CHEMWATCH

Bulletin Board

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ASIA PACIFIC

New Dangerous Goods (Storage and Handling) Regulations 2022 have commenced

2023-02-15

The Storage and Handling Regulations, made under the Dangerous Goods Act 1985, will help ensure the health and safety of people, property and the environment in the manufacture, storage, transfer, use, handling, sale and disposal of dangerous goods.

Changes incorporated into the Storage and Handling Regulations

The majority of amendments incorporated into the Storage and Handling Regulations are limited to formatting and structural updates, clarification of requirements and modernisation of language.

Download a copy of the Storage and Handling Regulations from the Victorian Legislation and Parliamentary Documents website.

For more information, call WorkSafe's Advisory Service on 1800 136 089 (between 7.30 am and 6.30 pm Monday to Friday) or alternatively email legislation@worksafe.vic.gov.au.

Read More

Work Safe Victoria, 15-02-23

https://comms.worksafe.vic.gov.au/pub/pubType/EO/pubID/zzzz63dc424919e96232/?aid=beb140817238fa63&#beb140817238fa63

CSAR Subsidiary Regulations: China to Implement the Strictest Cosmetic Sampling Testing Regulation

2023-01-21

In September 2020 and June 2022, China National Medical Products Administration (NMPA) issued two drafts of Measures for the Management of Cosmetic Sampling Testing. Finally, on January 12, 2023, NMPA released the finalized Measures, which will be implemented on March 1, 2023. [1] The Measures is divided into 8 chapters and 61 articles, providing detailed requirements on the formulation of sampling testing work plan, sampling, testing and result submission, objection and re-testing, verification and disposal of unqualified products, as well as information disclosure. The key points are summarized and analyzed as follows.

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Sampling Methods

To strengthen the supervision of cosmetic manufacture and operation in China, local medical products administration departments (MPAs) will organize the sampling testing according to their annual sampling testing plans.

Special personnel will be assigned to carry out the sampling through on-site sampling or online product sampling. Recognized testing institutions will be responsible for the sample testing.

- During on-site sampling, the sampling personnel shall show the sampling work certification documents to the manufacturers and operators of the sampled cosmetics;
- Online product sampling shall simulate the online shopping process, which means the sampling personnel shall not inform the manufacturers and operators of the purchase purpose.

Read More

Chemlinked, 21-01-23

https://cosmetic.chemlinked.com/news/cosmetic-news/csar-subsidiary-regulations-china-to-implement-the-strictest-cosmetic-sampling-testing-regulation

China Adds 111 Drugs to 2022 National Reimbursement Drug List

2023-01-20

On Jan. 18, 2023, China's National Healthcare Security Administration (NHSA) and the Ministry of Human Resources and Social Security issued the 2022 National Reimbursement Drug List (NRDL), a list of drugs fully or partially reimbursed by the national basic health insurance.

After bidding or price negotiation between NHSA and pharmaceutical companies, 111 drugs entered the 2022 NRDL and 3 drugs were delisted. The average price cut reached 60.1%.1

Among the newly added drugs, 56 are for chronic diseases (diabetes, hypertension, psychoactive disease, etc.), 23 for tumor, 17 for anti-infection, and 7 for rare diseases.

The adjusted NRDL now covers 2,967 drugs, including 1,586 western (chemical/biological) drugs and 1,381 Chinese patent medicines.

Two COVID-19 Drugs Enter the List

As China recently experienced a surge in COVID-19 cases, antiviral drugs for COVID-19 treatment were a focus in the price negotiation.

Pfizer's Paxlovid with high public attention did not enter NRDL, because the quote was too high, according to NHSA in an announcement on Jan. 8, 2023. Paxlovid currently costs 1,890 yuan (about 278 USD) for one course.2 Now the drug is temporarily covered by basic health insurance until the end of March this year.

Read More

Chemlinked, 20-01-22

https://baipharm.chemlinked.com/news/china-adds-111-drugs-to-2022-national-reimbursement-drug-list

Two more chemicals are ineligible for reported (introductions of 10 kg or less) category

2023-02-17

We have updated Step 3 of the 'Guide to categorising your chemical importation and manufacture' (Categorisation Guide) following the removal of Benzene, hexachloro- (HCB), CAS no. 118-74-1 and Benzene, 1,2,3,4,5-pentachloro- (PeCB), CAS no. 608-93-5 from the AICIS Inventory on 8 February 2023.

This means that low volume introductions of these chemicals (up to 10 kg in an AICIS registration year) are not eligible for the reported category type called 'introduction of 10 kg or less'. We have added the name and CAS numbers of these chemicals in Step 3.1 of Categorisation Guide and the corresponding decision tool.

Read More

AICIS, 17-02-23

https://www.industrialchemicals.gov.au/news-and-notices/two-more-chemicals-are-ineligible-reported-introductions-10-kg-or-less-category

More guidance on waivers for certificate applications

2023-02-16

Expanded guidance on information waivers that you can request in an assessment certificate application

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Information waivers refer to the omission of mandatory information about a chemical in a certificate application. You can request an information waiver in your application, but you must provide a valid reason or justification for not providing the information.

Our guidance covers:

- waiver types and pre-filled justifications that are available to select in IUCLID6 relating to physical and chemical properties, environment related endpoints and human health related endpoints
- justifications that we would consider for not submitting required information on polymers, including polymers of low concern (PLC)
- justifications that we would consider if your reason for a waiver is not an available option in IUCLID6 (in this case you should select 'Other justification').

Read More

AICIS, 16-02-23

https://www.industrialchemicals.gov.au/news-and-notices/more-guidance-waivers-certificate-applications

AMERICA

Flawed EPA Approach Threatens Formaldehyde Access for Key U.S. Industries

2023-01-31

Access to a proven "building-block" chemical that consumers extensively rely on and powers some of the largest sectors of the economy is under threat due to scientifically unjustified over-regulation. The building block is formaldehyde, which is a naturally occurring substance made simply of carbon, hydrogen and oxygen.

Due to its usefulness, formaldehyde is already one of the most well-studied, well-understood compounds in commerce. Federal agencies, including the Food and Drug Administration, the Occupational Safety and Health Administration, the Department of Housing and Urban Development, the Consumer Product Safety Commission, and agencies across the World, all agree that formaldehyde is safe for use in a variety of applications.

Maintaining access to this vital chemistry is critical for agriculture, building and construction, automobile manufacturing and healthcare sectors, as well as the nation's manufacturing capability, economic viability, health, safety and continuity of essential products and services. Unfortunately, the U.S. Environmental Protection Agency (EPA) is pursuing a rushed formaldehyde assessment and biased scientific review process that could upend economic progress and threaten public health.

What is formaldehyde?

All life forms — bacteria, plants, fish, animals and humans — naturally produce formaldehyde as part of normal metabolic functions. The human body produces approximately 1.5 ounces of formaldehyde per day as part of cell metabolism. It is naturally present in the environment and found in a wide variety of fruits, vegetables, meats, fish and beverages.

Formaldehyde does not accumulate in humans or the environment, plants or animals. Studies show that formaldehyde is quickly broken down by natural metabolic processes in the body, converted to carbon dioxide and exhaled. In the environment, formaldehyde is rapidly broken down in the air by moisture and sunlight or by bacteria in soil or water.

While formaldehyde is best known for its preservative and anti-bacterial properties critical for agriculture, formaldehyde-based chemistry is also used for a wide range of products in the building and construction, healthcare, and automotive sectors. Due to its usefulness, formaldehyde is one of the most well-studied, well-understood compounds in commerce.

Read More

American Chemistry Council, 31-01-23

https://www.americanchemistry.com/chemistry-in-america/news-trends/blog-post/2023/flawed-epa-approach-threatens-formaldehyde-access-for-key-us-industries

AAFA includes PFAS restrictions for first time

2023-02-07

The American Apparel & Footwear Association (AAFA) has included restrictions on per- and polyfluoroalkyl substances (PFAS) for the first time as part of its latest restricted substance list (RSL).

These PFAS restrictions are revealed as part of the AAFA's 23rd update of its stringent RSL, which also features an appendix covering the US states

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whose laws require reporting of chemicals in children's products, as well as European reporting rules.

The new RSL publishes PFAS limits of <100 ppm for total organic fluorine, which equates to California regulation A.B. 1817 that is effective January 1st, 2025, with RSL limits for PFAS then falling to <50 ppm two years later on January 1, 2027.

Read More

Ecotextile News, 07-02-23

https://www.ecotextile.com/2023020730347/dyes-chemicals-news/aafa-includes-pfas-restrictions-for-first-time.html

U.S. CPSC commissioners vote in favor of publication of NPR for button cell or coin batteries

2023-02-10

On February 9, 2023 the U.S. Consumer Product Safety Commission (CPSC) staff published within the Federal Register a Notice of Proposed Rulemakings for Button Cell or Coin Batteries.

As required by Reese's Law, to eliminate or adequately reduce the risk of injury from ingestion of button cell or coin batteries by children 6 years old and younger, the U.S. Consumer Product Safety Commission (CPSC or Commission) proposes a rule to establish performance requirements for battery compartments on consumer products that contain, or are designed to use, one or more button cell or coin batteries.

The proposed rule also requires warning labels on the packaging of button cell or coin batteries, as well as on the packaging, battery compartments, and accompanying instructions and manuals of consumer products containing button cell or coin batteries.

A "button cell or coin battery" is broadly defined in section 5 of Reese's Law as "(A) a single cell battery with a diameter greater than the height of the battery; or (B) any other battery, regardless of the technology used to produce an electrical charge, that is determined by the Commission to pose an ingestion hazard."

Public comments on the Button Cell or Coin Batteries NPR may be submitted up to March 13, 2023.

Read More

Bureau Veritas, 10-02-23

https://www.cps.bureauveritas.com/newsroom/us-cpsc-commissioners-vote-favor-publication-npr-button-cell-or-coin-batteries

U.S. cosmetic regulations get major updates

2023-02-02

After years of effort from the cosmetic industry, the Modernization of Cosmetics Regulations Act of 2022 (MoCRA) was signed into law on December 29, 2022 as part of the Consolidated Appropriations Act. MoCRA is the first major update to cosmetic regulations in the United States since the Federal Food, Drug, and Cosmetic Act became law in 1938.

The Modernization of Cosmetics Regulations Act of 2022 (MoCRA) includes a few new important definitions including:

Facility

- "The term 'facility' includes any establishment (including an establishment of an importer) that manufacturers or processes cosmetic products distributed in the United States."
- Exemptions include, but are not limited to:
- Cosmetic product retailers, including individual sales representatives, direct sellers (as defined in section 3508(b)(2) of the IRS Code of 1986), retail distribution facilities, and pharmacies, unless such establishment manufactures or processes cosmetic products that are not sold directly to consumers at that location
- Entities (such as hotels and airlines) that provide complementary cosmetic products to customers incidental to other services
- Trade shows and other venues where cosmetic product samples are provided free of charge
- An establishment that solely performs one or more of the following with respect to cosmetic products: Labeling, Relabeling, Packaging, Repackaging, Holding, Distributing (note: 'packaging' and 'repackaging' do not include filling a product container with a cosmetic product)

Responsible Person

"The manufacturer, packer, or distributor of a cosmetic product whose name appears on the label of such cosmetic product in accordance with

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section 609(a) [adverse event report labeling requirement] of this Act or section 4(a) of the Fair Packaging and Labeling Act."

As part of the overhaul of the Cosmetic Regulations, MoCRA includes the following new requirements for cosmetic products:

1) Mandatory serious adverse event reporting (Sec. 605 Adverse Events)

The responsible person shall submit to the FDA any report received of a serious adverse event associated with the use, in the United States, of a cosmetic product manufactured, packed, or distributed by such person within 15 business days of receipt.

The responsible person shall receive reports of adverse events through the domestic address, domestic telephone number, or electronic contact information on the label (see new labeling requirements information below).

Additionally, the responsible person shall maintain records relating to each adverse event report received for a period of 6 years, except small businesses shall maintain records for 3 years.

If the FDA suspects that the serious adverse event was due to a fragrance or flavor ingredient, they may request a list of substances in the fragrance or flavor ingredient.

Read More

Bureau Veritas, 02-02-23

https://www.cps.bureauveritas.com/newsroom/us-cosmetic-regulations-get-major-updates

EUROPE

Scientists detect microplastics in human veins, colon tissue, and urine

2023-02-15

Micro- and nanoplastics are omnipresent in the environment (FPF reported) as well as in foods and beverages (FPF reported and here) leading to the direct exposure of humans. The small plastic particles have been analyzed and detected in a wide range of human biological samples (FPF reported), including breastmilk (FPF reported) and placenta (FPF

reported), and potential effects are being evaluated (FPF reported and here). Three recently published research articles investigated the presence of microplastics in humans, analyzing human vein and colon tissues, as well as urine. A review focused on the health implications of this particle presence looking into potential carcinogenic effects.

In an article published on February 1, 2023, in the journal Plos One, Jeanette M. Rotchell and co-authors from the University of Hull and Castle Hill Hospital, Cottingham, UK, reported on the presence of microplastics in the human vein tissue.

The scientists collected saphenous (leg) vein tissues from five patients with a mean age of 72 years undergoing surgery. Upon tissue digestion and filtration, they assessed the number, polymer type, and shape of plastic particles using µFTIR spectroscopy (5 µm size limit). Rotchell and co-authors detected 15 plastic particles/g of tissue after subtracting the corresponding blanks. While "microplastics levels within tissue samples were not significantly higher ($p = 0.293$) than those identified within combined procedural blanks", they differed in polymer types. Alkyd resin, polyvinyl propionate/acetate (PVA), and nylon-ethylene-vinyl acetate were most abundant in the tissue. Comparing the levels with those reported for colon (FPF reported) and lung, they were found to be similar for the vein tissue.

This is the first scientific evidence that small plastic particles are present in human vascular tissues supporting "the phenomenon of transport of microplastics within human tissues." The small pilot study serves as a "starting point for more in depth analysis of the levels, types, and clinical implications of such presence."

Read More

Food Packaging Forum, 15-02-23

https://www.foodpackagingforum.org/news/scientists-detect-microplastics-in-human-veins-colon-tissue-and-urine

European Commission proposed occupational exposure limits for lead and di-isocyanates | Feedback period 14 February 2023 - 12 April 2023

2023-02-16

The European Commission has launched a public consultation on a proposal to amend Directive 98/24/EC on the protection of the health

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and safety of workers from the risks related to chemical agents at work. Specifically, the proposal would lower exposure limt value for lead and its compunds from 0,15 mg/m3 to 0,03 mg/m3 and introduces limits for dyisocyanates.

The public consultation is open until the 12th of April.

Read More

Chemycal, 16-02-23

https://chemycal.com/news/590517f3-fed3-45f1-a549-56bb8e6a6c0a/European_Commission_proposed_occupational_exposure_limits__for_lead_and_di-isocyanates__Feedback_period_14_February_2023_-_12_April_2023

UK | Revision of GB Biocidal Products Regulation Annexes II and III

2023-02-13

This consultation relates to the Great Britain Biocidal Products Regulation (GB BPR) (Regulation EU No 528/2012). GB BPR applies to the supply and use of biocidal products. Biocidal products are products that control harmful organisms, and include insecticides, rodenticides, wood preservatives, anti-fouling coatings on ships, disinfectants, and hand sanitisers. Biocides are essential to society to protect human health and infrastructure but can also cause risks to human and animal health and the environment if used incorrectly. GB BPR therefore aims to ensure a high level of protection for both human and animal health and the environment.

UK HSE is consulting on proposed revisions to Annexes II and III of GB BPR, which deal with the following:

Annex II – information requirements for biocidal active substances. The Annex details the information that must be submitted by applicants who wish to apply for a biocidal active substance to be approved.

Read More

Chemycal, 13-02-23

https://chemycal.com/news/97b617b1-4260-4688-9b54-a1e21fed4ee8/UK__Revision_of_GB_Biocidal_Products_Regulation_Annexes_II_and_III

INTERNATIONAL

Developing the science-policy panel on chemicals and pollution

2023-02-07

From January 30 to February 3, 2023, national delegates, civil society organizations, and other stakeholders met in Krung Thep Maha Nakhon (Bangkok), Thailand for the UN Environmental Assembly working group meeting to create a science-policy panel dedicated to the management of chemicals, waste, and pollution prevention (hereafter: the Panel). The meeting focused on defining the role of the Panel, and its scope and function within existing chemical regulatory bodies.

Defining the scope of the Panel is a large task due to the hundreds of thousands of chemicals on the market, the variety of products they are used in in different combinations, and with wildly variable effects on humans and the environment (FPF reported also here and here). Stakeholders and delegates will also have to decide how to deal with data gaps, as there are many chemicals and chemical effects for which information is not publicly available (e.g., polymerized PFAS, FPF reported).

As discussions were beginning in Thailand, Marlene Ågerstrand of Stockholm University, Sweden, and 21 other scientists in the field of chemical pollution published an article in Environmental Science and Technology highlighting "ten critical aspects for consideration in determining the settings of the Panel." The aspects include:

- Paralysis by analysis – "the Panel must avoid repeatedly re-assessing the same topics and substances" where continued research may expand or deepen the understanding of the issue(s) but would simply confirm earlier insights "and where, accordingly, action could and should have been taken earlier."
- Scope – "the Panel's work needs to be broad and inclusive to properly respond to the breadth and complexity of global chemical production, use, releases, and disposal, involving up to several hundred thousand chemicals, of which a substantial fraction is hazardous to humans and/or ecosystem health."
- Establish inclusive knowledge exchange – chemical use and regulation is globally diverse, and the Panel will need to integrate a diverse array of knowledge sources including natural and biomedical sciences, social sciences, humanities, traditional and local indigenous knowledge, and

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others. To get from knowledge to action, "the adequate involvement of experts in risk communication will be critical for the dissemination and contextualization of the Panel's work."

Read More

Food Packaging Forum, 07-02-23

https://www.foodpackagingforum.org/news/developing-the-science-policy-panel-on-chemicals-and-pollution

REACH Update

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Call for evidence: Investigation report on PVC and PVC additives

2023-02-01

The European Commission has asked us to prepare an investigation report on polyvinyl chloride (PVC) and PVC additives.

We are requesting interested parties to submit any information they have related to some PVC additives and additives used in alternative plastics.

This call for evidence is open until 31 March 2023.

Read More

ECHA, 01-02-23

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

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Janet's Corner

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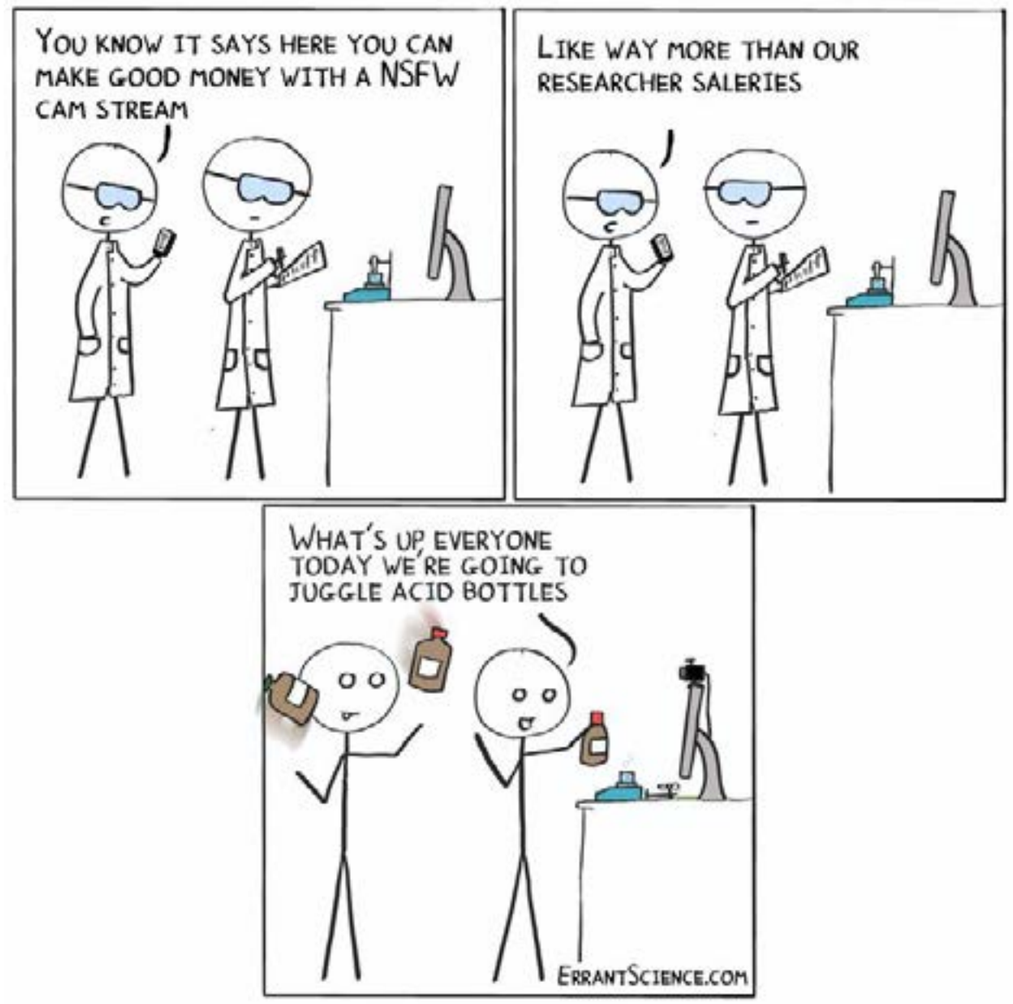
Not Safe For Work

2023-02-24



https://twitter.com/ErrantScience/status/1615314400449118215

Methanol

2023-02-24

Methanol, also known as methyl alcohol, wood alcohol, wood naphtha or wood spirits, is a chemical with the formula CH_3OH (often abbreviated MeOH). It is the simplest alcohol, and is a light, volatile, colourless, flammable liquid with a distinctive odour very similar to, but slightly sweeter than, ethanol (drinking alcohol). At room temperature, it is a polar liquid, and is used as an antifreeze, solvent, fuel, and as a denaturant for ethanol. Because of its toxic properties, methanol is frequently used as a denaturant additive for ethanol manufactured for industrial uses — this addition of methanol exempts industrial ethanol from liquor excise taxation. Methanol is often called wood alcohol because it was once produced chiefly as a by-product of the destructive distillation of wood. Methanol is produced naturally in the anaerobic metabolism of many varieties of bacteria, and is ubiquitous in the environment. As a result, there is a small fraction of methanol vapour in the atmosphere. Over the course of several days, atmospheric methanol is oxidised with the help of sunlight to carbon dioxide and water. [1]

USES [2]

Methanol is used in many ways. On its own, applications include:

- Transportation Fuel - Methanol is the most basic alcohol. It is easy to transport, readily available, and has a high octane rating that allows for superior vehicle performance compared to gasoline.
- Wastewater Denitrification - Methanol is also used by municipal and private wastewater treatment facilities to aid in the removal of nitrogen from effluent streams. As wastewater is collected in a treatment facility, it contains high levels of ammonia. Through a bacterial degradation process this ammonia is converted into nitrate. If discharged into the environment, the nutrient rich nitrate in sewage effluent can have a devastating effect on water ecosystems. Methanol, which quickly biodegrades, is a cost-effective way to help revitalise waterways tainted by the effects of nitrates.
- Fuel Cell Hydrogen Carrier - Methanol is used as a key component in the development of different types of fuel cells. From large-scale fuel cells to power vehicles or provide back-up power to remote equipment, to portable fuel cells for electronics and personal use, methanol is an ideal hydrogen carrier.

Methanol, also known as methyl alcohol, wood alcohol, wood naphtha or wood spirits, is a chemical with the formula CH3OH (often abbreviated MeOH).

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- Biodiesel Transesterification - In the process of making biodiesel fuel, methanol is used as a key component in a process called transesterification. Methanol is used to convert the triglycerides in different types of oils into usable biodiesel fuel. The transesterification process reacts methanol with the triglyceride oils contained in vegetable oils, animal fats, or recycled greases, forming fatty acid alkyl esters (biodiesel) and the by-product glycerin.
- Electricity Generation - Different companies are also exploring the use of methanol to drive turbines to create electricity.

Methanol is also used as a key component of hundreds of chemicals including formaldehyde, acetic acid and olefins –which are all basic chemical building blocks for a number of common products. An example of some types of materials that are made from methanol include:

- Plastics
- Synthetic fibres
- Paints
- Resins
- Magnetic film
- Safety glass laminate
- Adhesives
- Solvents
- Carpeting
- Insulation
- Refrigerants
- Windshield washer fluid
- Particle board
- Pigments and dyes

SOURCES & ROUTES OF EXPOSURE [3]

Exposure to methanol can occur in many ways. Occupational exposure to methanol can commonly occur through inhalation and dermal contact. Individuals may be exposed to methanol in the ambient air from its evaporation during solvent uses or from automobile exhaust, through the consumption of various foods, and through dermal contact with various consumer products such as paint thinners and strippers, adhesives, cleaners, and inks. Natural emission sources of methanol include volcanic

gases, vegetation, microbes, and insects; methanol is also formed during biological decomposition of biological wastes, sewage, and sludge.

HEALTH EFFECTS

Acute Effects [4]

Methanol may be acutely toxic following inhalation, oral or percutaneous exposure. Acute toxicity from methanol manifests as CNS depression, followed by a latent period of varying duration from 8-36 hours and occasionally up to 48 hours. Subsequently, metabolic acidosis develops, superimposed with headache, nausea and features of ocular toxicity. Ocular toxicity may range from photophobia and misty or blurred vision to markedly reduced visual acuity and complete blindness; ingestion of as little as 4-10 mL methanol in adults may cause permanent damage. Coma and death may occur after substantial exposures. The minimal lethal dose following ingestion is considered to be in the range of 300-1000 mg kg-1. Severe intoxication, if survived, may cause permanent damage to the CNS, manifest as a Parkinsonian-like condition and permanent blindness.

Chronic Effects [3]

Chronic inhalation or oral exposure to methanol may result in headache, dizziness, giddiness, insomnia, nausea, gastric disturbances, conjunctivitis, visual disturbances (blurred vision), and blindness in humans. EPA has not established a Reference Concentration (RfC) for methanol. The Reference Dose (RfD) for methanol is 0.5 milligrams per kilogram body weight per day (mg/kg/d) based on increased liver enzymes (SAP and SGPT) and decreased brain weight in rats.

Reproductive/Developmental Effects

No information is available on the reproductive or developmental effects of methanol in humans. Developmental effects have been observed in the offspring of rats and mice exposed to methanol by inhalation. These included skeletal, cardiovascular, urinary system, and central nervous system (CNS) malformations in rats and increased resorptions and skeletal and CNS malformations in mice.

Cancer Risk

No information is available on the carcinogenic effects of methanol in humans or animals. EPA has not classified methanol with respect to carcinogenicity.

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SAFETY [5]

First Aid Measures

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

Fire & Explosion

- Fire Hazards: Highly flammable in presence of open flames and sparks, of heat. Non-flammable in presence of shocks. When Methanol is heated to decomposition, it emits acrid smoke and irritating fumes.
- Explosion Hazards: Explosive in presence of open flames and sparks, of heat. Methanol is explosive in the form of vapour when exposed to heat or flame and may travel considerable distance to source of ignition and flash back. In addition, explosive mixtures are formed with air due to its low flash point. It is also explosive when mixed with choroform + sodium methoxide and diethyl zinc. It boils violently and explodes.

- Fire Fighting Media and Instructions: Flammable liquid, soluble or dispersed in water. SMALL FIRE: Use DRY chemical powder. LARGE FIRE: Use alcohol foam, water spray or fog.

Engineering Controls & Personal Protection

- Engineering Controls: Provide exhaust ventilation or other engineering controls to keep the airborne concentrations of vapours below their respective threshold limit value. Ensure that eyewash stations and safety showers are proximal to the work-station location.
- Personal Protection to be used when handling methanol include: Splash goggles, lab coat, vapour respirator (be sure to use an approved/certified respirator or equivalent) and gloves.
- Personal Protection in Case of a Large Spill: Splash goggles, full suit, vapour respirator, boots and gloves. A self contained breathing apparatus should be used to avoid inhalation of the product. Suggested protective clothing might not be sufficient; consult a specialist BEFORE handling this product.

REGULATION [5,6,7]

Exposure Limits

United States:

TWA: 200 from OSHA (PEL) [United States]

TWA: 200 STEL: 250 (ppm) from ACGIH (TLV) [United States] [1999] STEL: 250 from NIOSH [United States]

TWA: 200 STEL: 250 (ppm) from NIOSH SKIN

Australia:

TWA: 262 milligrams of methanol per cubic metre of air.

STEL: 328 milligrams of methanol per cubic metre of air.

Canada:

TWA: 200

STEL: 250 (ppm) [Canada]

European Union:

TWA: 200 PPM 8 hour(s).

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TWA: 260 MG/M3 8 hour(s).

REFERENCES

1. http://en.wikipedia.org/wiki/Methanol
2. http://www.methanol.org/Methanol-Basics/Methanol-Applications.aspx
3. http://www.epa.gov/ttn/atw/hlthef/methanol.html
4. http://www.hpa.org.uk/webc/HPAwebFile/HPAweb_C/1194947357226
5. http://www.sciencelab.com/msds.php?msdsId=9927227
6. http://www.npi.gov.au/substances/methanol/health.html
7. http://www.kpc.com.kw/InformationCentre/DataSheets/ProductsCrude%20Safety%20Data%20Sheets%20SDS/Methanol.pdf

Even brief exposure to diesel fumes alters activity in key brain network, study finds

2023-02-14

Even brief exposures to diesel fumes may alter the brain's function, messing with how signals zip through a major brain network, a new study suggests.

Past studies suggest that people exposed to air pollution may be more likely to develop mental health conditions and neurodegenerative diseases. Now, the new study, published Jan. 14 in the journal Environmental Health shows that exposure to diluted diesel exhaust resulted in less "functional connectivity" in a key brain network than exposure to filtered air.

Functional connectivity is a measure of how well different brain regions communicate with one another; after exercising in clean air, the study's participants showed a temporary boost in connectivity in a specific brain network, but after exposure to diesel-tainted air, the network's connectivity remained stagnant. Although the study didn't examine the cognitive impacts of the exposure, the network is linked to internal thought and introspection, and disruptions in its activity have been linked to various mental health, cognitive and attention-related disorders.

According to its authors, the study is the first to examine the brain's response to air pollution in such a controlled way. The researchers "have made a significant contribution to what we know about the impact of exposures to pollution," said Hao Yang Tan, a lead investigator at the Lieber Institute for Brain Development in Baltimore, who was not involved in the study.

The researchers took snapshots of brain activity in 25 adults using functional magnetic resonance imaging (fMRI); fMRI works by detecting increased blood flow to active neurons, therefore giving an indirect indication of brain activity. Then, participants were exposed to either filtered air or air mixed with diesel exhaust for two hours while they rode an exercise bike at a relaxed pace.

Immediately after the exposure, researchers took another fMRI. All participants took part in both the exposure and control scenarios at different times, and neither the participants nor the data collectors ever knew which group anyone was in.

An experimental study suggests that diesel fumes might disrupt the brain's typical pattern of activity.

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The researchers examined how exposure to diesel impacts the default mode network (DMN), which is involved in self-reflection and a person's internal thoughts, rather than external stimuli, said Dr. Michael Lipton, a professor of radiology at Albert Einstein College of Medicine and medical director of MRI services at Montefiore Medical Center, who was not involved in the study. Research suggests that people with psychiatric disorders, including anxiety and depression, show distinct changes in the DMN, said Tan.

DMN connectivity briefly increased after exposure to filtered air, which the researchers attributed to the exercise the participants were doing. Previous research has associated light exercise with increased DMN connectivity. DMN connectivity didn't change after diesel exposure.

The new study was limited by its small size and the fact that people are exposed to higher concentrations of air pollution for longer in the real world. The study also can't show exactly how the diesel may have caused the observed changes in connectivity.

"Diesel exhaust is known to cause systemic inflammation, which could affect the brain and change the DMN," senior study author Dr. Chris Carlsten, professor and head of respiratory medicine at the University of British Columbia, told Live Science in an email. "However, this is speculative." Lipton said he's not sure such a short exposure could cause substantial inflammation in the brain.

Tan said the study is a good first step towards better understanding how air pollution hurts the brain. It's also important to recognize that, regardless of the biological mechanisms behind this effect, there are other reasons air pollution doesn't impact everyone equally, he added. For example, socioeconomically disadvantaged communities are more likely to be exposed to air pollution, as they're more likely to live and work in polluted areas, Tan said.

Live Science, 14 February 2023

https://livescience.com

New Blood Test Detects Alzheimer's Disease 3.5 Years Before Clinical Diagnosis

2023-02-14

A blood-based test could be used to predict the risk of Alzheimer's disease up to 3.5 years before clinical diagnosis according to new research from

the Institute of Psychiatry, Psychology & Neuroscience (IoPPN) at King's College London.

The study, published on January 27 in the journal Brain, supports the idea that components in the human blood can modulate the formation of new brain cells, a process termed neurogenesis. Neurogenesis occurs in an important part of the brain called the hippocampus which is involved in learning and memory.

While Alzheimer's disease affects the formation of new brain cells in the hippocampus during the early stages of the disease, previous studies have only been able to study neurogenesis in its later stages through autopsies.

To understand the early changes, researchers collected blood samples over several years from 56 individuals with Mild Cognitive Impairment (MCI), a condition where someone will begin to experience a worsening of their memory or cognitive ability. While not everyone experiencing MCI goes on to develop Alzheimer's disease, those with the condition progress to a diagnosis at a much higher rate than the wider population. Of the 56 participants in the study, 36 went on to receive a diagnosis of Alzheimer's disease.

Dr. Aleksandra Maruszak, one of the study's joint first authors from King's IoPPN explains, "In our study, we treated brain cells with blood taken from people with MCI, exploring how those cells changed in response to blood as Alzheimer's disease progressed."

In studying how blood affected the brain cells, the researchers made several key discoveries. The blood samples collected from participants over the years who subsequently deteriorated and developed Alzheimer's disease promoted a decrease in cell growth and division and an increase in apoptotic cell death (the process by which cells are programmed to die). However, the researchers noted that these samples also increased the conversion of immature brain cells to hippocampal neurons.

While the underlying reasons for the increased neurogenesis remain unclear, the researchers theorize that it may be an early compensating mechanism for the neurodegeneration (loss of brain cells) experienced by those developing Alzheimer's disease.

Professor Sandrine Thuret, the study's lead author from King's IoPPN said, "Previous studies have shown that blood from young mice can have a rejuvenating effect on the cognition of older mice by improving hippocampal neurogenesis. This gave us the idea of modeling the process

The research suggests that blood components can influence neurogenesis, the formation of new brain cells, in the hippocampus, an essential part of the brain involved in learning and memory.

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of neurogenesis in a dish using human brain cells and human blood. In our study, we aimed to use this model to understand the process of neurogenesis and to use changes in this process to predict Alzheimer's disease and found the first evidence in humans that the body's circulatory system can have an effect on the brain's ability to form new cells."

When the researchers used only the blood samples collected furthest away from when the participants were diagnosed with Alzheimer's disease, they found that the changes in neurogenesis occurred 3.5 years prior to a clinical diagnosis.

Dr. Edina Silajdžić, the study's joint first author added, "Our findings are extremely important, potentially allowing us to predict onset of Alzheimer's early in a non-invasive fashion. This could complement other blood-based biomarkers that reflect the classical signs of the disease, such as the accumulation of amyloid and tau (the 'flagship' proteins of Alzheimer's disease)."

Dr. Hyunah Lee, the study's joint first author said, "It is now essential to validate these findings in a bigger and more diverse group of people. We are excited about the potential applications of the blood-based test we used. For example, it can help stratify individuals with memory problems for a clinical trial of disease-modifying drugs for Alzheimer's."

The researchers say that these findings could present an opportunity to further understand the changes the brain goes through at the earliest stages of Alzheimer's disease.

Sci Tech Daily, 14 February 2023

https://scitechdaily.com

Fish can recognize themselves in a photo, says new study

2023-02-14

The myth that goldfish have only a three-second memory might be giving us an unfair view of their mental capabilities. A new study has shown that some fish can recognize themselves in a photograph, meaning they join a pretty exclusive club of animals known to have some self-awareness.

While it might seem like a basic skill to us, self-recognition is an indication that an animal is capable of higher mental processes. It's most commonly tested using mirrors – many animals, like dogs, will react to their reflection as though it was another individual, but some are able to recognize that

Cleaner wrasses are fiercely territorial, and will attack intruders. In this case, they attacked the photos of unfamiliar fish but not photos of themselves.

what they're seeing is themselves. Apes, dolphins, elephants and some birds have passed the test, and it even takes human children about 18 months to figure it out.

A few years ago, a team of scientists investigated whether a fish species called cleaner wrasse could pass the mirror test. They marked the fish with what looked like a parasite on their throats, and placed a mirror in the tank. And sure enough, many of the animals saw the mark in their reflections and rubbed it off their throats, indicating they realized they were looking at themselves. This was confirmed by marking the mirror itself or other fish in adjacent tanks, which didn't cause the fish to rub off the mark.

In the new study, the researchers took it one step further – they wanted to check whether the fish could recognize themselves in a photograph. They presented each cleaner wrasse with four photos: one of themselves, one of an unfamiliar fish, one with their own face on a different fish's body, and one with an unfamiliar face on their own body.

Cleaner wrasses are fiercely territorial, and will attack intruders. In this case, they attacked the photos of unfamiliar fish but not photos of themselves. They also didn't attack the photos of their face on another body, but did attack those of a stranger's face on their own body, indicating the fish recognize facial features more than bodily ones.

These photo tests show that the fish aren't just recognizing themselves by matching movements in a mirror – they can actually build a mental model of their own faces. After all, only fish that had been trained on mirrors could pass the photo tests, giving them time to build up these mental images.

A possible alternate explanation was that the fish came to consider photos of themselves as close companions, so to investigate that the team presented them with photos showing a mark on their throats. And sure enough, six out of eight fish shown that image rubbed their throats to clean off the mark, behavior they didn't display when shown photos of themselves without marks, or photos of other fish with marks.

"This study is the first to demonstrate that fish have an internal sense of self," said Masanori Kohda, lead researcher on the study. "Since the target animal is a fish, this finding suggests that nearly all social vertebrates also have this higher sense of self."

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The research was published in the journal PNAS.

New Atlas, 14 February 2023

https://newatlas.com

Link found between common mouth bacteria and heart disease

2023-02-15

Coronary heart disease (CHD) is responsible for around one-third of all deaths worldwide. A new longitudinal study has investigated the link between a commonly occurring oral bacteria and CHD, improving our understanding of how infection affects the development of heart disease.

CHD is the most common form of heart disease. Over time, plaque collects on the walls of the arteries that supply blood to the heart (atherosclerosis), causing an obstruction to blood flow. The obstruction causes symptoms of chest pain (angina), breathing difficulties and chest tightness, and pain in the arms or shoulders. If plaque completely blocks an artery, it can result in a heart attack.

CHD is caused by a combination of genetic, environmental, and demographic factors. The main risk factors are smoking, diabetes, high blood fats (hyperlipidemia) and high blood pressure (hypertension). Age is also an important risk factor, and men are more likely to develop CHD than women.

Previous studies have also identified a link between the development of arterial plaque and the body's inflammatory response. These studies led to renewed interest in the role bacteria, viruses, and other microorganisms play in heart disease.

"Although enormous progress has been made in understanding how coronary heart disease develops, our understanding of how infections, inflammation, and genetic risk factors contribute is still incomplete," said Flavia Hodel, lead author of the current study.

The study followed 3,459 participants and monitored their heart health over 12 years. Data were collected on the participants' blood C-reactive protein (CRP) levels, a measure of inflammation. Participants were also tested for 22 human pathogens, including 15 viruses, six bacteria, and one parasite.

"Our study adds to growing evidence that inflammation triggered by infections may contribute to the development of coronary heart disease and increase the risk of a heart attack."

One of the bacteria tested for was Fusobacterium nucleatum, a bacterium that is prevalent in humans. It is a very common mouth bacteria that can lead to gum inflammation (gingivitis) and gum infection (periodontitis). Previous studies have also noted its potential to spread to the gut and to the female genital tract, causing inflammation and disease.

Based on the data collected, the present study demonstrated a link between previous or current infection with F. nucleatum and a slightly increased risk of CHD. The researchers hypothesize that the bacterium causes harm in two ways. First, in cases of oral infection, it causes a generalized inflammatory response in the body. Second, it migrates from the mouth and attaches itself directly to the walls of the coronary arteries, encouraging plaque growth.

"Our study adds to growing evidence that inflammation triggered by infections may contribute to the development of coronary heart disease and increase the risk of a heart attack," said Jacques Fellay, a professor at the School of Life Sciences of EPFL, Switzerland and senior author on the study.

Future studies are needed to confirm the link, but if confirmed, it may open the door to simple antibiotic therapy as a treatment option where the cause of CHD is infection.

"Our results may lead to new ways of identifying high-risk individuals or lay the groundwork for studies of preventive interventions that treat F. nucleatum infection to protect the heart," Fellay said.

The study was published in eLife.

New Atlas, 15 February 2023

https://newatlas.com

Iron flow batteries are coming to Australia

2023-02-17

The scramble to develop better and cheaper batteries to bolster the sustainable energy revolution continues with liquid-based flow batteries said to provide a cheaper, longer-lasting and less resource-intensive way to store power on energy grids.

Researchers at Queensland University of Technology are hoping to diversify the grid further, with the commissioning of an iron flow battery at its National Battery Testing Centre in Banyo in Brisbane.

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"This particular battery shows great potential in providing large-scale long-duration energy storage solutions to store energy for distribution when the wind is not blowing and the sun is not shining," says project lead Dr Joshua Watts.

Watts says that the battery will be 12 metres long, and a nominal 75 kW/400 kWh.

"It's not the type of battery you would buy for the backyard, but more targeted toward large-scale solar and wind farms, or new community developments where they're looking to build in more localised energy generation and distribution networks."

The power and energy storage (kW/kWh) is small compared to other, vanadium-based flow batteries scheduled to hit the Australian grid, which can be up to 4000 kW/16,000 kWh. The world's largest flow battery, in China, is 25 times larger than that again – roughly the same size as big Australian lithium-ion batteries.

But iron-flow batteries will be fully recyclable, as well as cheap and easy to scale because they rely on non-toxic iron chloride.

"You just increase the electrolyte volume, and you increase the capacity. You only need to make the tank bigger," says Watts.

Watts adds that the other components of iron flow batteries – mostly PVC pipes, water pumps and fibreglass tanks – makes them straightforward to manufacture locally.

Australia's first, large-scale iron flow battery manufacturing facility is also being constructed at Maryborough, getting developed by Energy Storage Industries – Asia Pacific (ESI).

ESI, along with the Future Battery Industries Cooperative Research Centre, is collaborating with QUT to test the iron flow battery.

"We'll be going through – over the next three months or so – a rigorous testing regime in collaboration with potential off takers to test the battery under different use conditions to get these batteries out into the wild supporting the energy grid as soon as possible," says Watts.

Cosmos, 17 February 2023

https://cosmosmagazine.com

Researchers are testing a little – but very easy to grow – flow battery.

MIT team makes a case for direct carbon capture from seawater, not air

2023-02-17

The oceans soak up enormous quantities of carbon dioxide, and MIT researchers say they've developed a way of releasing and capturing it that uses far less energy than direct air capture – with some other environmental benefits to boot.

Pulling greenhouse gases out of water is an odd-sounding idea, but the oceans are the planet's number one carbon sink, and direct air carbon capture has pretty serious problems: it costs a lot, and uses a lot of energy. According to IEA figures from 2022, even the more efficient air capture technologies require about 6.6 gigajoules of energy, or 1.83 megawatt-hours per ton of carbon dioxide captured.

Most of that energy isn't used to directly separate the CO2 from the air, it's in heat energy to keep the absorbers at operating temperatures, or electrical energy used to compress large amounts of air to the point where the capture operation can be done efficiently. But either way, the costs are out of control, with 2030 price estimates per ton ranging between US$300-$1,000. According to Statista, there's not a nation on Earth currently willing to tax carbon emitters even half of the lower estimate; first-placed Uruguay taxes it at US$137/ton. Direct air capture is not going to work as a business unless its costs come way down.

It turns out there's another option: seawater. As atmospheric carbon concentrations rise, carbon dioxide begins to dissolve into seawater. The ocean currently soaks up some 30-40% of all humanity's annual carbon emissions, and maintains a constant free exchange with the air. Suck the carbon out of the seawater, and it'll suck more out of the air to re-balance the concentrations. Best of all, the concentration of carbon dioxide in seawater is more than 100 times greater than in air.

Previous research teams have managed to release CO2 from seawater and capture it, but their methods have required expensive membranes and a constant supply of chemicals to keep the reactions going. MIT's team, on the other hand, has announced the successful testing of a system that uses neither, and requires vastly less energy than air capture methods.

In the new system, seawater is passed through two chambers. The first uses reactive electrodes to release protons into the seawater, which acidifies the water, turning dissolved inorganic bicarbonates into carbon dioxide gas, which bubbles out and is collected using a vacuum. Then

Pulling greenhouse gases out of water is an odd-sounding idea, but the oceans are the planet's number one carbon sink.

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the water's pushed through to a second set of cells with a reversed voltage, calling those protons back in and turning the acidic water back to alkaline before releasing it back into the sea. Periodically, when the active electrode is depleted of protons, the polarity of the voltage is reversed, and the same reaction continues with water flowing in the opposite direction.

In a new study published in the peer-reviewed journal Energy & Environmental Science, the team says its technique requires an energy input of 122 kJ/mol, equating by our math to 0.77 mWh per ton. And the team is confident it can do even better: "Though our base energy consumption of 122 kJ/mol-CO2 is a record-low," reads the study, "it may still be substantially decreased towards the thermodynamic limit of 32 kJ/mol-CO2."

The team projects an optimized cost around US$56 per ton of CO2 captured – although it's not fair to compare that directly against full-system direct air capture costs. The study cautions that this does not include vacuum degassing, filtration and "auxiliary costs outside of the electrochemical system" – analyses of which will have to be done separately. Some of these, however, could potentially be mitigated by integrating the carbon capture units in with other facilities, for example desalination plants, which are already processing large volumes of seawater.

There are some other benefits too; increased carbon buildup in the ocean over recent years has already caused problems with acidification, threatening coral reefs and shellfish. The alkaline output of this process, if directed where it's needed, could help redress the balance.

The team has a practical demonstration project planned for sometime in the next two years, and says there are plenty of things that still need work. For one, the researchers would love to be able to separate the gas out without a vacuum system. And mineral precipitates are fouling the electrodes on the alkalinization side, so there's plenty of progress yet to be made.

The study is open access in the journal Energy & Environmental Science.

New Atlas, 17 February 2023

https://https://newatlas.com/environment/mit-carbon-capture-seawater/

Promising male contraceptive pill works in 30 minutes, wears off in a day

2023-02-14

Male contraceptives have traditionally been limited to condoms or vasectomies, which aren't ideal solutions for many reasons. Now scientists have demonstrated a promising new method that takes the form of a pill that can be taken just before sex, greatly reducing fertility for 24 hours.

For decades women have shouldered much of the responsibility of contraceptives thanks to "the pill", but a male equivalent continues to elude science. Past attempts keep turning out to be ineffective, have too many side effects, take a long time to kick in or wear off, or some combination of these.

But a new drug, developed by scientists at Weill Cornell Medicine, seems to solve all those problems. It works by targeting a protein called soluble adenylyl cyclase (sAC), which is vital for sperm function. That makes the drug a sAC inhibitor, and we're not sure whether that pun is intended or not. Previous studies have found that mice and men who naturally lacked the gene for sAC were infertile but otherwise healthy, so the team set out to investigate whether blocking it worked as a contraceptive.

In tests, the scientists gave male mice a single dose of a sAC inhibitor called TDI-11861, and let them loose with the ladies. The inevitable occurred, but even after 52 mating attempts not a single female mouse fell pregnant. In contrast, the control group impregnated about a third of the females.

Importantly, the researchers say the drug was quick to work, inhibiting the mice's sperm within 30 to 60 minutes, and remained 100% effective for up to two and a half hours. By the three-hour mark, some sperm began to regain their motility, and after 24 hours the mice were essentially back to full fertility.

If those results carry across to humans, this has all the makings of a very useful male pill. If a date seems to be going well you could, say, head off to the bathroom after dinner to discreetly pop the pill, and be confidently covered for the night's activities. It could be a one-off thing when you think you might get lucky, or it could be a daily regimen – after all, the team found no negative effects after giving the mice these drugs continuously for six weeks.

For decades women have shouldered much of the responsibility of contraceptives thanks to "the pill", but a male equivalent continues to elude science.

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That flexibility makes it a more appealing option than other experimental male contraceptives, which can take weeks to reduce fertility or regain it if you want to start trying for children. And taking a pill is less invasive than getting a gel injected into your vas deferens.

The research was published in the journal Nature Communications.

New Atlas, 14 February 2023

https://newatlas.com

PFAS can thwart immune system 'first responders'

2023-02-16

The study is an important first step in understanding how both legacy and emerging PFAS chemicals might affect the body's innate immune system.

PFAS are a class of per- and polyfluoroalkyl chemicals used to make consumer and industrial products more resistant to water, stains, and grease. According to the US Environmental Protection Agency, there are more than 12,000 known PFAS, which also include fluoroethers such as GenX.

"It's pretty well-established that PFAS are toxic to the adaptive immune system, but there hasn't been as much research done on their effects on the innate immune system," says Drake Phelps, a former PhD student at North Carolina State University and first author of the study.

The human immune system has two branches: adaptive and innate. The adaptive branch contains T cells and B cells that "remember" pathogens the body has encountered, but it is slow to mount a defense, acting days—sometimes weeks—after it detects a pathogen.

The innate immune system serves as the body's first responders, and contains white blood cells that can be dispatched to the site of an invasion within hours. These white blood cells include neutrophils, which can dump reactive oxygen species—think tiny amounts of bleach or hydrogen peroxide that neutrophils manufacture inside their cells—directly onto pathogens, killing them. That process is called the respiratory burst.

Drake and the research team looked at the effect of nine environmentally relevant legacy and emerging PFAS on neutrophils from zebrafish embryos, neutrophil-like cells (cells that can be chemically treated to behave like neutrophils), and human neutrophil cells cultured from donor blood.

New research in cells finds that the PFAS chemical GenX suppresses the neutrophil respiratory burst—the method white blood cells known as neutrophils use to kill invading pathogens.

Emerging PFAS are chemicals, like GenX, developed to replace older, legacy PFAS that had proven toxic. All of the PFAS included in this study were detected in both the Cape Fear River in North Carolina and the blood serum of residents whose drinking water came from the Cape Fear River.

The embryos and cells were exposed to 80 micromolar solutions of each chemical:

perfluorooctanoic acid (PFOA), perfluorooctane sulfonic acid potassium salt (PFOS-K), perfluorononanoic acid (PFNA), perfluorohexanoic acid (PFHxA), perfluorohexane sulfonic acid (PFHxS), perfluorobutane sulfonic acid (PFBS), ammonium perfluoro(2-methyl-3-oxahexanoate) (GenX), 7H-perfluoro-4-methyl-3,6-dioxa-octane sulfonic acid (Nafion byproduct 2), and perfluoromethoxyacetic acid sodium salt (PFMOAA-Na).

Of the nine PFAS tested, only GenX suppressed the neutrophil respiratory burst in embryonic zebrafish, neutrophil-like cells, and human neutrophils. PFHxA also suppressed the respiratory burst, but only in embryonic zebrafish and neutrophil-like cells.

The researchers caution that while the results of this preliminary study are interesting, they raise more questions than they answer.

"The longest chemical exposure in our study was four days, so obviously we can't compare that to real human exposure of four decades," says Jeff Yoder, professor of comparative immunology and corresponding author of the work. "We looked at a high dose of single PFAS over a short period, whereas people in the Cape Fear River basin were exposed to a mixture of PFAS—a low dose over a long period.

"So while we can say that we see a toxic effect from a high dose in the cell lines, we can't yet say what effects long-term exposure may ultimately have on the immune system. This paper isn't the end of the road—it's the first step. Hopefully our work may help prioritize further study of these two chemicals."

The study appears in the Journal of Immunotoxicology and had support from the National Institute of Environmental Health Sciences (NIEHS), the North Carolina State University Center for Environmental and Health Effects of PFAS, and the North Carolina State University Center for

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Human Health and the Environment (CHHE). Jamie DeWitt, professor of pharmacology and toxicology at East Carolina University, is coauthor.

Futurity, 16 February 2023

https://futurity.org

Radioactive waste isn't going away. We've found a new way to trap it in minerals for long-term storage

2023-02-21

There are around 440 nuclear power plants operating in 32 countries around the world, supplying some 10% of the world's electricity. Another 60 reactors are under construction, and 300 more are proposed.

Australia has only one reactor, used for research and medical purposes. But Australia typically produces more than 5,000 tonnes of uranium each year. This is about 9% of the world's total.

Uranium mining and processing, and nuclear power plant operations, can produce a range of radioactive elements (called radionuclides). These may be long-lasting hazards if released into the environment. Liquid radioactive wastes present a particular challenge: they often contain a mixture of radionuclides, and few technologies can reliably capture and safely contain these contaminants quickly and efficiently.

We have invented a fast process to capture radionuclides from liquid waste in a clay-like mineral, which can then be baked to form a stable material for disposal and long-term storage. The research is published in Nature Scientific Reports and will soon be presented at the Waste Management Symposium, the world's largest radioactive waste management conference.

Catching radioactive elements

It has long been known some minerals can capture certain radionuclides. However, this process often involves passing contaminated water through numerous filters packed with these materials.

In contrast, our technology (called EUREECA) uses an approach where a clay-like mineral called a layered double hydroxide is formed within radionuclide-contaminated waters. These minerals are a natural absorbent that can remove a range of radionuclides at once, incorporating these and other contaminants as building blocks in their structure.

Liquid radioactive wastes present a particular challenge: they often contain a mixture of radionuclides, and few technologies can reliably capture and safely contain these contaminants.

This simple approach has many advantages over conventional technologies. In practice, two common industrial chemicals are added to the contaminated water. A reaction occurs in a matter of seconds to produce the layered double hydroxide mineral with the radionuclides trapped inside.

Importantly, the mineral typically comprises less than 0.5% of the mass of the treated water. This means the contaminants become hundreds of times more concentrated.

The mineral is also easily separated from the water using conventional industrial separation techniques.

In studies using wastewater from an Australian uranium mine, the mineral contained up to 1% uranium – a higher concentration than in the mine's ore. A host of other contaminants were also captured, including a range of radionuclides liberated during mining and associated activities.

Baking for long-term storage

After the contaminants have been captured in the layered double hydroxide mineral, they need to be locked up in perpetuity.

This is the next step of the EUREECA process: baking the mineral to transform it, like pottery in a kiln.

We heated the mineral to more than 1,300 , similar to that of a Hawaiian lava flow and, with colleagues at Curtin University, analysed how it changed at the atomic level. Several fascinating changes had occurred.

The first was that the layered double hydroxide was transformed into three separate minerals: olivine, periclase and spinel. This is a combination of minerals typically found in the lower mantle, about 2,500km beneath Earth's surface.

These minerals are not only stable at high temperatures and pressures, but also largely resistant to radiation damage.

When the baked minerals cooled down, we discovered the radionuclides had been concentrated even further. Uranium, thorium, lead and other contaminants were now squeezed into new minerals formed on the microscopically thin boundaries between the olivine, periclase and spinel.

In these boundary regions, the concentration of radionuclides was around 50,000 times greater than in the original uranium-bearing wastewaters.

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Easier decontamination

Our process has many potential applications for capture, containment and storage of soluble radioactive wastes in perpetuity. Beyond treating uranium mine wastewater, it could be used to capture and contain radionuclides from medical waste streams.

It would also have been of great use after the Fukushima Daiichi nuclear disaster in 2011, which generated huge amounts of complex liquid waste.

Rather than using multiple steps and substantial, often complex water treatment procedures and infrastructure, the EUREECA technology could have been rapidly deployed to decontaminate the water and remove radionuclides into solid minerals for long-term storage.

The Conversation, 21 February 2023

https://theconversation.com

U.S. food additives banned in Europe: Expert says what Americans eat is "almost certainly" making them sick

2023-02-20

From baguettes to focaccia, Europe is famous for its bread. But there's one ingredient conspicuously missing: Potassium bromate. It's a suspected carcinogen that's banned for human consumption in Europe, China and India, but not in the United States.

In the U.S., the chemical compound is used by some food makers, usually in the form of fine crystals or powder, to strengthen dough. It is estimated to be present in more than 100 products.

"There is evidence that it may be toxic to human consumers, that it may even either initiate or promote the development of tumors," professor Erik Millstone, an expert on food additives at England's University of Sussex, told CBS News. He said European regulators take a much more cautious approach to food safety than their U.S. counterparts.

Asked if it can be said with certainty that differences in regulations mean people in the U.S. have developed cancers that they would not have developed if they'd been eating exclusively in Europe, Millstone said that was "almost certainly the conclusion that we could reach."

It's not just potassium bromate. A range of other chemicals and substances banned in Europe over health concerns are also permitted in the U.S.,

In the U.S., the chemical compound [potassium bromate] is used by some food makers, usually in the form of fine crystals or powder, to strengthen dough. It is estimated to be present in more than 100 products.

including Titanium dioxide (also known as E171); Brominated vegetable oil (BVO) (E443); Potassium bromate (E924); Azodicarbonamide (E927a) and Propylparaben (E217).

Millstone, who's spent almost half a century researching food and agriculture science, said most Americans were likely completely unaware that they were being exposed on a daily basis to substances in their food viewed as dangerous in Europe.

"They probably just think, 'Well, if it's available or it's in the store, it's probably fine,'" he said.

In a statement to CBS News, the U.S. Food and Drug Administration (FDA) said all food additives require "pre-market evaluation" and "regulations require evidence that each substance is safe at its intended level of use before it may be added to foods."

"Post-approval, our scientists continue to review relevant new information to determine whether there are safety questions and whether the use of such substance is no longer safe," the agency added.

Stacy McNamara is from upstate New York, but she has lived in London for a decade. She said raising children in the U.K. had opened her eyes to what's allowed in foods in the U.S.

McNamara has no plans to ever move back home, and she told CBS News that food safety was "for sure" a part of that decision.

In a statement to CBS News, the FDA said that when used properly, potassium bromate converts into a harmless substance during food production.

The FDA acknowledged, however, that not all of the compound used in any given recipe may convert during the production process, but that control measures were utilized to minimize the amount in final products.

CBS News, 20 February 2023

https://cbsnews.com

Snakes can hear you scream, new research reveals

2023-02-15

Experts have long understood that snakes can feel sound vibrations through the ground – what we call "tactile" sensing – but we've puzzled over whether they can also hear airborne sound vibrations, and particularly over how they react to sounds.

In a new paper published in PLOS ONE, we conclude snakes use hearing to help them interpret the world, and finally dispel the myth that snakes are deaf to airborne sound.

Our research, which included 19 different snakes from seven species, reveals that not only do snakes have airborne hearing, but that different species react differently to what they hear.

How snakes respond to airborne and ground-borne sounds

Although seeing and tasting (the air) are the main ways snakes sense their environment, our study highlights that hearing still plays an important role in snakes' sensory repertoire.

This makes sense from an evolutionary perspective. Snakes are susceptible to predators including monitor lizards, cats, dogs and other snakes. Hearing is an important sense for both predator avoidance and injury avoidance (such as being trodden on).

A coastal taipan sits at the centre of a large black and white grid on the ground.

For our experiments, we collaborated with the Queensland University of Technology's School of Creative Practice to fit-out a soundproof room and test one snake at a time.

Using silence as our control, we played one of three sounds, each including a range of frequencies: 1–150Hz, 150–300Hz and 300–450Hz. For comparison, the human voice range is about 100–250Hz, and birds chirp at about 8,000Hz.

In one previous study, researchers hung western diamondback rattlesnakes (Crotalus atrox) in a steel mesh basket and observed their restricted behaviours in response to sound frequencies between 200Hz and 400Hz. In another, researchers surgically implanted electrodes into the brains of partially anaesthetised snakes, detecting electrical potentials in response to sound up to 600Hz.

Researchers conclude snakes use hearing to help them interpret the world, and finally dispel the myth that snakes are deaf to airborne sound.

But our research is the first to investigate how multiple snake species respond to sounds in a space where they can move freely. We also used an accelerometer to detect whether the sounds produced ground vibrations. In this way we confirmed the snakes were indeed registering airborne sounds, and not just feeling ground vibrations.

Do snakes move toward or away from sound?

Most of the snakes exhibited very different types of behaviours in sound trials compared to the control.

Woma pythons (Aspidites ramsayi) – a non-venomous snake found throughout Australia's arid interior – significantly increased their movement in response to sound and actually approached it. They exhibited an interesting behaviour called "periscoping", in which snakes raise the front third of their body in a manner that suggests curiosity.

In contrast, three other genera – Acanthophis (death adders), Oxyuranus (taipans) and Pseudonaja (brown snakes) – were more likely to move away from sound, signalling potential avoidance behaviour.

Death adders are ambush predators. They wait for their prey to come to them using the lure on their tail (which they wiggle to look like a worm), and they can't travel quickly. So it makes sense they trended away from the sound. For them, survival means avoiding being trodden on by large vertebrates such as kangaroos, wombats or humans.

Brown snakes and taipans are active foragers that rapidly pursue their prey during the day. This means they may be vulnerable to daytime predators such as raptors. In our experiments, both of these snakes appeared to have acute senses. Taipans in particular were likely to display defensive and cautious behaviours in response to sound.

Can snakes hear us?

Our study further debunks the myth that snakes are deaf. They can hear – just not as well as you or I. Snakes can only hear low frequencies, roughly below the 600Hz mark, whereas most of us can hear a much wider range. Snakes probably hear muffled versions of what we do.

So, can snakes hear us? The frequency of the human voice is about 100–250Hz, depending on sex. The sounds we played in our trials included these frequencies, and were played at a distance of 1.2m from the snakes at 85 decibels. This is about the amplitude of a loud voice.

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The snakes in our study responded to this sound, and many significantly so. So it's probably safe to say snakes can hear people speaking loudly or screaming. That doesn't mean they can't hear someone talking (a normal conversation is about 60 decibels) – we just didn't test sound at this noise level.

The Conversation, 15 February 2023

https://theconversation.com

How pesticides impair our senses

2023-02-16

Fifteen years ago, Tim Parton, a farm manager at Brewood Park Farm in Staffordshire in the UK, decided to take a leap and start to experiment with biological farming. Instead of using synthetic pesticides and fertilisers, he applies self-brewed biologically active natural inputs, such as trichoderma, a type of fungus, onto his crops, to help them both grow and fix nitrogen and phosphorus into the soil.

Parton is part of a growing farming community practising regenerative agriculture. Regenerative agriculture is an approach to farming that prioritises soil and environmental health by minimising synthetic inputs.

He switched to using biologically active inputs after experiencing headaches and skin rashes from using pesticides. After sheep dipping, which involves immersing sheep in insecticide and pesticide mixtures to eliminate parasites, lumps would often show up on his arms. The reaction would stay for several days. "I would be a mess, but if I went to the doctors, they would say 'you've just had a reaction' and would not take it seriously," he says.

Since adopting a biological farming method, Parton has not experienced any negative health impacts. He has not had to use any phosphorus and potassium fertilisers on his crops for over 10 years. "I try to keep the plant as nutritionally balanced as I can, and if the plant has got all the correct nutrition, it doesn't get ill," he says.

He says he has observed a big increase in insect and bird species since he stopped using pesticides to control insects and weeds. "The knock-on effect is that I've got more bird numbers here than I should have, lots of threatened species are multiplying here because the food source is here," he says.

Pesticides are widely used worldwide to boost plant growth. Although effective, they contain toxic chemicals that can seriously impair our senses and nervous system.

Pesticides are substances or chemicals used to repel, destroy and control pests, weeds or other organisms that affect plant growth. Although effective, pesticides contain toxic chemicals that can have wide-ranging, and sometimes chronic, effects on human's sensory organs and nervous system.

First deployed in the 1930s to protect crops in the US, many agricultural communities soon became dependent on their use because of their dramatic effect on yields. Today, around one-third of the world's agricultural products are pesticide dependent.

According to the World Health Organization (WHO), over 1,000 types of pesticides are used globally, with some of the most common types being herbicides (49%), fungicides and bactericides (27%) and insecticides (19%). In 1990, global pesticide consumption was at 3.72 billion lb (1.69 billion kg); this figure grew over 57% in the past two decades, reaching 5.86 billion lb (2.66 billion kg) by 2020.

A UN Environment Programme report forecasts continued growth in pesticide use. As the world's population is expected to reach 9.3 billion people by 2050, a 60% increase in the rate of food production is required. To sustain this demand, researchers believe farmers will need to use even more pesticides.

According to a study on European farming systems, omitting pesticides altogether can lead to a 78% loss of fruit production, a 54% decrease in vegetable harvests and a 32% loss of cereal yields. But our dependence on pesticides also comes at a significant cost to the environment, with research showing pesticides may be responsible for the loss of smell in honeybees and salmon, and have contaminated water bodies, threatening aquatic ecosystems.

Pesticides can also enter the food chain, through a process known as bioaccumulation. This occurs when a substance builds up in the body due to our inability to break it down. Since many synthetic pesticides cannot be broken down by animals or humans, they may end up bioaccumulating in body fat.

This can have a detrimental impact on human health. Despite global regulations on pesticide use, one study estimates that about 385 million cases of unintentional, acute pesticide poisoning occur among farm workers each year.

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When sprayed, pesticides produce vapours that may turn into air pollutants. In the US, 37-54% of pesticide-related illnesses among agricultural workers are attributed to spray drifts; symptoms can range from headaches and nausea to burning sensations on the skin.

Early symptoms of pesticide exposure can include headaches, nausea, dizziness and respiratory secretion, says Michelle Perro, a former paediatrician who co-founded the non-profit GMO Science, a public platform where physicians discuss and analyse the impact of genetically engineered crops and foods. Acute health impacts can range from seizures to respiratory depression. The mode and length of exposure and the type of pesticide used all affect its impact on our sensory and nervous systems. "Exposure by inhaling pesticides through our lungs can be more toxic, because our gut contains microbes that help to detoxify pollutants," says Perro.

Pesticide exposure has also been linked to sensory deterioration. One of the earliest known incidences occurred in the 1960s in Japan's Saku agricultural region. Residents of the region were found to have a high incidence of visual defects after exposure to organophosphates. The effect of Saku disease included blurring of vision, eye movement disorders, myopia and astigmatism. A study of the residents in the area found that aside from farmers, the wives of farmers, who may have been exposed via take-home contamination or spray drift from nearby fields, also suffered from decreased visual acuity and loss of vision.

"When pesticide applicators have pesticide residues on their skin or clothing, those around them can inhale these residues – extended secondary exposure can also lead to harmful effects on health," says Honglei Chen, a professor of epidemiology and biostatistics at Michigan State University.

Chen is part of a 2019 Michigan State University study investigating the effect of pesticide exposure on olfactory functioning. The study monitored 11,232 farmers over a period of 20 years. Of the studied farmers, 10.6% experienced a high pesticide exposure event (HPEE). A HPEE is not officially defined and is dependent on the farmers' interpretation of the severity of their pesticide exposure. Farmers with a history of HPEE had a 49% higher chance of having a poor sense of smell.

A 2020 study found that of the estimated 860 million agricultural workers worldwide, 44% are affected by pesticide poisoning annually. This is due to a lack of protective equipment or defective equipment, which increases exposure through skin absorption, inhalation or ingestion.

"When pesticides enter the body through inhalation, [they] bypass our blood brain barrier and impair nerve function," says Chen. "Alternatively, [pesticides] can enter our bloodstream through our gastrointestinal tract if ingested."

Many studies also establish a link between pesticide use and neurodegenerative diseases. Pesticide exposure has been associated with conditions such as attention deficit hyperactivity disorder (ADHD) and Parkinson's disease. A study from the University of Guelph in Canada suggests that pesticides cause animal cells to mutate in a way that mimics the effects of mutations which are known to cause Parkinson's. In another study pyrethroid pesticides were found to cause increased DAT (dopamine transporter expression) in mice. DAT is a type of gene expression also observed in individuals with ADHD. Exposure to pesticides during pregnancy or early life has also been associated with the development of autism among children.

Because they are designed to target an organism's nervous tissue, insecticides such as organophosphates, carbamates and organochlorine pesticides are more toxic than herbicides. Although there is strong evidence that acute, high-quantity exposure can lead to nervous system damage, it is still being studied whether chronic, moderate exposure has the same impact. Chen says that establishing a clear causal link between pesticides and deteriorating health remains a challenge because "there are many environmental toxins in the atmosphere, such as air pollutants, viruses and volatile organic compounds…these can all build up in the body and cause a cumulative adverse health effect".

From the microplastics sprayed on farmland to the noxious odours released by sewage plants and the noise harming marine life, pollutants are seeping into every aspect of our existence. Sensory Overload explores the impact of pollution on all our senses and the long-term harm it is inflicting on humans and the natural world. Read some of the other stories from the series here:

Children are particularly vulnerable to pesticides because of their physiology, faster metabolic rate and behaviours. "Children are often closer to the ground because of their height, they also exhibit frequent hand-to-mouth activity, so they have a higher risk of accidentally ingesting pesticides compared to adults," says Perro. According to a paper published in the journal Environmental Toxicology, children risk absorbing higher doses of pesticides because of the greater intake of food or fluids per pound of body weight.

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In 2014, schoolchildren experienced pesticide poisoning in France's Bordeaux region. In a primary school located near a vineyard, 23 schoolchildren experienced nausea, headaches and skin irritations after fungicides were sprayed in the vineyard. The case resulted in a €30,000 ($31,842/ £26,488) fine for the two vineyards involved, after a private lawsuit was filed by two French environmental associations Sepanso and Génération Futures.

Cases of children falling ill from pesticide exposure can be found around the globe, from Hawaii to New Zealand. In India, pesticide poisoning among children has been a significant public health issue for decades. A study documenting the impact of the agricultural pesticide ALP on children in rural northern India found that of the 30 children admitted into intensive care, 14 children did not survive pesticide poisoning.

Elderly people are also particularly vulnerable due to their thinner skin, which increases risks of poisoning from dermal contact. As their organ functions deteriorate, the liver and kidneys may take longer to remove toxins, making it more likely for pesticides to accumulate in their bodies and cause physical or neurological damage.

Although pesticide poisoning is more likely during acute or chronic exposure, consumers are susceptible via accidental ingestion or dermal contact. It is not uncommon for pesticide residues to remain on fresh produce. In 2022, the US Environmental Working Group (EWG) found that over 70% of non-organic fresh produce contains residues of potentially harmful pesticides. In a 2020 European Food Safety Authority report of pesticide residues in food, it was found that 29.7% of produce contained one or more residues equal to or below permitted limits, while 1.7% exceeded the legal limit.

Based on data gathered by the WHO and Food Agriculture Organization, governments and intergovernmental bodies will set food standards and establish "maximum residue limits" for pesticides in different types of food.

Consumers may have limited control over the frequency and amount of pesticides applied on their food, but the negative effects can be mitigated by the basic act of washing and cleaning their skin or food following exposure. It is possible to reduce pesticide levels by 10-80% through cooking and processing methods such as blanching, boiling and frying. A 2022 comparative study found that washing with water or boiling is the most effective way to remove pesticide residue.

Certain regions and countries have placed bans on specific pesticides. In 1962, biologist Rachel Carson's book Silent Spring brought the adverse impacts of pesticides on the environment to the public eye. This led to a national environmental movement in the US, which instigated a ban on DDT, an insecticide commonly used in agriculture.

The 2001 Stockholm Convention on Persistent Organic Pollutants, signed by 90 countries, has also banned over 20 substances to protect the environment and safeguard human health. The substances, which include pesticides such as aldrin and DDT, were selected due to their toxicity, resistance to degradation and ability to bioaccumulate in animals and ecosystems.

However, there are also countries that legally require the use of specific pesticides to control disease outbreak in crops. In 2014, France's wine-producing region Burgundy fined a winemaker €500 ($531, £441) for disobeying government requirements to spray his organic vineyard with pesticides. The requirement was announced after Flavescene dorée, a vine disease, spread in the region.

As part of the EU's strategy to shift to a more sustainable food system, the European Commission has committed to halving both the use and risk of pesticides by 2030. But some agricultural communities still find this target insufficient. A group of agricultural workers and consumers have formed the "Save bees and farmers initiative", calling for an 80% reduction in pesticide use by 2030 and a complete phase out by 2035.

Success stories such as Parton's show that farming without synthetic inputs is possible. At the 2020 British Farming Awards, Parton was named 'Farm Innovator of the Year' for this no-till and biological approach.

Since replacing pesticides with nitrogen-fixing bacteria, he says his yields have remained the same or surpassed previous years. The farm saves £90,000 ($111,000) a year on pesticides compared to 10 years ago.

"Last century was the chemical century," he says. "This century is going to be the biological one because we cannot keep polluting the planet in which we live."

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"I farm in the heartbeat of nature, creating a healthy ecosystem on the farm for generations to come," says Parton. "Together we can make the changes needed to heal the planet in which we live. There is no planet B."

BBC News, 16 February 2023

https://bbc.com

Inhalable powder could shield lungs from COVID

2023-02-15

The powder, called Spherical Hydrogel Inhalation for Enhanced Lung Defense, or SHIELD, reduced infection in both mouse and non-human primate models over a 24-hour period, and can be taken repeatedly without affecting normal lung function.

"The idea behind this work is simple—viruses have to penetrate the mucus in order to reach and infect the cells, so we've created an inhalable bioadhesive that combines with your own mucus to prevent viruses from getting to your lung cells," says Ke Cheng, corresponding author of the paper describing the work. "Mucus is the body's natural hydrogel barrier; we are just enhancing that barrier."

Researchers have developed an inhalable powder that could protect lungs and airways from viral invasion.

Cheng is a professor in regenerative medicine at North Carolina State University's College of Veterinary Medicine and a professor in the NC State/UNC-Chapel Hill joint department of biomedical engineering.

The inhalable powder microparticles are composed of gelatin and poly(acrylic acid) grafted with a non-toxic ester. When introduced to a moist environment—such as the respiratory tract and lungs—the microparticles swell and adhere to the mucosal layer, increasing the "stickiness" of the mucus.

The effects are most potent during the first eight hours after inhalation. SHIELD biodegrades over a 48-hour period, and is completely cleared from the body.

In a mouse model, SHIELD blocked SARS-CoV-2 pseudovirus particles with 75% efficiency four hours after inhalation, which fell to 18% after 24 hours. The researchers found similar results when testing against pneumonia and H1N1 viruses.

In a non-human primate model of both the original and Delta SARS-CoV-2 variants, SHIELD-treated subjects had reduced viral loads—from 50 to 300-fold less than control subjects—and none of the symptoms commonly

associated with infection in primates, such as lung inflammation or fibrosis. Since primates do not exhibit the same symptoms of infection as humans, viral load is the standard marker used to determine exposure.

The researchers also looked at potential toxicity both in vitro and in vivo: 95% of cell cultures exposed to a high concentration (10 mg ml-1) of SHIELD remained healthy, and mice who were given daily doses for two weeks retained normal lung and respiratory function.

"SHIELD is easier and safer to use than other physical barriers or anti-virus chemicals," Cheng says. "It works like an 'invisible mask' for people in situations where masking is difficult, for example during heavy exercise, while eating or drinking, or in close social interactions. People can also use SHIELD on top of physical masking to have better protection.

"But the beauty of SHIELD is that it isn't necessarily limited to protecting against COVID-19 or flu. We're looking at whether it could also be used to protect against things like allergens or even air pollution—anything that could potentially harm the lungs."

The study appears in Nature Materials. Funding comes from the National Institutes of Health, the American Heart Association, and special funding from the NC State Provost's Office. The researchers have filed a patent and are working on FDA approval for human use.

Futurity, 15 February 2023

https://futurity.org

Glimpse beneath iconic glacier reveals how it's adding to sea-level rise

2023-02-15

Researchers have dropped a submersible vehicle down a hole in Antarctic ice to get their closest-ever look at the underside of Thwaites Glacier — a massive and increasingly unstable body of ice that has become an icon of climate change — and the first-ever glimpse at the spot where the ice meets the land.

The observations, published in two papers in Nature on 15 February, could help to pin down one of the biggest uncertainties in current projections of rising global sea levels. The studies imply that models of how the West Antarctic Ice Sheet and glacier flow respond to climate change are missing some important details. Incorporating these insights should clarify how and why the ice will change in the future.

Data-gathering instruments under the melting Thwaites Glacier are helping researchers to figure out how the ice will change in future.

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For now, the work brings "neither good news nor bad news" in terms of sea-level rise, says co-author Peter Davis, a physical oceanographer at the British Antarctic Survey in Cambridge, UK. "The glacier is still moving as quickly as it ever has been."

Reducing uncertainty

The Intergovernmental Panel on Climate Change predicts that sea levels will probably rise by between 38 and 77 centimetres by 2100, but the collapse or melting of ice sheets in Greenland and the Antarctic could theoretically contribute an additional metre. "All of this is to beat down those uncertainties," says Britney Schmidt, an Earth scientist at Cornell University in Ithaca, New York, who is a co-author of both papers.

Thwaites Glacier is a fast-moving block of ice, the size of Florida, in the West Antarctic. Satellite studies have shown that its 'grounding line' — where ice attached to bedrock transitions to ice floating in the sea — has shifted 14 kilometres inland since the late 1990s, and some parts of it are retreating as fast as 1.2 kilometres per year.

'Grounding-line retreat' is what makes Thwaites responsible for about 4% of today's global sea-level rise (see 'Retreating glacier'). As the grounding line moves inland, it levers up more, ever-thicker ice to float on the sea. This, in turn, raises the sea level and makes the glacier move faster. The process can lead to accelerating collapse, as the erosion of the coastal ice allows kilometres of ice behind it to flow ever more rapidly out to sea.

Researchers think that grounding-line retreat is driven by warm ocean water melting the underside of the ice. Climate change has shifted wind patterns in the region, allowing a patch of warm water to flow towards the West Antarctic.

Drilling for data

To investigate this process, Davis, Schmidt and their colleagues decided to drill down into the glacier and have a look at the grounding line.

They drilled a hole roughly 30 centimetres wide through nearly 600 metres of ice, using hot water, and lowered down instruments and a remotely operated vehicle called Icefin. This allowed them to observe the underside of the ice, the grounding line, more closely than ever before. Over five days in January 2020, they took images and videos of the underside of the glacier and collected data about water temperature, salinity and more. Some instruments left on site have now been taking data for more than a year.

The researchers found that melt rates on the underside of the ice were just 2–5.4 metres per year, much lower than the 14–32 metres predicted by models1. "That was very surprising," says Davis.

The water was about 1.5 °C above the freezing point. However, they found that a thin layer of cold, fresh melt water was coating the underside of the ice — and, because the water was very still, this prevented heat from being transferred to the ice. "There's more than enough heat, actually, to drive really rapid melting, but you need to get that heat through the protective layer," says Davis.

The melt rate was highest in areas under the ice where there were cracks and steep, staircase-like features2. These divert the cold, protective melt water, allowing the heat to reach the ice, and melt it to widen crevasses.

Sensitive ice

Both papers might help to clarify what's missing from simple models of Antarctic ice that don't seem to capture large changes thought to have happened during warmer periods of Earth's history, says Eric Steig, a glaciologist at the University of Washington in Seattle. The results show ways in which the ice might be more sensitive: glacial retreat can be rapid despite low rates of melting from underneath; and the most pronounced melting is helping to carve out crevasses from below, which might encourage large bits of ice to break off. "Maybe you don't need as much melt to affect the structural integrity," Steig says.

"These types of hard-fought observations are absolutely critical to refining the treatment of these processes in the models we use to predict the ice sheet's future," says Robert DeConto, a geophysicist and ice modeller at the University of Massachusetts Amherst. "We need more of them."

When this information does get built into models, it should tighten predictions of what will happen to Antarctic ice and global sea levels. It's unknown whether this will paint a more frightening picture or a more reassuring one. "I really couldn't speculate," says Schmidt.

Nature, 15 February 2023

https://nature.com

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North Carolina man developed 'uncontrollable' Irish accent during prostate cancer treatment

2023-02-17

A North Carolina man developed an "uncontrollable Irish accent" until his death after being treated for prostate cancer, according to research published in the British Medical Journal.

The patient, who was only identified as a man in his 50s, was presumably afflicted with foreign accent syndrome (FAS) after receiving androgen deprivation therapy and being prescribed abiraterone acetate/prednisone.

The report said the man lived in England during his 20s and had friends and distant family members from Ireland, but had never visited the country or spoken with the foreign accent.

"His accent was uncontrollable, present in all settings and gradually became persistent," the four researchers wrote in their report, adding that it first began 20 months into his treatment.

Several similar cases have been studied across the globe in recent years, but this was reportedly the first case of FAS described in a patient with prostate cancer and the third described in a patient with malignancy.

Researchers said the man developed foreign accent syndrome 20 months into his treatment and it remained until his death

The researchers believe his voice change was caused by a condition called paraneoplastic neurological disorder (PND), which happens when cancer patients' immune systems attack parts of their brain, muscles, nerves and spinal cord.

"Despite chemotherapy, his neuroendocrine prostate cancer progressed resulting in multifocal brain metastases and a likely paraneoplastic ascending paralysis leading to his death," they wrote.

Even as his condition worsened, the accent remained until his death months later. The report said the man did not have any neurological examination abnormalities or psychiatric history. An MRI taken at symptom onset also did not display brain abnormalities.

According to the BBC, others who have dealt with FAS described it as an unsettling feeling of hearing a "stranger in the house" whenever they speak.

One of the first recorded cases was in 1941, when a young Norwegian woman developed a German accent after she was hit by bomb shrapnel during a World War II air raid, Medical News Today reported. The accent

caused people to ostracize her, and she was thought to be a Nazi spy by locals.

In 2006, MNT said Linda Walker, a United Kingdom woman with a Geordie accent, adopted a Jamaican-sounding voice after she suffered a stroke.

A 2019 report by the British Medical Journal found that most reported having a foreign accent for two months to 18 years, with a mean length of three years. The study included 49 people who developed foreign accent syndrome.

Fox News, 17 February 2023

https://foxnews.com

Could Alzheimer's be caused by an infection?

2023-02-19

As Davangere Devanand, a neurologist at Columbia University Medical Center, combed through the reams of scientific data on Alzheimer's, he stumbled across a surprising idea – could an infection be involved in driving the disease?

"I was looking for an Alzheimer's treatment approach that had a reasonable shot of working," he says. "I found this old theory, going back 35 years, which linked herpes viruses to the disease, and there were all these indirect lines of evidence."

The further Devanand looked, the more he found. Since the mid-80s, a handful of scientists around the world had doggedly pursued the idea that either a virus or a bacterium could play a role in Alzheimer's, despite almost complete antipathy from those studying more accepted theories about the disease. Colleagues snubbed them, leading scientific journals and conferences rejected their work and funding had been threadbare, but slowly and surely, they built an increasingly compelling case.

In particular, evidence pointed towards herpes simplex virus 1 (HSV-1) – a pathogen found in 70% of the UK population, and the cause of oral herpes – as a prominent suspect. Studies in the UK, France and Scandinavia suggested that people who had been infected with herpes were more likely to get Alzheimer's. When Prof Ruth Itzhaki from Oxford University's Institute of Population Ageing – who has done more than any other scientist to advance the HSV-1 theory of Alzheimer's – examined postmortem brain samples from patients, she found greater amounts of the virus's DNA than in people who had not died of the disease.

Research into the disease has focused on plaques in the brain. But some scientists think viruses and bacteria play a role – and their work is gaining ground.

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"Then there was this 2018 study from Taiwan, which was quite dramatic," says Devanand. "When people with herpes were treated with a standard antiviral drug, it decreased their risk of dementia nine-fold."

Devanand was intrigued because while the major hallmarks of Alzheimer's are well-known, we still have little idea about what triggers it. We know that toxic plaques and tangles form inside the brain, causing damaging inflammation and the death of brain cells. Certain genes and lifestyle factors such as loneliness, lack of exercise and poor diet can all increase the risk of developing Alzheimer's, but how and why it begins remains a mystery. Could a virus be the smoking gun that scientists have been looking for?

Others have suggested that various bacteria may also be capable of initiating the neurodegeneration that leads to Alzheimer's. Chlamydia pneumoniae, which causes lung disease, Borrelia burgdorferi, which is associated with Lyme disease, and even gum infections have all been put forward as possible triggers.

The main idea for why viruses like HSV-1 and possibly bacteria may be capable of triggering Alzheimer's is that they invade the body before burrowing into the central nervous system, and travelling to the brain sometime in midlife. Once there, they stay dormant for many years before being reactivated in old age, either because the ageing immune system can no longer keep them in check, or something else – a traumatic episode, a head injury or perhaps another infection – spurs them to life. Once awakened – so the theory goes – they begin to wreak havoc.

For a long time, neurologists treated these ideas as fanciful, until more and more irrefutable evidence arose for the role of pathogens in chronic illness. Last year, the Epstein-Barr virus was identified as the main risk factor for multiple sclerosis, while other studies have shown that a bout of measles can lead many years later to a progressive neurological disorder called subacute sclerosing panencephalitis.

So when Devanand approached the US National Institute on Aging for a grant of several million dollars to run a clinical trial investigating whether a herpes antiviral drug called valacyclovir could slow the progression of Alzheimer's in patients in the early stages of the disease, they agreed to back him.

The ongoing trial, which is expected to be completed by early 2024, could have significant implications for how we look at the disease.

For decades, the number-one focus of almost all Alzheimer's endeavours has been a protein fragment called beta-amyloid, often referred to as simply amyloid. Orthodox Alzheimer's theories suggest that this accumulates in the brain as a kind of toxic waste, causing the signature plaques that kill brain cells and lead to the disease. Funding bodies and drug developers have largely shunned alternative explanations for why Alzheimer's may occur, and instead have continued to pump resources into amyloid research.

But scientists are starting to show that the amyloid and microbial theories of Alzheimer's may not be mutually exclusive. For while amyloid has long been seen as the villain of the story, some scientists believe it is actually a key element of our brain's defence mechanisms against external threats. Fifteen years ago, Rudolph Tanzi, a neurology professor at Harvard Medical School who has discovered many of the key genes linked to Alzheimer's, made a surprising discovery – amyloid has antimicrobial properties, helping to defend the brain against any invading pathogen. More than a decade's worth of experiments later, he has developed a viable theory for why plaques form.

"When an infection attacks your brain, your first response is these little sticky peptides that bind to the microbe, glutinate it into a ball and trap it," he says. "We found that amyloid is one of the major peptides in the brain that goes after microbes. I believe the plaques we see in Alzheimer's brains actually evolved as a way to protect the brain."

According to Tanzi, for much of our lives our body is able to seamlessly clear these clumps of amyloid. Immune cells known as microglia, which cleanse the brain of debris, gobble them up during deep sleep. But as we age, this finely tuned system can break down, and if amyloid is left lingering in the brain, it ends up harming us.

People with certain genetic vulnerabilities – such as the APOE4 gene variant found in up to 25% of the general population – are unable to shovel out amyloid quite as efficiently as others, meaning it is more likely to accumulate. Ageing also weakens the immune system, making it easier for pathogens to access the brain and more amyloid to form.

"As you get older, your immune system starts to wane, and the barrier between your bloodstream and the brain is not what it used to be," says Tanzi. "So you're creating a perfect storm because microbes can proliferate better, and the brain does not clear amyloid as well as it used to."

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Hugo Lövheim, a researcher in geriatric medicine at Umeå University, says that we also know that lifestyle factors such as social isolation and lack of exercise can weaken the immune system. He suggests this could have two consequences – making it harder for the body to keep microbes such as HSV-1 in check, and then being unable to clear the resulting plaques.

"We know that psychological factors or stress can affect the risk of being unable to control a herpes virus infection at a particular time point," says Lövheim.

The burden of Alzheimer's and all forms of dementia on patients, families and society at large is unspeakably huge. By next year, it is predicted that there will be more than 1 million people in the UK living with dementia, numbers that our healthcare system is not equipped to deal with. The total cost of dementia care in this country stands at around £34.7bn a year, but the starkest statistic is that two-thirds of this burden is being covered by families themselves, either in unpaid care or private social care.

But the landscape of Alzheimer's treatments could not be sparser. Almost all clinical trials testing drugs attempting to reduce the amount of amyloid in the brain have failed to stop the disease. Even lecanemab, the new amyloid-targeting Alzheimer's medication that hit the headlines towards the end of 2022, only offers marginal benefits in slowing down memory loss. Medicinal chemist Derek Lowe, who writes a blog on the pharma industry for the journal Science, commented that lecanemab shows that while amyloid is definitely involved in Alzheimer's disease, it is perhaps unlikely to be the underlying cause.

"Lecanemab did indeed show substantial amyloid clearance in the brain, so it is definitely working on target," wrote Lowe. "The fact that the drug has such effects on amyloid and still just barely slows the course of the disease, argues for that point of view."

Some scientists suspect that the reason why anti-amyloid drugs have been ineffective in stopping Alzheimer's is because we give them too late in the disease course, years or decades after the plaques have started to accumulate. By this point, it is widespread neuroinflammation that is killing off cells, which is why some companies, such as Switzerland-based AC Immune, are now looking to target the inflammation pathways in the Alzheimer's brain.

While anti-amyloid drugs could be tried on people in midlife to see if it stops them developing the disease, Tanzi says that the costs of this are likely to be impractical. "If every American had a blood test for amyloid

today, 40 million would find out that they need to do something about it," he says. "But if you have anti-amyloid treatments that cost $26,000 a year, good luck getting those to 40 million people, especially when each one would need three MRI scans a year to make sure that they don't have any brain swelling or haemorrhaging as a side effect."

Instead, if scientists can generate some more proof that a microbe is definitely instigating the disease in at least a proportion of patients, it could open the door to some more practical disease prevention initiatives. Making antivirals available to all people who have been infected by herpes could be one idea, or even encouraging more midlife vaccinations, for example against the varicella zoster virus (VZV) that causes shingles. It has been suggested that VZV is capable of reactivating the HSV-1 virus from a dormant state, and Itzhaki has found that giving people a shingles vaccine seems to lessen their risk of developing Alzheimer's.

But Alzheimer's is a devilishly complex disease and there is still much to be done in order to convince the majority of scientists that infections are involved. For while epidemiology and lab studies seem to show that it is possible, several clinical trials have ended in failure. When Canadian scientists gave Alzheimer's patients multiple antibiotics, it showed no benefit. San Francisco-based biotech Cortexyme – now known as Quince Therapeutics – spent years developing a drug that could target Porphyromonas gingivalis, a bacteria that causes gum disease and secretes harmful enzymes that can leak into the brain. But when it has been tried clinically, it also failed to work.

Tanzi suspects that once again, we may be giving treatment to patients too late in the day. "If an infection drove the amyloid formation, it could have happened 30 years ago," he says. "It just took 30 years before you got enough neuroinflammation to get the disease."

Devanand's trial will provide crucial evidence regarding where to go next. If it shows some sign of benefit, it may help persuade funding bodies to stump up money to give antivirals to people in their 40s and 50s who are genetically at risk of Alzheimer's, or vaccinate a large number of people against various common viruses.

Devanand, and scientists such as Itzhaki who have dedicated their lives to this line of research, are hoping for just some hint that they are on the right track. "We're not curing the disease in this trial," he says. "We're looking to see if patients who get an antiviral experience less decline than

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those who get a placebo. And if herpes is a contributing factor, it should be good to treat it."

The Guardian, 19 February 2023

https://theguardian.com

Astrophysicists Discover a Mysterious Perfect Explosion in Space – "It Makes No Sense"

2023-02-16

Kilonovae — the giant explosions that occur when two neutron stars orbit each other and finally collide — are responsible for creating both great and small things in the universe, from black holes to the atoms in the gold ring on your finger and the iodine in our bodies. They give rise to the most extreme physical conditions in the Universe, and it is under these extreme conditions that the Universe creates the heaviest elements of the periodic table, such as gold, platinum, and uranium.

But there is still a great deal we do not know about this violent phenomenon. When a kilonova was detected at 140 million light-years away in 2017, it was the first time scientists could gather detailed data. Scientists around the world are still interpreting the data from this colossal explosion, including Albert Sneppen and Darach Watson from the University of Copenhagen, who made a surprising discovery.

"You have two super-compact stars that orbit each other 100 times a second before collapsing. Our intuition, and all previous models, say that the explosion cloud created by the collision must have a flattened and rather asymmetrical shape," says Albert Sneppen, PhD student at the Niels Bohr Institute and first author of the study published in the journal Nature.

This is why he and his research colleagues are surprised to find that this is not the case at all for the kilonova from 2017. It is completely symmetrical and has a shape close to a perfect sphere.

"No one expected the explosion to look like this. It makes no sense that it is spherical, like a ball. But our calculations clearly show that it is. This probably means that the theories and simulations of kilonovae that we have been considering over the past 25 years lack important physics," says Darach Watson, associate professor at the Niels Bohr Institute and second author on the study.

About Kilonovae

When neutron stars collide they produce an explosion that, contrary to what was believed until recently, is shaped like a perfect sphere.

Neutron stars are extremely compact stars that consist mainly of neutrons. They are typically only about 20 kilometers across, but can weigh one and a half to two times as much as the Sun. A teaspoon of neutron star matter would weigh about as much as Mount Everest.

When two neutron stars collide, the phenomenon of a kilonova occurs. This is the name of the gigantic explosion that the merger creates. It is a radioactive fireball that expands at enormous speed and consists mostly of heavy elements formed in the merger and its aftermath — both the lighter and the very heavy elements — which are ejected into space.

The phenomenon was predicted in 1974 and first clearly observed and identified in 2013. In 2017, detailed data from a kilonova was obtained for the first time, when the detectors LIGO (in the USA) and Virgo (in Europe) sensationally succeeded in measuring gravitational waves from the kilonova AT2017gfo, which was in a galaxy 140 million light years away.

The spherical shape is a mystery

But how the kilonova can be spherical is a real mystery. According to the researchers, there must be unexpected physics at play:

"The most likely way to make the explosion spherical is if a huge amount of energy blows out from the center of the explosion and smooths out a shape that would otherwise be asymmetrical. So the spherical shape tells us that there is probably a lot of energy in the core of the collision, which was unforeseen," says Albert Sneppen.

When the neutron stars collide, they are united, briefly as a single hypermassive neutron star, which then collapses to a black hole. The researchers speculate whether it is in this collapse that a large part of the secret is hidden:

"Perhaps a kind of 'magnetic bomb' is created at the moment when the energy from the hypermassive neutron star's enormous magnetic field is released when the star collapses into a black hole. The release of magnetic energy could cause the matter in the explosion to be distributed more spherically. In that case, the birth of the black hole may be very energetic," says Darach Watson.

However, this theory does not explain another aspect of the researchers' discovery. According to the previous models, while all elements produced are heavier than iron, the extremely heavy elements, such as gold or uranium, should be created in different places in the kilonova than the lighter elements such as strontium or krypton, and they should be

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expelled in different directions. The researchers, on the other hand, detect only the lighter elements, and they are distributed evenly in space.

They therefore believe that the enigmatic elementary particles, neutrinos, about which much is still unknown, also play a key role in the phenomenon.

"An alternative idea is that in the milliseconds that the hypermassive neutron star lives, it emits very powerfully, possibly including a huge number of neutrinos. Neutrinos can cause neutrons to convert into protons and electrons, and thus create more lighter elements overall. This idea also has shortcomings, but we believe that neutrinos play an even more important role than we thought," says Albert Sneppen.

A New Cosmic Ruler

The shape of the explosion is also interesting for an entirely different reason:

"Among astrophysicists there is a great deal of discussion about how fast the Universe is expanding. The speed tells us, among other things, how old the Universe is. And the two methods that exist to measure it disagree by about a billion years. Here we may have a third method that can complement and be tested against the other measurements," says Albert Sneppen.

The so-called "cosmic distance ladder" is the method used today to measure how fast the Universe is growing. This is done simply by calculating the distance between different objects in the universe, which act as rungs on the ladder.

"If they are bright and mostly spherical, and if we know how far away they are, we can use kilonovae as a new way to measure the distance independently – a new kind of cosmic ruler," says Darach Watson and continues:

"Knowing what the shape is, is crucial here, because if you have an object that is not spherical, it emits differently, depending on your sight angle. A spherical explosion provide much greater precision in the measurement."

He emphasizes that this requires data from more kilonovae. They expect that the LIGO observatories will detect many more kilonovae in the coming years.

Sci Tech Daily, 16 February 2023

https://scitechdaily.com

Can Air Pollution Make You Depressed?

2023-02-20

Only 3 percent of the world's cities meet World Health Organization air quality standards.

And yet research shows exposure to air pollution puts people at an increased risk of mental health outcomes like depression and anxiety. Still, questions remain about how hazardous it is to be exposed to air pollution for many years.

Now, two new studies may help shine a light. Together, they suggest there is a link between long-term exposure to multiple air pollutants and detrimental mental health effects.

One study was published in JAMA Psychiatry this month. The research team used data from the UK Biobank to analyze the health and wellness of 389,185 participants over the course of 10.9 years.

Their work establishes a connection between long-term exposure to low levels of air pollutants to subsequent depression and anxiety. It also examined the effects of fine particulate matter pollution (PM2.5), nitrogen dioxide, and nitric oxide, which is emitted from vehicles and various industrial sources. PM2.5 refers to fine inhalable particles with diameters that are 2.5 micrometers or smaller; these particles are emitted from various sources, including cars, power plants, and construction sites.

Guoxing Li is the study's senior author and is a visiting professor at Imperial College and an associate professor at Peking University. He tells Inverse these findings suggest "more strict air quality standards should be adopted."

The second study was also published this month in JAMA Network Open. In this investigation, the researchers focused on over 8 million people over the age of 64 who were also enrolled in Medicare.

The investigation ran from 2005 to 2016 and aimed to see whether or not there was a link between air pollution exposure and late-onset depression.

New findings suggest "more strict air quality standards should be adopted."

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In this study, the researchers find a connection between long-term exposure to fine particulate matter (PM2.5), nitrogen dioxide, and ozone and an increased risk of a depression diagnosis in older adults. The study suggests ozone is especially dangerous and warrants further examination.

"This finding with O3 [ozone], if validated to be true, informs us of the importance of long-term ambient O3 regulation because it is one of the key pollutants projected to increase for certain regions under future climate change scenarios," writes the study authors.

Why can pollution cause depression?

In the JAMA Psychiatry study, Li and his colleagues found that men are especially likely to experience anxiety after exposure to PM2.5. Other research jibes with this finding: A study on mice found diesel exhaust particles are more likely to induce neuroinflammation in male mice compared to female mice.

We can't explain why males may be more affected by exposure to forms of air pollution without more research, but Li says animal studies suggest the sex hormone estrogen could — at least in part — explain the difference.

Overall, "further research is needed to clarify the mechanisms that underlie the association between air pollution and mental health," explains Li. But it's possible that air pollution might increase the risk for poor mental health through physiological pathways. For example, air pollutants may affect the central nervous system through inflammatory and oxidative stress pathways, he explains.

Still more studies have found that exposure to particulate matter can lead to acute and chronic inflammation in the brain and can damage the blood-brain barrier. Meanwhile, nitrogen dioxide can cause oxidative stress, a phenomenon implicated in the development of several mental health conditions.

Meanwhile, there are actions we can all take to reduce air pollution, which disproportionately afflicts marginalized communities. These include advocating for strong policies to curb climate change, public transportation expansion, and better air quality standards.

Inverse, 20 February 2023

https://inverse.com

What Physicists Can Learn From the Unique Spiral Shape of Shark Intestines

2023-02-20

Shark intestines have a unique spiral shape that favors fluid flow in one direction. By learning about the workings of this phenomenon, physicists hope to apply the principles to robotics and other applications.

Inventor Nikola Tesla patented a type of pipe that he called a "valvular conduit" in 1920. It was built to draw fluid in one direction without any moving parts or added energy and has applications ranging from soft robotics to medical implants. In 2021, scientists discovered that sharks' spiral-shaped intestines work much the same way, favoring fluid flow in one direction—from head to pelvis.

Ido Levin, a physicist in the lab of Sarah Keller at the University of Washington, became interested in the physics flow of fluid through these shark spirals. On Monday, February 20 at the 67th Annual Biophysical Society Meeting in San Diego, California, he will present how 3D printing models of shark intestines is helping them learn about how these spirals work.

Levin explained that "the researchers of the 2021 study connected a tube to the shark intestines, and put water with glycerin—a very viscous fluid—through these pipes. And they showed that if you connect these intestines in the same direction as a digestive tract, you get a faster flow of fluid than if you connect them the other way around. We thought this was very interesting from a physics perspective… One of the theorems in physics actually states that if you take a pipe, and you flow fluid very slowly through it, you have the same flow if you invert it. So we were very surprised to see experiments that contradict the theory. But then you remember that the intestines are not made out of steel—they're made of something soft, so while fluid flows through the pipe, it deforms it."

To study the fluid dynamics through spiral pipes, Levin and Keller collaborated with their colleagues in the Nelson Group at the University of Washington to create soft, 3D structures that mimic aspects of the shark intestines. "15 or 20 years ago, it was impossible to try and reconstruct these shapes in manmade materials," Levin said. When they used a rigid material to 3D print the shapes, there was no difference in fluid flow in one direction or the other. However, printing the shapes using a softer elastomer led to faster fluid flow in one direction. Using these 3D-printed structures, the team is studying how the radius, pitch, and thickness

Different kinds of sharks have intestines with different spiral patterns that favor fluid flow in one direction.

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of the inner structure impacts the fluid flow. With the softer materials, they can also study the coupling between flow rate and how the pipe deforms. Understanding these parameters will help in engineering similar structures that can be used for things like soft robotics.

Up until recently, robots have been made with rigid materials and hinges. But using soft materials that can deform in different ways, like an octopus does, opens up a whole world of possibilities, Levin explains, "this is one step forward in trying to understand the basic mechanics of the interaction between membranes and flow." One day, this seemingly simple system could control industrial or medical devices.

Sci Tech Daily, 20 February 2023

https://scitechdaily.com

Dark energy from supermassive black holes? Physicists spar over radical idea

2023-02-17

Earlier this week, a study made headlines claiming that the mysterious "dark energy" cosmologists believe is accelerating the expansion of the universe could arise from supermassive black holes at the hearts of galaxies. If true, the connection would link two of the most mind-bending concepts in physics—black holes and dark energy—and suggest that the source of the latter has been under theorists' noses for decades. However, some leading theorists are deeply skeptical of the idea.

"What they are proposing makes no sense to me," says Robert Wald, a theoretical physicist at the University of Chicago who specializes in Albert Einstein's general theory of relativity, the standard understanding of gravity. Other theorists were more receptive to the radical claim—even if it ends up being wrong. "I'm personally excited about it," says astrophysicist Niayesh Afshordi of the Perimeter Institute for Theoretical Physics.

At first blush, black holes and dark energy seem to have nothing to do with each other. According to general relativity, a black hole is a pure gravitational field so strong that its own energy sustains its existence. Such peculiar beasts are thought to emerge when massive stars collapse to an infinitesimal point, leaving just their gravitational fields behind. Supermassive black holes having millions or billions of times the mass of our Sun are believed to lurk in the hearts of galaxies.

New theory aims to account for one of the universe's great mysteries.

In contrast, dark energy is a mysterious phenomenon that literally stretches space and is accelerating the expansion of the universe. Theorists think dark energy could represent some new sort of field in space, a bit like an electric field, or it could be a fundamental property of empty space itself.

So how could the two be connected? Quantum mechanics suggests that the vacuum of empty space should contain a type of energy known as vacuum energy. This is thought to be spread throughout the universe and exert a force opposing gravity, making it a prime candidate for the identity of dark energy. In 1966, Soviet physicist Erast Gliner showed that Einstein's equations could also produce objects that to outside observers look and behave exactly like a black hole—yet are, in fact, giant balls of vacuum energy.

If such objects were to exist, it would mean that rather than being uniformly spread throughout space, dark energy is actually confined to specific locations: the interiors of black holes. Even bound in these particular knots, dark energy would still exert its space-stretching effect on the universe.

One consequence of this idea—that supermassive black holes are the source of dark energy—is that they would be linked to the constant stretching of space and their mass should change as the universe expands, says astrophysicist Duncan Farrah of the University of Hawaii, Manoa. "If the volume of the universe doubles, so does the mass of the black hole," he adds.

To test this possibility, Farrah and his colleagues studied elliptical galaxies, which contain black holes with millions or billions of times the Sun's mass in their centers. They focused on galaxies with little gas or dust floating around between their stars, which would provide a reservoir of material that the central black hole could feed on. Such black holes wouldn't be expected to change much over the course of cosmic history.

Yet by analyzing the properties of ellipticals over roughly 9 billion years, the team saw that black holes in the early universe were much smaller relative to their host galaxy than those in the modern universe, indicating they had grown by a factor of seven to 10 times in mass, Farrah and colleagues reported this month in the Astrophysical Journal.

The fact that the black holes swelled while the galaxies didn't is the key, Farrah says. If the black holes had grown by feeding on nearby gas and dust, that material should have also generated many new stars in parts of

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the galaxy far from the black hole. But if black holes were made from dark energy, they would react to changes in the universe's size in exactly the way that researchers observed in the centers of elliptical galaxies, Farrah's team additionally reported this week in Astrophysical Journal Letters.

Wald is unpersuaded. He questions how an orb of pure dark energy could be stable. He also says the numbers don't seem to add up: Dark energy is known to make up 70% of the mass-energy of the universe, whereas black holes are a mere fraction of the ordinary matter, which constitutes less than 5% of the universe. "I don't see how it is in any way conceivable that such objects could be relevant to the observed dark energy," he says.

Others are taking a wait-and-see attitude. "At the moment, this is an interesting possibility," says cosmologist Geraint Lewis of the University of Sydney, but "there would have to be a lot more evidence on the table if this is even a remotely plausible source of dark energy."

Afshordi agrees. If black holes and dark energy are linked in this way, it would likely have other visible consequences in the universe, he says. At the moment, though, he's unsure what those would be. Determining exactly how galaxies evolve over time is a tricky business, he adds, and there could be other mechanisms to grow black holes that the team hasn't considered.

Nevertheless, Afshordi is supportive of efforts to rethink fundamental assumptions about the universe. "Most new theoretical ideas are dismissed by skepticism," he says. "But if we dismiss all the new ideas then there won't be anything left."

Science, 17 February 2023

https://science.org

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