreased longitivtiy then genetic studies can attempt to home in on what exactly is going on.

The new study was published in Scientific Reports.

New Atlas, 14 November 2022

https://newatlas.com

The Urgent Quest To Find Banana's "Mystery Ancestors"

2022-11-16

It is believed that humans domesticated bananas for the first time 7,000 years ago on the island of New Guinea. However, the history of banana domestication is complicated, and the distinction between species and subspecies is often unclear.

A new study published in the journal Frontiers in Plant Science reveals that this history is significantly more complicated than previously imagined. The findings show that the genomes of the current domesticated varieties include remnants from three extra, as of yet unidentified, ancestors.

"Here we show that most of today's diploid cultivated bananas that descend from the wild banana M. acuminata are hybrids between different subspecies. At least three extra wild 'mystery ancestors' must have contributed to this mixed genome thousands of years ago, but haven't

Scientists are peeling back ancient layers of banana DNA in order to find the "mystery ancestors" before they go extinct.

been identified yet," said Dr. Julie Sardos, a scientist at The Alliance of Bioversity International and CIAT in Montpellier, France, and the study's first author.

Complex domestication history

Domesticated bananas (except for Fei bananas in the Pacific) are believed to have descended from a group of four ancestors, which were either subspecies of the wild banana Musa acuminata or different but closely related species. Before being domesticated, M. acuminata existed in Australasia and seems to have developed on the northern borderlands between India and Myanmar about 10 million years ago. Another complication is that domesticated varieties may contain two ('diploid'), three ('triploid'), or four ('tetraploid') copies of every chromosome, and many are derived from the wild species M. balbisiana.

Recent smaller-scale studies suggested that other ancestors linked to M. acuminata may have been involved in the domestication, suggesting that even this highly complicated scenario may not be the whole story. The latest findings not only validate this to be the case but also demonstrate for the first time that these gene pools are common in domesticated banana genomes.

Banana collecting missions

The authors sequenced the DNA in 226 extracts leaf extracts from the world's largest collection of banana samples at The Alliance of Bioversity International and CIAT's "Musa Germplasm Transit Centre" in Belgium. Among these samples, 68 belonged to nine wild subspecies of M. acuminata, 154 to diploid domesticated varieties descended from M. acuminata, and four more distantly related wild species and hybrids as comparisons. Many had previously been gathered in dedicated 'banana collecting missions' to Indonesia, the island of New Guinea, and the autonomous region of Bougainville.

The researchers first measured the levels of relatedness between cultivars and wild bananas and made "family trees" based on the diversity at 39,031 Single Nucleotide Polymorphisms (SNPs). They used a subset of these – evenly spread across the genome, with each pair demarcating a block of approximately 100,000 "DNA letters" – to statistically analyze the ancestry of each block. For the first time, they detected traces of three further ancestors in the genome of all domesticated samples, for which no matches are yet known from the wild.

CHEMWATCH
Bulletin Board
Curiosities
NOV. 25, 2022

Mystery ancestors might survive somewhere

The mystery ancestors might be long since extinct. "But our personal conviction is that they are still living somewhere in the wild, either poorly described by science or not described at all, in which case they are probably threatened," said Sardos.

Sardos and his team have a good idea of where to look for them: "Our genetic comparisons show that the first of these mystery ancestors must have come from the region between the Gulf of Thailand and west of the South China Sea. The second is from the region between north Borneo and the Philippines. The third, from the island of New Guinea."

Could help breed better bananas

Which useful traits these mystery ancestors might have contributed to domesticated bananas is not yet known. For example, the crucial trait of parthenocarpy, fruit setting without the need for pollination, is thought to have been inherited from M. acuminata, while cooking bananas owe a large chunk of their DNA to the subspecies (or perhaps separate species) M. acuminata banksii.

Second corresponding author Dr. Mathieu Rouard, likewise at Bioversity International, said: "Identifying the ancestors of cultivated bananas is important, as it will help us understand the processes and the paths that shaped the banana diversity observed today, a crucial step to breed bananas of the future."

"Breeders need to understand the genetic make-up of today's domesticated diploid bananas for their crosses between cultivars, and this study is a major first step toward the characterization in great detail of many of these cultivars."

Sardos said: "Based on these results, we will work with partners to explore and genotype wild banana diversity in the three geographic regions that our study pinpointed, with the hope to identify these unidentified contributors to cultivated bananas. It will also be important to investigate the different advantages and traits that each of these contributors provided to cultivated bananas."

Sci Tech Daily, 16 November 2022

https://scitechdaily.com

Does the film around detergent pods really biodegrade? A debate is raging.

2022-11-15

Easy-to-use detergent pods have become ubiquitous in American homes, containing just the right combination and amount of cleaning agents to leave clothes fresh and dishes sparkling. But now a debate is raging over whether they may contribute to the growing plastic pollution problem that threatens human health and the environment.

An eco-friendly company that sells cleaning products and advocacy groups petitioned the Environmental Protection Agency on Tuesday to take action against the use of the "plastic film" that surrounds the pods, arguing that the material does not completely break down in water as advertised. The petition urges the agency to require health and environmental safety tests for polyvinyl alcohol, also known as PVA or PVOH, which encases the pods. The petition calls on the EPA to remove the compound from its Safer Choice and Safer Chemical Ingredients lists until the tests are conducted and PVA is proved safe.

Blueland, a company which sells a "dry-form" laundry detergent tablet, has spearheaded the effort to subject pods to greater federal scrutiny. Its actions have angered major players within the cleaning-products industry, including a trade association and the manufacturer of the film used in detergent pods.

"Polyvinyl alcohol is a polymer, so by definition it is a plastic — it's a synthetic petroleum-based plastic," said Blueland co-founder Sarah Paiji Yoo.

Yoo added that she and others at the New York City-based company view the popular pods and newer laundry detergent sheets that use PVA as "arguably worse than straws."

"At least with a straw you can look at it and know like, 'Okay, this is trash. I should put this in the trash can,' " she said. "These pods and sheets are plastics that are designed to go down our drains and into our water systems that ultimately empty out into the natural environment," she said.

Asked for comment, an EPA spokesperson said the agency "will review the petition and respond accordingly."

PVA, which is also used in the textile industry, has been widely regarded as safe. In addition to being included on the EPA's Safer Chemical Ingredients list, the compound is approved by the Food and Drug Administration for

A cleaning-products company and anti-plastics groups are asking the EPA to assess the safety of polyvinyl alcohol, which encases detergent pods.

CHEMWATCH
Bulletin Board
Curiosities
NOV. 25, 2022

use in food packaging, dietary supplements and pharmaceutical products. The Environmental Working Group has also rated PVA as a low-hazard ingredient in personal care products.

What's more, single-dose detergent pods that use PVA are often considered to be a more environmentally friendly alternative to traditional liquid products that come in plastic containers.

Research touted by the American Cleaning Institute, or ACI, a trade group, suggests that at least 60 percent of PVA film biodegrades within 28 days and 100 percent of the film within 90 days. The group says water containing the dissolved film will go to wastewater treatment plants, where bacteria and other microorganisms break down the material "through natural biodegradation."

Blueland commissioned and helped fund a peer-reviewed study last year that challenges that claim. Its petition, which is supported by several organizations dedicated to fighting plastic pollution, cites the study's estimate that about 75 percent of PVA from laundry and dishwasher pods remained intact after passing through conventional wastewater treatment.

"It is now urgent for the scientific community to focus its attention on these new emerging pollutants," said Stefano Magni, an assistant professor of ecology in the biosciences department at the University of Milan who has studied the compound's possible toxicity but was not involved in the study commissioned by Blueland. "Indeed, a huge amount of PVA is annually produced, placed on the market and then used and released in the environment," particularly in aquatic ecosystems.

Charles Rolsky, co-author of the Blueland-funded study and a senior research scientist at the Shaw Institute in Maine, said that earlier research suggesting PVA could leave no trace over time often involved conditions that typically aren't found in the real world. Those results could lead consumers to believe that a pod product using PVA film may "seem more eco-friendly and biodegradable than it actually is," he added.

Yoo said that "at this point, there are probably millions of consumers who are buying these sheets or pods thinking they're doing a really great thing for the planet. They're converting into these products because of the sustainability messaging, because of the plastic-free messaging, but unbeknownst to them, they're actually sending plastic particles down their drains."

Fully biodegrading PVA requires the presence of the right species and concentration of microorganisms, which also have to be trained to break the compound down, Rolsky said. And there isn't "a single wastewater treatment plant in the United States where water sits with those microbes for anything close to 28 days," he said. "At most, it might be a week, but more realistically it's days to hours."

While more research is needed on PVA's potential effects on humans and the planet, the concern is that the film is "very similar to conventional plastics that we see on a regular basis," Rolsky said. But there's one major difference, he said: PVA "just happens to be water soluble."

He compared PVA's ability to dissolve to pouring salt into water. "The salt will disappear, but you can still very much taste the salt itself, even though you can't see it."

A growing body of research suggests that plastic pollution can have serious health and environmental effects, including those posed by the ability of small plastic particles to absorb chemicals, contaminants and heavy metals and move those harmful substances up the food chain. But evidence of the potential effects of PVA "are scarce," said Magni, who co-authored a study that did not find toxic effects associated with the compound in fish embryos and a species of water flea. He added that environmental tests of PVA are "urgently needed."

Both MonoSol, the Indiana-based company that manufactures the wrapping, and the ACI rejected the call for federal officials to regulate use of the film in consumer goods.

In a statement, Matthew Vander Laan, MonoSol's vice president of corporate affairs, called the petition a "publicity stunt" and accused Blueland of "exploiting the credibility of the EPA in pursuit of its own commercial goals."

"Decades of study, including evaluations by the EPA, FDA, regulatory and certification bodies around the world, have proven the safety and sustainability of PVA," Vander Laan said.

Meanwhile, the ACI issued a lengthy statement that highlighted benefits of PVA film and supporting research findings. The trade association also reiterated its criticisms of the research commissioned by Blueland, noting that the study "presents a flawed model based on theoretical assumptions and uses flawed data in that model."

CHEMWATCH
Bulletin Board
Curiosities
NOV. 25, 2022

"Because this chemistry has enabled these innovative laundry and automatic dishwashing product formats, it is extremely disappointing to learn about the misinformation that is being spread about PVA/PVOH," the ACI statement said.

But Rolsky said that he and other experts are calling for more research: "PVA shouldn't be vilified."

"We can't speculate," he added. "We have the tools to do the analysis. We should do the analysis and learn how it actually behaves."

Magni agreed. Research into this and other water-soluble polymers is "in the zero year," he said. "There is still everything to do."

Washington Post, 15 November 2022

https://washingtonpost.com

Kids learn faster than adults. This neurotransmitter could explain why.

2022-11-15

Differences in GABA concentrations can tell scientists more about why young learners have an advantage.

For adults who have struggled with understanding new math homework or marveled at how quickly kids can learn a second language, there is new evidence that shows kids really can learn things much faster than adults.

A study published today in Current Biology finds that children and adults have different concentrations of a key brain messenger called gamma-aminobutyric acid or GABA. This messenger stabilizes newly learned material, which is why it plays a role in how the brain learns new things.

GABA is a neurotransmitter that slows down the brain by blocking specific signals in the body's central nervous system. According to the Cleveland Clinic, GABA also produces a calming effect and is thought to play a major role in controlling nerve cell hyperactivity associated with anxiety, stress, and fear.

"Our results show that children of elementary school age can learn more items within a given period of time than adults, making learning more efficient in children," said study co-author Takeo Watanabe of Brown University, in a statement.

Previous studies have examined the role GABA plays on age and learning, but this study's authors noted that GABA in kids had only been measured

at one point in time after an experiment measuring GABA levels and didn't show any special significance in terms of how the brain learns

"It is often assumed that children learn more efficiently than adults, although the scientific support for this assumption has, at best, been weak, and, if it is true, the neuronal mechanisms responsible for more efficient learning in children are unclear," Watanabe said.

The team used neuro-imaging techniques similar to functional magnetic resonance imaging (fMRI) to examine visual perceptive learning in elementary school aged children and adults. Participants were shown multiple different images and later asked questions about them following the test.

The visual learning triggered an increase of GABA in children's visual cortex, the area of the brain area that processes visual information and the GABA boost also persisted for several minutes after training ended. GABA levels didn't change at all when adults underwent the same visual tests.

Children participants kept that GABA boost for hours after training ended, while the concentrations of GABA remained consistent in the adults studied.

"In subsequent behavioral experiments, we found that children indeed stabilized new learning much more rapidly than adults, which agrees with the common belief that children outperform adults in their learning abilities," study co-author Sebastian M. Frank, now at the University of Regensburg, Germany, said in a statement. "Our results therefore point to GABA as a key player in making learning efficient in children."

These results, the authors argue, should encourage teachers and parents to keep giving children many opportunities learn anything from riding a bike to playing an instrument to learning times tables throughout their childhood.

The findings also may change neuroscientists' conception of brain maturity in children. It's possible that this ability to retain GABA levels and rapidly stabilize the new concepts or skills they learn helps kids learn more items within a given period of time and makes learning more efficient.

According to Watanabe, children are in many ways superior visual learners, Watanabe said. "Although children's brains are not yet fully matured and many of their behavioral and cognitive functions are not as efficient as in adults, children are not, in general, outperformed in their abilities by adults," he adds.

CHEMWATCH
Bulletin Board
Curiosities
NOV. 25, 2022

In future studies, the team plans to explore the differences in maturation rates between brain regions and functions and GABA responses in other types of learning, such as reading and writing.

Popular Science, 15 November 2022

https://popsci.com

Recycled wastewater makes the cleanest drinking water

2022-11-17

"We expected that potable reuse waters would be cleaner, in some cases, than conventional drinking water due to the fact that much more extensive treatment is conducted for them," says William Mitch, senior author of the study in Nature Sustainability comparing conventional drinking water samples to wastewater purified as a drinking water, also known as potable reuse water.

"But we were surprised that in some cases the quality of the reuse water, particularly the reverse-osmosis-treated waters, was comparable to groundwater, which is traditionally considered the highest quality water."

As drinking water sources become more scarce, the discovery is promising news for a thirsty public and utility companies struggling to keep up with demand.

Limited water supplies

Several potable reuse systems are up and running around the United States. The Orange County Water District has run the world's largest water recycling plant since the 1970s. Water providers in Atlanta, Georgia, and Aurora, Colorado, also use potable reuse water as part of their drinking water supplies. Los Angeles plans to recycle all of its wastewater by 2035.

But decades of drought have intensified the urgency to make recycling wastewater as common as recycling an empty can of La Croix.

Water utilities, particularly those in the drought-stricken western US, are scrambling to find reliable water supplies. Traditional water sources from places such as the Colorado River and Sierra Nevada snowmelt have dried up. Instead, utilities have set their sights on potable reuse as a dependable water supply—one that utilities already conveniently manage and own.

"There are additional benefits beyond a secure water supply. If you're not relying on importing water, that means there's more water for ecosystems in northern California or Colorado," says Mitch, a professor of civil and

Recycled wastewater is as safe to drink as conventional potable water, and may be less toxic than many sources of water we already drink daily, researchers say.

environmental engineering in Stanford Engineering and the Stanford Doerr School of Sustainability.

"You're cleaning up the wastewater, and therefore you're not discharging wastewater and potential contaminants to California's beaches."

Cleaning up recycled water is also known to cost a lot less and require less energy than plucking the salt out of seawater.

Wastewater vs. river water

The engineers found that, after treatment, potable reuse water is cleaner than conventional drinking water sourced from pristine-looking rivers. In most rivers, someone upstream is dumping in their wastewater with much less treatment than occurs in potable reuse systems. Conventional wastewater treatment plants just aren't equipped to deep clean. This leaves many organic contaminants, such as chemicals from shampoos and medicines, floating down river and straight into a drinking water plant.

Regulators demand more extensive treatment at potable reuse treatment plants. They specify that treatment systems must remove harmful pathogens, such as viruses and amoebas, and utilities flush out other contaminants using reverse osmosis, ozonation, biofiltration, and other cleaning techniques.

Reverse osmosis treatment pushes water at high pressure through a filter that's so small, it squeezes out even sodium and chloride. Mitch and his colleagues discovered the process cleans wastewater as much if not more than groundwater, the gold standard.

Even when reverse osmosis wasn't applied, reuse waters were less toxic than the samples of conventional drinking waters sourced from rivers across the United States.

Skip those plastic water bottles

The Environmental Protection Agency aims to protect people from toxic drinking water by regulating a slew of chemicals. But some of the stuff floating in our water has yet to be identified or categorized by scientists.

In order to suss out the toxicity of different sources of tap water, the researchers applied water from various sources to hamster ovary cells, because they act similarly to human cells. Mitch and his colleagues looked at whether cells slowed or stopped growing, compared to untreated cells.

CHEMWATCH
Bulletin Board
Curiosities
NOV. 25, 2022

"Ideally, we picked up the effects of chemicals specifically measured by the EPA, as well as those that aren't," Mitch says.

The engineers discovered the compounds regulated by the EPA accounted for less than 1% of the harm to the ovary cells.

"Even if we include all these other unregulated compounds that a lot of us in this field have been focusing on, that still accounted for only about 16% of the total," Mitch says. "It really says we're not necessarily focusing on the right contaminants."

The culprits may be associated with disinfection. No matter where your tap water comes from, it will carry residual disinfectant to prevent pathogens growing in the pipes. Disinfectants like chlorine react with chemicals in the water and convert them to something else, and that may be what's killing the hamster cells.

The EPA regulates disinfection byproducts, but not all. "Our study indicates that maybe the toxicity exerted by these byproducts regulated by the government may not be so important."

Mitch says his team plans to further investigate whether other side effects from disinfecting water could be causing toxicity. His team is looking specifically at larger byproducts formed when disinfectants mix with pesticides, proteins, or other organic matter.

Disinfecting water is necessary: Without it, we'd die from cholera and other waterborne diseases. But Mitch notes that disinfection is a balancing act between killing pathogens and minimizing exposure to harmful byproducts.

"We can't get to zero contaminants. That would be ridiculously expensive, and probably unwarranted from a health point of view," he says.

Whatever you do, Mitch warns, don't stock your fridge with bottles of water. That plastic taste in bottled water tells you plastic compounds have migrated into the water, he says.

"At the end of the day, yes, there's stuff in everything, but the reuse water quality is as good as tap water, which is pretty darn good."

Stephanie Lau, a postdoctoral scholar in civil and environmental engineering, is the paper's lead author. Additional coauthors are from the University of Illinois at Urbana-Champaign.

The National Science Foundation and the Water Research Foundation funded the work.

Futurity, 17 November 2022

https://website

Want to learn about something in space? Crash into it.

2022-11-17

NASA engineers devote lots of time and effort to make sure spacecraft are durable enough to survive the hazards of space. Sometimes, though, rockets or probes are designed to crash on purpose!

In 2022, there have been a number of notable space crashes, both planned and unplanned. While unexpected events can be dangerous, planned crashes can provide important information about our solar system—revealing features as diverse as a planet's atmosphere or the chemicals in an asteroid's surface. They pave the way for future space missions by testing new technologies, too. And crashing a machine into a space rock can even give data that could one day be used to protect Earth from a threatening asteroid.

The history of space exploration is rich with crashes—humanity's early voyages to the moon relied on impacts to study the lunar surface in detail, like the Russian Luna 2 that became the first spacecraft to touch the surface of the moon in 1959, and the NASA Ranger program that returned the first close-up images of the moon in the 1960s. This decades-old tradition is carried on by modern missions, from Deep Impact smashing into a comet in 2005 to DART knocking around an asteroid in 2022. It's very likely there will be more deliberate crashes in the future, too.

The NASA lander designed to crash

One of the riskiest parts of a mission to Mars is the landing. Many mechanical parts and software programs have to work properly to avoid such a situation—a computer glitch caused a European Mars lander to catastrophically crash in 2016. So far, NASA has dealt with this through a variety of technologies: giant bouncing airbags, parachutes designed to slow down the craft in the thin Martian atmosphere, and even their complicated sky crane system—essentially a jetpack that gently lowers a lander to the surface—that the Perseverance rover used.

As successful as these technologies are, they're also expensive. Engineers at NASA's Jet Propulsion Lab (JPL) are working on a new technique that

Colliding a craft with a cosmic object is a dramatic way to reveal new insights about our solar system.

CHEMWATCH
Bulletin Board
Curiosities
NOV. 25, 2022

may reduce costs—a device intended to crash, known as SHIELD. They call it an impact attenuator, something that's made to absorb all the force of the crash and protect the sensitive electronics inside. It's made of steel, with the shape of an upside-down wedding cake. When it hits the ground, it crumples, absorbing the shock of the impact just like the "crumple zone" of modern cars.

While the largest and most ambitious missions will always need traditional landing gear, they also take a long time to prepare. SHIELD's tech allows for smaller, more frequent missions in addition to those. Lou Giersch, a mechanical engineer at JPL and leader of the SHIELD project, says this device could "increase the rate of scientific discovery" by making missions to Mars speedier and cheaper. "It's sort of a complement to the more conventional Mars landing," Giersch adds.

The team tested SHIELD at full Mars-landing speed–a whopping 110 miles per hour–for the first time in August 2022, strapping a smartphone to it. The smartphone survived and remained fully functional, even after hitting a two-inch-thick steel plate, which is much harder than actual Martian dirt.

NASA hopes this sort of tech will allow it to send more small missions to Mars, maybe even establishing a network of probes across the Red Planet. These could be like the local weather stations we use on Earth. One day, atmospheric scientists might tell you the local daily forecasts for Olympus Mons or Schiaparelli Crater. Being able to monitor the whole globe at once could reveal more about Mars' dust, its atmosphere, and even marsquakes—and it all may happen after repeated successful crash landings.

A mysterious rocket on the moon

Astronomers puzzled over a surprise crash this year, when a piece of rocket debris smashed into the moon on March 4. NASA's Lunar Reconnaissance Orbiter (LRO) later spotted a strange double crater created by the impact. Although some astronomers hoped this impact may be able to give them new information about the lunar surface, nothing much came of it besides a hunt for the wayward rocket's culprit.

Astronomer Bill Gray first identified it as a SpaceX part, but later realized it was actually part of a 2014 Chinese test mission, called Chang'e 5-T1. Chinese officials deny this was their booster, though, so its origin remains somewhat of a mystery. The biggest takeaway here is how alarming it is that no one was sure exactly what this piece was, or where it came from—and that there are many other lost hunks of space debris just like it.

Although this crash was a loss for lunar scientists, there have been intentional impacts on the moon before—notably LCROSS, a mission to hit a permanently shadowed crater on the moon's south pole in 2009. NASA astronomers sent one spacecraft to strike the surface, followed shortly after by a probe containing scientific instruments to measure the materials stirred up by the impact. This mission helped confirm a fact we now take for granted—the existence of water ice on the lunar surface.

University of Hawaii planetary scientist Chiara Ferrari-Wong notes that LCROSS data is still keeping scientists busy—the materials it revealed on the moon are strikingly different from those on Mercury, which is similarly cratered. "We are working to untangle what happened in each planet's unique history that makes them similar yet different," she says.

Knocking around asteroids

A clear highlight of this year in space crashes comes from DART, NASA's Double Asteroid Redirection Test, a spacecraft that smacked an asteroid to nudge its orbit. This was the first test of planetary defense technology meant to protect Earth in the event we find an asteroid hurtling toward us.

"Thankfully, no known asteroid big enough to penetrate our atmosphere is a threat to impact Earth at any time in the next century," says Angela Stickle, planetary scientist at Johns Hopkins Applied Physics Lab and DART team member. But if an as-yet undiscovered asteroid is on a collision course with Earth, she adds, "we want to be prepared."

DART targeted an asteroid known as Dimorphos, which orbits another bigger asteroid called Didymos. By measuring the change in the time it takes for Dimorphos to orbit Didymos, before and after the impact, astronomers could determine how big of a punch their impacting spacecraft packed. The spacecraft changed the asteroid's orbital period by 32 minutes, more than 25 times the goal time NASA set for a successful mission. "This was incredibly exciting and the team is still working on the details of why and how," Stickle says.

This mission taught scientists about Didymos itself, which is actually a loose collection of rocks known as a rubble pile, showing how diverse the population of asteroids really is. For future asteroid diversions to be successful, astronomers need to know what each asteroid is made of, so they know how big of a push it needs.

This isn't the first time scientists have hit an asteroid, though—the Japanese Hayabusa2 mission shot a small cannon into the asteroid Ryugu

CHEMWATCH
Bulletin Board
Curiosities
NOV. 25, 2022

in 2019, blowing up the surface just enough to expose the lower layers of dirt and to fling debris toward the main spacecraft for sample collection. But that impact was on a much smaller scale than DART, and meant for a totally different purpose.

Now, Hayabusa2 is beginning a new mission, one that will contribute to DART's goals of planetary protection. It's hurtling toward a little-studied asteroid named 2001 CC21. They won't collide; instead, the spacecraft is going to experiment with precision navigation around a fairly unknown target, a crucial skill for an asteroid-targeting planetary defense mission.

"My ideal next mission would be a spacecraft hitting an asteroid with one spacecraft watching the whole thing happen," Stickle said about DART's impact. "The more times we can test this technology, the better we will get."

Popular Science, 17 November 2022

https://popsci.com

Technical Notes

NOV. 25, 2022

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

CHEMICAL EFFECTS

Bone mass density following developmental exposures to perfluoroalkyl substances (PFAS): a longitudinal cohort study

Triphenylmethane dye (C52H54N4O12) is potentially a hazardous substance in edible freshwater fish at trace level: toxicity, hematology, biochemistry, antioxidants, and molecular docking evaluation study

Factors associated with elevated Per- and Polyfluoroalkyl substances serum levels in older adults

Urinary volatile organic compound metabolites and reduced lung function in U.S. adults

ENVIRONMENTAL RESEARCH

Long-term residential exposure to source-specific particulate matter and incidence of diabetes mellitus - A cohort study in northern Sweden

Consequences of exposure to pollutants on respiratory health: From genetic correlations to causal relationships

PHARMACEUTICAL/TOXICOLOGY

The associations of particulate matter short-term exposure and serum lipids are modified by vitamin D status: A panel study of young healthy adults

Assessment of risks, implications, and opportunities of waterborne neurotoxic pesticides

Genetic risk modifies the effect of long-term fine particulate matter exposure on coronary artery disease

OCCUPATIONAL

The effect of occupational exposure to welding fumes on trachea, bronchus and lung cancer: A systematic review and meta-analysis from the WHO/ILO Joint Estimates of the Work-related Burden of Disease and Injury