CHEMWATCH

Bulletin Board

Contents

MAR. 11, 2022

(click on page numbers for links)

REGULATORY UPDATE

ASIA PACIFIC

Environmental Protection Authority to demand '100 times' more data on use of chemicals 4

Completion of evaluation of bis-aminopropyl diglycol dimaleate 5

Addition of equivalent CAS details - 8 February 2022 5

AMERICA

'We can't wait 15 years': Legislative committee works to overhaul Kansas water policy 7

Toxicological Profile for Beryllium 8

Toxicological Profile for Methyl-tert-butyl Ether 9

Div. of Public Health unveils Delaware's own health limits on 'forever chemicals' 9

EUROPE

Microplastics pollution – measures to reduce its impact on the environment 11

UK overrules scientific advice by lifting ban on bee-harming pesticide 12

UK companies feel post-Brexit rules pain 12

INTERNATIONAL

Brazil Revises Legislation on Food Contact Materials and Articles 13

Historic day in the campaign to beat plastic pollution: Nations commit to develop a legally binding agreement 14

REACH UPDATE

How to make your registration fulfil REACH information requirements 16

JANET'S CORNER

DNA Polymerase Shift Manager 18

HAZARD ALERT

Hydrogen Sulfide 19

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

CHEMWATCH

Bulletin Board

Contents

MAR. 11, 2022

GOSSIP

Environmental impact of hand-sanitizing practices during the COVID-19 pandemic....24
Data scientist builds a detailed network map of 'The Witcher'....25
The pandemic's disproportionate effect on women in the workforce is impacting academic medicine....28
First-ever scan of a dying human brain reveals life may actually 'flash before your eyes'....30
First gene-editing treatment injected into the blood reduces toxic protein for up to 1 year....32
Researchers demonstrate how milk can trigger MS symptoms....34
Discovered: An easier way to create 'flexible diamonds'....36
MicroRNA shown to regrow 90% of lost hair, research finds....38
State-of-the-art "living" concrete alternative soaks up carbon and heals itself....39
The future of data storage is double-helical, research indicates....40

CURIOSITIES

Why Is Cancer-Linked Benzene in So Many Personal Care Products?....44
Clues to better batteries emerge from tracking lithium....45
Why do cats love boxes so much?....49
Glitchy protein production may hasten aging....50
Should we kill every mosquito on Earth?....52
Stalled weather: how stuck air pressure systems drive floods and heatwaves....55
How do snakes hiss if they don't have front teeth?....58
5 signs of how climate change is unraveling Earth's ecosystems....60
How can computer engineering predict the future of gene synthesis?....63
What explains our lower back pain? Anthropologists turn to Neandertals for answers....66

TECHNICAL NOTES

CHEMICAL EFFECTS....69
ENVIRONMENTAL RESEARCH....69
PHARMACEUTICAL/TOXICOLOGY....69
OCCUPATIONAL....69

CHEMWATCH

Bulletin Board

Regulatory Update

MAR. 11, 2022

ASIA PACIFIC

Environmental Protection Authority to demand '100 times' more data on use of chemicals

2022-03-03

A new report from the Parliamentary Commissioner for the Environment has found the country is largely ignorant about how much is used and where, even of some seriously risky chemicals and others that build up to toxic levels over time.

One of its key recommendations is the EPA expand its powers to require much more data from chemical importers, manufacturers and sellers.

EPA chief executive Dr Allan Freeth said it would bring in new rules later this year to switch from collecting data voluntarily on just a few chemicals, to demanding more of it about many more substances.

"It'll be 100 times more probably. I was going to use something like, [from getting] 10 books in a bookshop, you know, to getting the whole bookshop sort of thing," Freeth told RNZ.

"So yeah, we would expect we'd be getting a lot more information.

"We want a much wider capture system to actually understand the volumes and amounts of the chemicals or hazardous substances that are coming into the country, and where they're going to."

He acknowledged the whole system was fragmented across four regulators (EPA, Ministry for Primary Industries, Medsafe and WorkSafe) and had a long way to go to be good enough, but they lacked funding to get there.

"We need funding for reassessing our priority chemical list - we've got some extra funding for that, but it's nowhere near enough."

The EPA needed further funding to import the latest chemical modelling and adapt it.

Read More

RNZ, 3-03-22
https://www.rnz.co.nz/news/national/462685/environmental-protection-authority-to-demand-100-times-more-data-on-use-of-chemicals

The Environmental Protection Authority says it is working hard to fill big gaps in the regulation of chemicals but needs more funding.

Completion of evaluation of bis-aminopropyl diglycol dimaleate

2022-02-28

We have completed an evaluation about the human health risks associated with the introduction and use of 1-Propanamine, 3,3′-[oxybis(2,1-ethanediyloxy)]bis-, (2Z)-2-butenedioate (1:2) (also known as bis-aminopropyl diglycol dimaleate), which is currently under an assessment certificate.

This evaluation is issued by the AICIS Executive Director under section 73 of the *Industrial Chemicals Act 2019* and is listed below.

Subject of evaluation: 1-Propanamine, 3,3›-[oxybis(2,1-ethanediyloxy)] bis-, (2Z)-2-butenedioate (1:2) (bis-aminopropyl diglycol dimaleate)

CAS number: 1629579-82-3

Proposed means for managing risks: Information relating to safe introduction and use

Download Evaluation Statement:

EVA00047 - Evaluation Statement - 28 February 2022 [478KB].pdf

Read More

Industrial Chemicals, 28-02-22

https://www.industrialchemicals.gov.au/news-and-notices/completion-evaluation-bis-aminopropyl-diglycol-dimaleate

Addition of equivalent CAS details - 8 February 2022

2022-02-08

Under s 85 of the *Industrial Chemicals Act 2019*, we added equivalent Chemical Abstracts Service (CAS) names and numbers to the following chemicals on the Australian Inventory of Industrial Chemicals (the Inventory) on 18 January 2022. These substances are chemically identical (equivalent) to the reference substance on the Inventory. For details of their listings, search our Inventory.

CHEMWATCH
Bulletin Board
Regulatory Update
MAR. 11, 2022

Equivalent chemicals added to the Inventory		Chemicals listed on the Inventory	
CAS Number	**CAS Name**	**CAS Number**	**CAS Name**
771-03-9	2*H*-Pyran-2-one, 3-acetyl-4-hydroxy-6-methyl-	16807-48-0	4*H*-Pyran-4-one, 3-acetyl-2-hydroxy-6-methyl-
12671-74-8	1H-Thioxantheno[2,1,9-def]isoquinoline-1,3(2H)-dione, 2-octadecyl-	27870-92-4	1H-Thioxantheno[2,1,9-def]isoquinoline-1,3(2H)-dione, 2-octadecyl-
31692-79-2	Poly[oxy(dimethylsilylene)], .alpha.-hydro-.omega.-hydroxy-	70131-67-8	Polysiloxanes, di-Me, hydroxy-terminated
32055-14-4	Carbonic dichloride, polymer with benzenamine and formaldehyde	9016-87-9	Isocyanic acid, polymethylene-polyphenylene ester
32289-58-0	Poly(iminocarbonimidoyliminocarbonimidoylimino-1,6-hexanediyl), hydrochloride	27083-27-8	Guanidine, *N*,*N*‴-1,6-hexanediylbis[*N*′-cyano-, polymer with 1,6-hexanediamine, hydrochloride
196823-11-7	Oxirane, 2-methyl-, polymer with oxirane, monoisotridecyl ether, block	50861-66-0	Oxirane, methyl-, polymer with oxirane, monoisotridecyl ether

Read More

Industrial Chemicals, 8-02-22
https://www.industrialchemicals.gov.au/news-and-notices/addition-equivalent-cas-details-8-february-2022

AMERICA

'We can't wait 15 years': Legislative committee works to overhaul Kansas water policy

2022-02-20

Time to protect water in Kansas is running short.

Parts of the aquifer in far western Kansas may only have 10 years of water left. Small towns are struggling to provide clean drinking water, and upgrading their facilities would bankrupt them.

If the state is going to preserve its water resources, it has to act soon, say proponents of an overhaul to the state's water regulation.

"I don't like to use the word 'crisis,' but our situation in our state is serious," said Rep. Ron Highland, chairman of the House Water Committee.

For years, the state hasn't fully funded its water plan. It has failed to secure federal grants to help with water projects because they require a state match. Gov. Laura Kelly has proposed in her budget that the state fund its share for water programs — $8 million — for the first time in more than a decade.

But fully addressing the state's ever-smaller supply of water will take more like $55 million per year, according to a task force convened under former Gov. Sam Brownback. It will also take, Highland says, a cabinet secretary who's at the table when budget priorities are set.

Highland has led the House Water Committee through a series of studies, site visits and, now, an effort to completely restructure the way Kansas thinks about its water resources.

"One of the problems we noticed when we were going through all of this is that the water programs have been underfunded for years," Highland said, "and part of the reason for that is you don't have a seat at the table when budget discussions occur."

Environmental groups, municipal water utilities and water experts lauded the committee's effort to elevate water as a concern in Kansas, allocate money to the issue and clarify a confusing web of governmental departments.

Zack Pistora, a lobbyist for the Kansas Chapter of the Sierra Club, called the bill the most transformational water policy bill in more than 30 years.

"I don't like to use the word 'crisis,' but our situation in our state is serious," said Rep. Ron Highland, chairman of the House Water Committee.

CHEMWATCH
Bulletin Board
Regulatory Update
MAR. 11, 2022

"(If) you champion this across the Legislature this year, (it) will create a legacy for our generation, current generations, but generations to come for Kansas," Pistora said. "I think we can't lose sight of that."

Big changes to Kansas water policy

House Bill 2686 would elevate water concerns to the governor's cabinet by establishing a new Kansas Department of Water and Environment. Currently, water issues are housed in the Kansas Department of Health and Environment, the Kansas Department of Agriculture, the Kansas Water Authority, and other state and federal agencies.

The worst part, Highland said, is that Kansas missed out on an unknown sum in federal grants because it didn't pay for its portion of the projects.

"We left a lot of federal funds on the table," Highland said. "We never got those funds because we could not match them."

Read More

Kansas Reflector, 20-02-22

https://kansasreflector.com/2022/02/20/we-cant-wait-15-years-legislative-committee-works-to-overhaul-kansas-water-policy/

Toxicological Profile for Beryllium

2022-03-01

CAS#: 7440-41-7

Draft for Public Comment

Comments may be submitted via Regulations.gov

Public Comment Period Closes on May 23, 2022

Toxicological Profile Information

The ATSDR toxicological profile succinctly characterizes the toxicology and adverse health effects information for the toxic substance described therein. Each peer-reviewed profile identifies and reviews the key literature that describes a substance's toxicological properties.

A useful two page information sheet, the ToxFAQs™, is also available.

Read More

ATSDR, 01-03-22
https://wwwn.cdc.gov/TSP/ToxProfiles/ToxProfiles.aspx?id=1441&tid=33

Toxicological Profile for Methyl-tert-butyl Ether

2022-03-01

CAS#: 1634-04-4

Draft for Public Comment

Comments may be submitted via Regulations.gov

Public Comment Period Closes on May 23, 2022

Toxicological Profile Information

The ATSDR toxicological profile succinctly characterizes the toxicology and adverse health effects information for the toxic substance described therein. Each peer-reviewed profile identifies and reviews the key literature that describes a substance's toxicological properties.

A useful two page information sheet, the ToxFAQsTM, is also available.

Read More

ATSDR, 01-03-22
https://wwwn.cdc.gov/TSP/ToxProfiles/ToxProfiles.aspx?id=228&tid=41

Div. of Public Health unveils Delaware's own health limits on 'forever chemicals'

2022-03-01

Delaware is finally getting its own health limits on so-called forever chemicals in drinking water.

The Division of Public Health last week published long-awaited proposals on enforceable limits for two kinds of the PFAS chemicals, which are linked to an array of illnesses including some cancers.

If finalized, the new regulations aim to protect public health by requiring water companies to ensure their supply does not exceed the limits for

CHEMWATCH
Bulletin Board
Regulatory Update
MAR. 11, 2022

The Division of Public Health last week published long-awaited proposals on enforceable limits for two kinds of the PFAS chemicals, which are linked to an array of illnesses including some cancers.

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PFOA and PFOS, two of the most commonly found types of the PFAS family of chemicals.

The proposed "maximum contaminant limits" (MCLs) -- of 21 parts per trillion (ppt) for PFOA and 14 ppt for PFOS -- are in line with levels recent set by some other states, and are much stricter than a guidance level set by the federal government.

The division also set an "exceedance" level if half of the two chemicals combined exceed 17 ppt.

Water systems will be required to begin testing within six months of the regulation being finalized, and then to test annually unless the chemicals are found at above a minimum detection limit, in which case they will have to test quarterly.

Until now, Delaware has followed the non-enforceable federal level of 70 ppt which many scientists say is too lax to fully protect public health. The absence of a federal regulation, and the growing discovery of the chemicals in public water supplies, have led an increasing number of states to set their own regulations at much lower levels.

On Feb. 26, Pennsylvania published its own proposal to regulate the same two chemicals at similar levels to Delaware's new limits. That follows health limits on three kinds of PFAS chemicals that have been formally adopted by New Jersey in the last few years.

In response to longstanding criticism of federal inaction on PFAS, the U.S. Environmental Protection Agency, too, has stepped up its efforts to monitor for the chemicals, and has begun a process that would eventually lead to regulation, although any national standards could be years away.

Read More

Delaware Public Media, 1-03-22
https://www.delawarepublic.org/science-health-tech/2022-03-01/dept-of-public-health-unveils-delawares-own-health-limits-on-forever-chemicals

EUROPE

Microplastics pollution – measures to reduce its impact on the environment

2022-03-01

About this initiative

Summary

This initiative aims to tackle microplastics unintentionally released into the environment. It will focus on labelling, standardisation, certification and regulatory measures for the main sources of these plastics.

It aims to:

- improve the science on the risks and occurrence of microplastics in the environment, tap water and food
- reduce environmental pollution and potential health risks, while respecting the principles of the single market and encouraging competitiveness and innovation.

Topic

Environment

Type of act

Proposal for a regulation

Category

Commission Work Programme

Read More

European Commission, 1-03-22
https://ec.europa.eu/info/law/better-regulation/have-your-say/initiatives/12823-Microplastics-pollution-measures-to-reduce-its-impact-on-the-environment_en

The government overruled its own scientific advisers and the decision was called "scandalous" by campaigners.

CHEMWATCH
Bulletin Board
Regulatory Update
MAR. 11, 2022

UK overrules scientific advice by lifting ban on bee-harming pesticide

2022-03-02

An insecticide banned due to its harm to bees will be used on sugar beet in Britain this year after ministers authorised an emergency exemption. The government overruled its own scientific advisers and the decision was called "scandalous" by campaigners.

The neonicotinoid, called thiamethoxam, was banned in 2018 across Europe after a series of studies found it damaged bees. But British Sugar applied for an emergency exemption and on Tuesday the conditions for the exemption were met.

A national forecast of the proportion of the crop expected to suffer from virus yellows, a disease spread by aphids, predicted a level of 69%, far above the 19% threshold that had been set.

The exemption was also granted in 2021 but was not implemented as the forecast for virus yellows turned out to be low. In 2020, according to the government, the virus cut the national yield of sugar beet by a quarter.

Read More

The Guardian, 2-03-22

https://www.theguardian.com/environment/2022/mar/01/bee-harming-pesticide-thiamethoxam-uk-emergency-exemption

UK companies feel post-Brexit rules pain

2022-02-28

At the height of the 2016 Brexit referendum campaign, businesses were promised that leaving the EU could deliver a regulatory dividend worth more than £12bn a year, if the British government used its newfound freedom boldly. And although the business world overwhelmingly favoured remaining in the EU, it welcomed the prospect of lighter touch regulation when Britons voted to leave. The Institute of Directors found that 60 per cent of its members wanted to reduce the volume of "unnecessary red tape" from Brussels. Little over a year since the UK's legal exit from the EU single market, on January 1 2021, Britain's leading business organisations report that members are tired and frustrated by the lived experience of Brexit. Small businesses with less time, money and staff

Regulatory divergence was meant to create flexibility for industry. What's gone wrong and what needs to change?

to absorb the costs of regulatory requirements — which had hoped to gain most from post-Brexit deregulation — have found it hardest to adapt to the customs and export rules that apply when trading with the EU as a "third country". Mike Cherry, chair of the Federation of Small Businesses (FSB) says: "Small firms were promised that one upside of leaving the EU would be reduced red tape. They live in hope of delivery." The British Chambers of Commerce has been equally scathing. In a report to mark the end of the first year of the implementation of the EU-UK Trade and Cooperation Agreement, the BCC found that nearly half of all members surveyed had struggled to trade with the EU. The difficulties include the bureaucracy of the EU and the new UK regulatory requirements — such as the UKCA quality control mark and the creation of a "UK Reach" chemical safety database — that duplicate EU rules for no obvious commercial gain. These systems were born of the UK decision to prioritise full legal separation from Brussels, and the EU's determination — explicitly stated by Michel Barnier — that the UK should lose its position as a "regulatory and certification hub" for the EU single market.

Read More

Financial Times, 28-02-22
https://www.ft.com/content/a009ce74-b6a0-4939-95f0-5ea83771ca78

INTERNATIONAL

Brazil Revises Legislation on Food Contact Materials and Articles

2022-02-28

In December 2021, Brazil's Ministry of Health/National Health Surveillance Agency (Ministério da Saúde/Agência Nacional de Vigilância Sanitária (ANVISA)) published Resolution of the Collegiate Board of Directors No. 589 of December 20, 2021 (Resolução de Diretoria Colegiada RDC No. 589, de 20 de dezembro de 2021, 589/2021) to transpose GMC/Mercosur Resolution Nos. 19/2021, 20/2021 and 21/2021 into national law on food contact materials and articles.

The latest transposition revises three pieces of national legislation on food contact materials and articles:

Brazil has revised several pieces of legislation on food contact materials and articles. These will become effective on January 3, 2023.

CHEMWATCH
Bulletin Board
Regulatory Update
MAR. 11, 2022

- Resolution No. 105/1999 'General provisions for food contact plastics'
- Resolution RDC No. 56/2012 'Positive list for food contact plastics'
- Resolution RDC No. 88/2016 'Food contact cellulosic materials and articles'

Read More

SGS, 22-02-22

https://www.sgs.com/en/news/2022/02/safeguards-02822-brazil-revises-legislation-on-food-contact-materials-and-articles

Historic day in the campaign to beat plastic pollution: Nations commit to develop a legally binding agreement

2022-02-02

Heads of State, Ministers of environment and other representatives from 175 nations endorsed a historic resolution at the UN Environment Assembly (UNEA-5) today in Nairobi to End Plastic Pollution and forge an international legally binding agreement by 2024. The resolution addresses the full lifecycle of plastic, including its production, design and disposal.

"Against the backdrop of geopolitical turmoil, the UN Environment Assembly shows multilateral cooperation at its best," said the President of UNEA-5 and Norway's Minister for Climate and the Environment, Espen Barth Eide. "Plastic pollution has grown into an epidemic. With today's resolution we are officially on track for a cure."

The resolution, based on three initial draft resolutions from various nations, establishes an Intergovernmental Negotiating Committee (INC), which will begin its work in 2022, with the ambition of completing a draft global legally binding agreement by the end of 2024. It is expected to present a legally binding instrument, which would reflect diverse alternatives to address the full lifecycle of plastics, the design of reusable and recyclable products and materials, and the need for enhanced international collaboration to facilitate access to technology, capacity building and scientific and technical cooperation.

The UN Environment Programme (UNEP) will convene a forum by the end of 2022 that is open to all stakeholders in conjunction with the first session of the INC, to share knowledge and best practices in different parts of the world. It will facilitate open discussions and ensure they are informed by

"Plastic pollution has grown into an epidemic. With today's resolution we are officially on track for a cure."

science, reporting on progress throughout the next two years. Finally, upon completion of the INC's work, UNEP will convene a diplomatic conference to adopt its outcome and open it for signatures.

"Today marks a triumph by planet earth over single-use plastics. This is the most significant environmental multilateral deal since the Paris accord. It is an insurance policy for this generation and future ones, so they may live with plastic and not be doomed by it." said Inger Andersen, Executive Director of UNEP.

"Let it be clear that the INC's mandate does not grant any stakeholder a two-year pause. In parallel to negotiations over an international binding agreement, UNEP will work with any willing government and business across the value chain to shift away from single-use plastics, as well as to mobilise private finance and remove barriers to investments in research and in a new circular economy," Andersen added.

Read More

UNEP, 2-02-22
https://www.unep.org/news-and-stories/press-release/historic-day-campaign-beat-plastic-pollution-nations-commit-develop

How to make your registration fulfil REACH information requirements

2022-02-28

ECHA has updated its recommendations to help companies improve their registration dossiers and has added more advice on using read-across and weight of evidence. Statistics are available on the progress made in evaluating registered substances in 2021.

Helsinki, 28 February 2022 – ECHA has further developed its recommendations to registrants on how they can improve their registrations, based on observations during compliance checks and following recent changes in information requirements under REACH.

The improvements particularly concern rules for adaptations such as how to apply read-across and weight of evidence, or combine the two approaches. These approaches should be used to fulfil legal requirements without further testing on animals if they can be justified in a robust manner.

The recommendations also cover suggestions on how to address a read-across between substances of unknown or variable composition, complex reaction products or of biological materials (UVCBs) as well as additional advice on dose setting for toxicity testing.

Registrants should check the amended REACH annexes as well as the latest recommendations and make their dossiers comply with the information requirements, where needed.

In 2021, ECHA conducted 371 compliance checks covering more than 2 100 registration dossiers and addressing 341 substances. 300 of these checks were so called full compliance checks, addressing all relevant endpoints of substances of potential concern. They resulted in 280 draft decisions sent to companies, requesting more data to clarify long-term effects on human health or the environment. Overall, in 2009-2021, ECHA has checked the compliance of 2 500 registered substances.

ECHA also adopted 10 substance evaluation decisions in 2021, requesting further information to assess the safety of substances of potential concern. Among them was the toxicity of nanoforms of titanium dioxide, as inhaling this substance can be a risk for human health.

A list of all substances that were evaluated in 2021 includes full details of the information requests to companies.

ECHA has further developed its recommendations to registrants on how they can improve their registrations, based on observations during compliance checks and following recent changes in information requirements under REACH.

REACH Update

MAR. 11, 2022

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ECHA, 28-02-22

https://echa.europa.eu/nl/-/how-to-make-your-registration-fulfil-reach-information-requirements

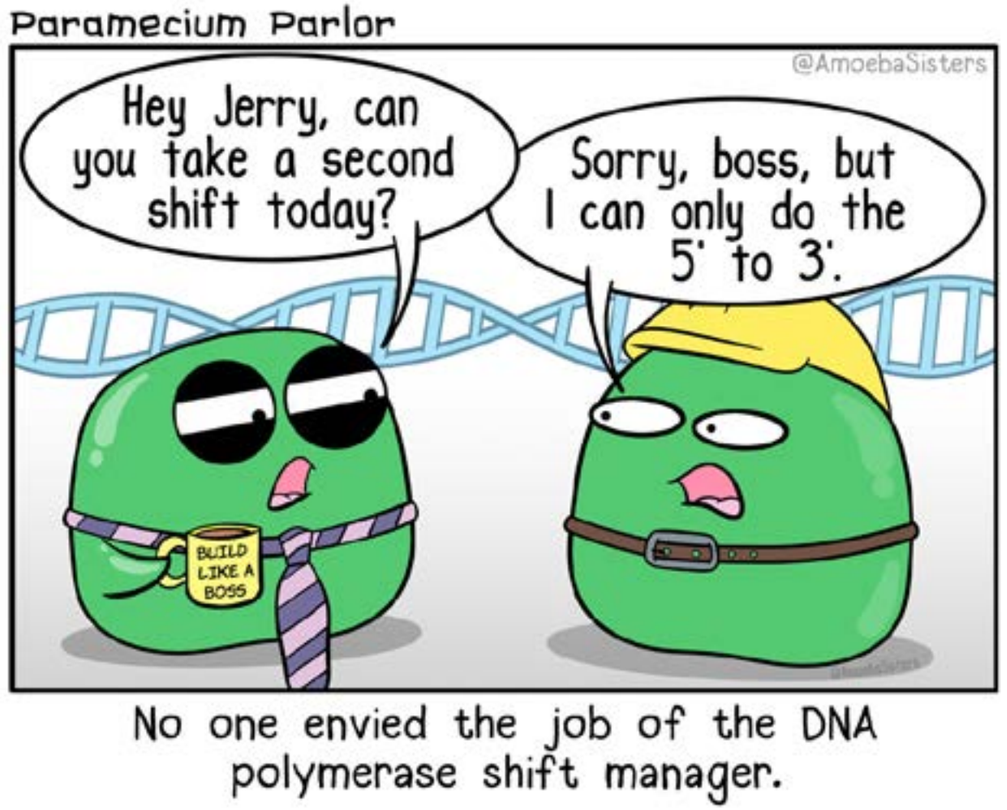
CHEMWATCH
Bulletin Board

Janet's Corner

MAR. 11, 2022

DNA Polymerase Shift Manager

2022-03-11



https://www.amoebasisters.com/parameciumparlorcomics/dna-polymerase-shift-manager

Hydrogen Sulfide

2022-03-11

Hydrogen sulfide is the chemical compound with the formula H_2S. It is a colourless, very poisonous, flammable gas or colourless liquid at extremely low temperatures or under very high pressure. Hydrogen sulfide has the characteristic foul odour of rotten eggs at very low concentrations. At concentrations between 30-100 ppm, it has sickening sweet odour and the ability to smell it can begin to dull at 50 ppm and be completely lost [1,2].

USES [3]

Hydrogen sulfide is used in the manufacture of pulp and paper (digesting agent), in tanneries and in sulfide ores. Most man made hydrogen sulfide is produced as a by-product of industry, rather than for industry.

SOURCES OF EMISSION & ROUTES OF EXPOSURE

Sources of Emission [3]

- Industry sources: Potential large emitters of hydrogen sulfide are electric power plants (burning coal or fuel oil containing sulfur), oil and gas extraction operations, oil refineries, pulp and paper mills, sewage treatment plants, large pig farms and other confined animal feeding operations, Portland cement kilns, municipal waste landfills, coke ovens, sulfur products and hydrogen sulfide production, asphalt production and storage and geothermal power plants. Most hydrogen sulfide releases are to the air.
- Diffuse sources: Other potential emitters of hydrogen sulfide are breweries, fertiliser producers, glue manufacturers, processing of ores (Lead, gold, and copper) and sugar beet and sugar cane processing.
- Natural sources: Hydrogen sulfide is found in coal pits, volcanic gases, natural gas wells, sulfur springs, and decaying organic matter which contains sulfur.
- Transport sources: Found in car exhaust.
- Consumer products: It is not believed that there are any consumer products that contain hydrogen sulfide. Some consumer products may release hydrogen sulfide, such as septic tanks and the burning of coal or oil.

Hydrogen sulfide is the chemical compound with the formula H2S.

CHEMWATCH
Bulletin Board
Hazard Alert
MAR. 11, 2022

Routes of Exposure [4]

The primary route of exposure to hydrogen sulfide for both workers and the general population is inhalation. The gas is absorbed rapidly by the lungs. Oral and dermal are both minor routes of exposure; these routes only contribute a small amount to the overall body burden.

HEALTH EFFECTS [5]

Hydrogen sulfide is both an irritant and a chemical asphyxiant with effects on both oxygen utilisation and the central nervous system. Its health effects can vary depending on the level and duration of exposure. Repeated exposure can result in health effects occurring at levels that were previously tolerated without any effect. Low concentrations irritate the eyes, nose, throat and respiratory system (e.g., burning/tearing of eyes, cough, shortness of breath). Asthmatics may experience breathing difficulties. The effects can be delayed for several hours, or sometimes several days, when working in low-level concentrations. Repeated or prolonged exposures may cause eye inflammation, headache, fatigue, irritability, insomnia, digestive disturbances and weight loss. Moderate concentrations can cause more severe eye and respiratory irritation (including coughing, difficulty breathing, accumulation of fluid in the lungs), headache, dizziness, nausea, vomiting, staggering and excitability. High concentrations can cause shock, convulsions, inability to breathe, extremely rapid unconsciousness, coma and death. Effects can occur within a few breaths, and possibly a single breath.

Hydrogen sulfide is not known to cause cancer. No human or animal information was located. The International Agency for Research on Cancer (IARC) has not evaluated the carcinogenicity of this chemical.

SAFETY

First Aid Measures [2]

- Inhalation: H_2S is extremely flammable and very toxic. Take proper precautions to ensure your own safety before attempting rescue (e.g. remove any sources of ignition, wear appropriate protective equipment, use the buddy system). Remove source of contamination or move victim to fresh air. If breathing is difficult, trained personnel should administer emergency oxygen. DO NOT allow victim to move about unnecessarily. Symptoms of pulmonary oedema can be delayed up to 48 hours after exposure. If breathing has stopped, trained

personnel should begin artificial respiration (AR) or, if the heart has stopped, cardiopulmonary resuscitation (CPR) or automated external defibrillation (AED) immediately. Avoid mouth-to-mouth contact by using mouth guards or shields. Quickly transport victim to an emergency care facility. NOTE: Victims who have been exposed to 500 ppm or higher may pose a threat to responders due to H_2S released from their clothing, skin and exhaled air.

- Skin Contact:
- GAS: Remove, double bag, seal, label and leave contaminated clothing, shoes and leather goods at the scene for safe disposal. Any skin contact will involve significant inhalation exposure.
- LIQUEFIED GAS: Quickly remove victim from source of contamination and briefly flush with lukewarm, gently flowing water. DO NOT attempt to rewarm the affected area on site. DO NOT rub area or apply dry heat. Gently remove clothing or jewellery that may restrict circulation. Carefully cut around clothing that sticks to the skin and remove the rest of the garment. Loosely cover the affected area with a sterile dressing. DO NOT allow the victim to drink alcohol or smoke. Quickly transport victim to an emergency care facility. Double bag, seal, label and leave contaminated clothing, shoes and leather goods at the scene for safe disposal.
- Eye Contact:
- GAS: If irritation occurs, immediately flush the contaminated eye(s) with lukewarm, gently flowing water for 15-20 minutes, while holding the eyelid(s) open. Immediately obtain medical attention. Any eye contact will also involve significant inhalation exposure.
- LIQUEFIED GAS: Quickly remove victim from source of contamination. Immediately and briefly flush eye(s) with lukewarm, gently flowing water until the chemical is removed. DO NOT attempt to rewarm. Cover both eyes with a sterile dressing. DO NOT allow victim to drink alcohol or smoke. Quickly transport victim to an emergency care facility.
- Note to Physicians: Amyl nitrite has been recommended as an antidote to hydrogen sulfide toxicity. However, its use is controversial, as researchers have concluded that it can only be effective within the first few minutes following exposure and may actually slow sulfide removal thereafter. A recent review concludes that nitrite therapy, although not entirely free of controversy, should be considered if the level of medical preparedness and supervision is sufficient to carry out this procedure safely and efficiently.

CHEMWATCH
Bulletin Board
Hazard Alert
MAR. 11, 2022

Storage [5]

Store cylinders in a well-ventilated, secure area, protected from the weather. Cylinders should be stored up-right with valve outlet seals and valve protection caps in place. Storage should be away from heavily travelled areas and emergency exits. There should be no sources of ignition. All electrical equipment should be explosion-proof in the storage areas. Storage areas must meet National Electrical Codes for Class 1 hazardous areas. Flammable storage areas should be separated from oxygen and other oxidisers by a minimum distance of 20 ft. or by a barrier of non-combustible material at least 5 ft. high, having a fire resistance rating of at least 1/2 hour. Post "No Smoking or Open Flames" signs in the storage and use areas. Do not allow storage temperature to exceed 125 °F (52 °C). Full and empty cylinders should be segregated. Use a first-in, first-out inventory system to prevent full containers from being stored for long periods of time. Consideration should be taken to install leak detection and alarm equipment for storage areas.

Exposure Control & Personal Protection [5]

Engineering Controls

- Ventilation: Hydrogen Sulfide detectors should be installed in or near areas where the chemical is being used or stored. If appropriate, install automatic monitoring equipment to detect the level of oxygen and the presence of potentially explosive air-gas mixtures. Because of the high hazard associated with H_2S, stringent control measures such as a gas cabinet enclosure or isolation may be necessary. Provide natural or explosion-proof ventilation adequate to ensure it does not reach exposure limits. Local exhaust ventilation is preferred, because it prevents gas dispersion into the work place by eliminating it at its source.
- Respiratory Protection: Maintain exposure levels of H_2S below recommended exposure level. Use supplied air respiratory protection if levels exceed exposure limits or during emergency response to a release of this product. If respiratory protection is required, follow the requirements of the Federal OSHA Respiratory Protection Standard (29 CFR 1910.134), or equivalent State standards. NIOSH respiratory protection recommendations for hydrogen sulfide are: Up to 100 ppm - Powered airpurifying respirator, gas mask with canister, SAR or full-facepiece SCBA.
- Eye Protection: Safety glasses. Additionally, face-shields should be worn if there is a potential for contact with liquid H_2S. Eye wash

stations/safety showers should be near areas where the chemical is used or stored.

- Skin Protection: Work gloves are recommended when handling cylinders of H_2S. Use thermally insulated gloves when working with containers of Liquid H_2S. Wear chemically-resistant gloves when using this gas. Butyl rubber, chlorinated polyethylene, neoprene nitrile, and polyvinyl rubber are recommended. Use fire-resistant gloves and clothing in emergency situations. Use double gloves for spill response.
- Other protective Clothing: Use body protection appropriate for task. Static-resistant clothing is recommended. Safety shoes are recommended when handling cylinders. Transfer of large quantities under pressure may require use of fire retardant and/or chemically impervious clothing

REGULATIONS:

United States [7]

OSHA: The Occupational Safety & Health Administration has set the following permissible exposure limits (PEL) for hydrogen sulfide:

- General Industry: 29 CFR 1910.1000 Z-2 Table -- Exposures shall not exceed 20 ppm (ceiling) with the following exception: if no other measurable exposure occurs during the 8-hour work shift, exposures may exceed 20 ppm, but not more than 50 ppm (peak), for a single time period up to 10 minutes.
- Construction Industry: 29 CFR 1926.55 Appendix A -- 10 ppm, 15 mg/m3 TWA
- Maritime: 29 CFR 1915.1000 Table Z-Shipyards -- 10 ppm, 15 mg/m3 TWA

ACGIH: The American Conference of Governmental Industrial Hygienists has established the following Threshold Limit Value (TLV) for hydrogen sulfide: 1 ppm, 14 mg/m3 TWA; 15 ppm, 21 mg/m3 STEL

NIOSH: The National Institute for Occupational Safety and Health has set the following Recommended Exposure Limits (REL) for hydrogen sulfide: 10 ppm, 15 mg/m3 Ceiling (10 Minutes)

NIOSH has set a concentration of 100 ppm as IDLH (immediately dangerous to life and health).

CHEMWATCH
Bulletin Board
Hazard Alert
MAR. 11, 2022

Australia [3]

Safe Work Australia: For hydrogen sulfide, it is allowable for workers to be exposed to concentrations of 10 parts per million, averaged over an eight hour workshift, with the exposure not exceeding 15 parts per million.

Australian Drinking Water Quality Guidelines (NHMRC and ARMCANZ, 1996): Aesthetic: Maximum of 0.05 mg/L (i.e. 0.00005 g/L).

United Kingdom [8]

Hydrogen sulfide has a WEL of 5 ppm 8-hour TWA based on data indicating a shift towards anaerobic respiration at exposures to 10 ppm.

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Environmental impact of hand-sanitizing practices during the COVID-19 pandemic

2022-02-25

The use of hand sanitizing gels and increased hand-washing practices throughout the COVID-19 pandemic has had a negative impact on the environment and—by extension—public health.

In the first study of its kind, scientists underline that the environmental damage caused has been significant and more eco-friendly options are needed.

Among the headline findings are that the production and use of hand sanitizing gels has contributed around 2% of our usual carbon footprint; and that, on average and depending on the sanitizing gel or handwashing practice used, human health has been affected such that people may lose between 16 and 114 hours per year based on a comprehensive disability-adjusted life years (DALYs) impact analysis.

Hand hygiene is one of the most important means of avoiding or reducing pathogen transmission, which is why the World Health Organization (WHO) and NHS England recommend hand washing with soap and water or cleaning hands with alcohol sanitiser to provide some protection against COVID-19.

However, these practices have an impact on planetary health (the health of human civilisation and the natural systems on which it depends). For example, washing hands requires water, while the production of sanitizing gel packaging contributes to carbon emissions—as do the active ingredients themselves—and thus ozone layer breakdown and global climate change.

Until now, the significance of these impacts was unknown.

In the study, just published in the journal Environmental Science and Pollution Research, the scientists conducted a detailed analysis in which they modeled the impacts of the UK population adopting each of the following four hand-washing practices over the course of one year: 1) ethanol-based sanitizing gel; 2) isopropanol-based sanitizing gel; 3) liquid soap and water; and 4) bar soap and water.

They compared the impacts across 16 different categories (which included climate change, freshwater ecotoxicity, ozone layer depletion, water use etc.).

The production and use of hand sanitizing gels has contributed around 2% of our usual carbon footprint.

CHEMWATCH
Bulletin Board
Gossip
MAR. 11, 2022

Key findings

All forms of hand hygiene have an environmental cost

Isopropanol-based sanisiting gels had the lowest impacts in 14 of the 16 categories

For the climate change impact category, these gels had a four-times lower impact than did liquid soap hand washing (producing the equivalent of 1,060 million Kg CO2 compared with 4,240 million Kg CO2)

At the lower end of the scale, using isopropanol-based sanitizing gels would cause a per person loss of 16 hours in disability-adjusted life years (a small reduction in life expectancy)

At the upper end, using a liquid soap and hand-washing approach would cause a per person loss of 114 hours (almost five days in life expectancy)

Dr. Brett Duane, associate professor in Trinity College Dublin's School of Dental Science, is the first author of the journal article. He said: "Hand hygiene has certainly made a big difference in slowing the transmission of COVID-19 over the past two years, but this research—the first of its kind that assesses the use of sanitizing gels and increased hand-washing practices in a way that clearly quantifies the impacts on human and planetary health—shows these practices do cause significant harm.

"Importantly, the work shows that sanitizing gels cause less harm than soap-and-water practices, with isopropanol-based gels in particular leaving a relatively lower impact. That is useful information for reducing further damage but the work also underlines the need for new gels that are more environmentally friendly."

Phys Org, 25 February 2022

https://phys.org

Data scientist builds a detailed network map of 'The Witcher'

2022-02-28

"The Witcher," a fantasy novel series by Andrzej Sapkowski, has become increasingly popular, following the release of several videogames and a spin-off series by Netflix. The latest season of the show, uploaded on Netflix in December 2021, was watched by users worldwide for 2.2 billion minutes in its debut week alone.

Milán Janosov, lead scientist at Datopolis with a Ph.D. in Network Science from Central European University recently tried to summarize the plot and character relationships in "The Witcher" using network science. In a paper published on Nightingale, arXiv and ResearchGate, he introduced the first visual network map outlining the hidden patterns, storylines and character relationships in the fantasy series.

"I started reading "'The Witcher' early last year, shortly after I got hooked to the Netflix show, and the storyline just sucked me in," Janosov told TechXplore. "It was a somewhat similar experience to watching 'Game of Thrones' a few years ago, which had also inspired one of my research articles. When I was about to finish watching the new season of Witcher, I started to wonder how I could get more out of this."

Although "The Witcher" videogames are also highly popular and iconic, Janosov was more drawn to the storylines and relationships outlined in the books and Netflix series. On a quest to understand the iconic series' world more in depth, he thus set out to create a social map of 'The Witcher.'"

The first step for his research was to collect data that he could then use to create the network map. He started by looking at the Netflix show's subtitles, but soon realized that he would need more than that and decided to analyze the whole text of the book series, too.

"To build a network, I also needed a complete list of the characters who appeared in the series," Janosov said. "After collecting these initial pieces of information, my job was fairly simple. I wrote a computer program that screened through every single sentence of all the books and took a note every time it matched a character's name into a sentence."

Using his computer program, Janosov derived the mentions for every character in sentences. This allowed him to determine how close or far two characters were, in terms of how often they were mentioned in similar parts of the texts (e.g., whether two characters were mentioned in the same sentence, two sentences apart, and so on).

"As it turns out, these proximities are pretty good indicators of whether two characters have actually met or were featured in the same plots," Janosov said.

After looking at the proximity between character mentions, Janosov defined the elements in his network. More specifically, he decided to

"While context is relatively easy to interpret for humans, for a computer, it is not that simple," Janosov explained.

CHEMWATCH
Bulletin Board
Gossip
MAR. 11, 2022

represent every character with a node, linking nodes when characters were mentioned in the same "context" or part of the text.

"While context is relatively easy to interpret for humans, for a computer, it is not that simple," Janosov explained. "So to capture the context of the characters mentioned, I assumed that two characters were mentioned in the same context as they were not mentioned further than five sentences from each other. While the number five is somewhat arbitrary, it was chosen for the sake of simplicty (and OCD-friendliness), because three, four or even six sentence-distances lead to very similar results too, also staying consistent for example with the typical paragraph lengths in written text."

Janosov's paper is a valuable example of how network science can be used to reveal hidden patterns in large amounts of unstructured data, such as texts, novels, or movie scripts. After reading books or other texts that are thousands of pages long, humans can get a general idea of how a story is structured. However, they will generally be unable to memorize all the characters and remember all details of the plot.

If they were to draw a map of the story, therefore, this map would most likely be biased. In contrast, network science tools can help to summarize a saga or book series in a quantitive and objective way.

"I was surprised and excited to see the different plots clustered into network communities," Janosov said. "You know that kind of Eureka moment when suddenly everything starts to make sense—who met whom, who is together, where the main conflicts and smaller spin-off plots fold out, etc., almost like in a detective movie. At this point,the skeptic may ask—why would we care so much about a fantasy novel? While the example of 'The Witcher' is certainly fun, it indeed does not seem to bear that crucial practical importance at first."

While the network map of "The Witcher" resulting from this study and other maps that Janosov created in the past are unique and interesting, his work is merely an example of how network science could be implemented in the real-world. In fact, similar data analysis tools could also be used to summarize other networks in the real world.

"In our daily lives, we are surrounded by social networks: our friends on social media, our colleagues at work, friends from school, family, sports and hobbies, and many more," Janosov said. "All these social systems are intertwined by networks of which we almost always only have a partial and subjective understanding. To overcome this lack of knowledge

and sparsity of information, network science comes really handy as it provides a set of tools and a framework of thinking that can help us better understand these social networks we participate in daily, just as it helped to clear the fog around 'The Witcher.'"

Network science tools like the ones employed by Janosov could also be applied (or are already in use) in a series of real-world settings. For instance, they could be used by HR specialists to design better work environments or enhance collaboration between co-workers, by scientific organizations to optimize the sharing of research funding across different research groups, or even to analyze and improve international trade and telecommunications.

"As the Academy Awards are coming next month, I am now thinking to revisit my previous research capturing the role of luck in the success of films and music, to see how much luck counts this year," Janosov added.

Tech Xplore, 28 February 2022

https://techxplore.com

The pandemic's disproportionate effect on women in the workforce is impacting academic medicine

2022-03-07

Like women in every other sector of the economy, those working in academic medicine have been negatively impacted by the exceptional demands put on them by the COVID-19 pandemic, according to a commentary called "Pandemic-related barriers to the success of women in research: A framework for action." It was published last month in Nature Medicine.

"During the first year of the pandemic, when schools shut down and went to 100% remote learning, we saw that it affected women disproportionately, having to stay home and teach their children while their research languished," said co-author Anne B. Curtis, MD, Charles and Mary Bauer Professor and Chair of Medicine in the Jacobs School of Medicine and Biomedical Sciences at the University at Buffalo. Pamela B. Davis, MD, dean emerita of the School of Medicine at Case Western Reserve University, is first author.

The commentary was written by Davis, Curtis and their co-authors, all of whom are members of the Clinical Research Forum's (CRF) Academic Achievement Committee, which was established by the CRF during the

Even prior to the pandemic, the authors note, women in academic medicine were paid less than men in comparable positions, received lower startup funds for laboratory research and took longer to be promoted.

CHEMWATCH
Bulletin Board
Gossip
MAR. 11, 2022

pandemic in response to awareness that women in academic medicine were being more negatively impacted than their male counterparts. The mission of the CRF is to provide leadership to the national clinical and translational research enterprise; it was formed in 1996 to address the "unique and complex challenges to clinical research in academic health centers."

Even prior to the pandemic, the authors note, women in academic medicine were paid less than men in comparable positions, received lower startup funds for laboratory research and took longer to be promoted.

Gender disparities in research

In addition, they write, women have fewer "conventional markers of achievement" in academia than do men, such as principal investigator positions on research grants. Women write fewer grant applications than men; they have fewer grant renewals; they get lower funding amounts for initial grants; and are first or last author on fewer papers.

The reasons for these disparities have long been known, said Curtis. The pandemic sharply exacerbated them.

"Society expects women to assume the major portion of the burden for child rearing, and women themselves feel an obligation to put family above their own needs, to the detriment of their own career development," she said. "There still isn't the sharing of responsibilities in two-career families to mitigate these problems."

The paper includes a detailed "menu" of proposed solutions. These include providing financial support to hire technicians who can continue lab-based research for two to three years while women researchers deal with their child care responsibilities at home, or supporting child care at home so women can continue their lab-based research. Curtis said the Doris Duke Foundation was an early proponent of these solutions, and has provided such grant support to women.

Slowing the tenure clock

The paper also proposes slowing down tenure clocks, delaying the tenure decision by two to three years to make up for lost time while women give birth and care for young children.

In addition to such programs, the list includes a category of solutions termed "cultural," described as creating the cultural expectation that gender equity is a shared responsibility and incorporating those

expectations into bonuses and merit raises of institutional leaders. Also included is the need to engage university and hospital boards of trustees to support gender equity.

The goal of the paper, said Curtis, is to highlight the fact that these gender differences persist and that global phenomena like the pandemic only make them worse.

"As much as we would like to think that gender differences in career development no longer exist, they do, and they adversely affect women more than men," she said. "Understanding these issues and implementing solutions are the best ways to minimize potentially adverse effects on women's careers."

With the easing of the pandemic and related restrictions, Curtis said, "The situation is improving now that schools are open, but the next pandemic may only be a mutation away."

Medical Xpress, 7 March 2022

https://medicalxpress.com

First-ever scan of a dying human brain reveals life may actually 'flash before your eyes'

2022-02-26

The accidental finding was made when a man suddenly died during a routine brain scan.

After an elderly patient died suddenly during a routine test, scientists accidentally captured unique data on the activity in his brain at the very end of his life: During the 30 seconds before and after the man's heart stopped, his brain waves were remarkably similar to those seen during dreaming, memory recall and meditation, suggesting that people may actually see their life "flash before their eyes" when they die.

The phenomenon of replaying past memories when you die has been reported by some people who have had near-death experiences. But this is the first scientific evidence that this "flash" might be real. However, as this is the only case study, it is impossible to make further assumptions about how common the phenomenon may be or what the experience may be like.

Researchers made the startling discovery in 2016 while studying the brain activity in an 87-year-old Canadian man who had developed epilepsy. The team was performing an electroencephalogram (EEG) — a test that detects abnormalities in the electrical activity of the brain — to learn more about what was happening during his seizures. That's when the man

CHEMWATCH
Bulletin Board
Gossip
MAR. 11, 2022

suffered a sudden and fatal heart attack. The patient's unexpected death meant that the team had accidentally made the first-ever recording of a dying brain, the researchers said in a statement.

In total, the researchers recorded around 900 seconds of brain activity leading up to and immediately after the patient's death. This allowed them to see how his neural oscillations — repetitive patterns of neural activity, also known as brain waves — changed as he was dying. They found that in the 30 seconds before and after his heart stopped, there was an unusual change in his brain wave activity.

"Just before and after the heart stopped working, we saw changes in a specific band of neural oscillations," senior researcher Dr. Ajmal Zemmar, a neurosurgeon at the University of Toronto in Canada at the time of the man's case, said in the statement. These specific types of oscillations are known as gamma waves, added Zemmar, who is now at the University of Louisville in Kentucky.

Neural oscillations are classified based on their frequency and amplitude. Gamma waves have a frequency between 30 and 100 hertz, the highest frequency of any oscillations, and are most commonly observed in the brain when people access their memory center, in a region called the hippocampus, during dreams.

The team also gathered data on other types of oscillations during death, including delta, theta, alpha and beta waves. But it was the gamma waves that pointed toward the man replaying memories from throughout his life in his brain — a phenomenon known as life recall.

"Through generating oscillations involved in memory retrieval, the brain may be playing a last recall of important life events just before we die, similar to the ones reported in near-death experiences,"Zemmar said in the statement.

Experiments in rats have shown that the rodents also experience similar levels of gamma oscillations around the time of death, according to the statement. Therefore, the researchers speculate that life recall may be a universal experience shared by a majority of mammal dying brains, although there is minimal evidence to back this up.

But the researchers warned that it would be premature to conclusively state that life recall is a real phenomenon. The dying man was elderly and had epilepsy, which is known to alter gamma wave activity. This could have meant his brain activity during death was different from that of

someone without epilepsy. Moreover, there is no way to know if the man was actually seeing, or perceiving, his past memories or if he was just in a dream-like state brought on by his failing nervous system.

Therefore, much more research is needed to make concrete conclusions about life recall, the researchers cautioned. The report of the man's case was not published until six years after his death because the researchers were hoping to uncover more case studies of dying brains to support their claims, but they came up empty-handed, according to the BBC.

However, the findings could provide a source of comfort to friends and family members during the "indescribably difficult" experience of losing loved ones, the researchers said. "Although our loved ones have their eyes closed and are ready to leave us to rest, their brains may be replaying some of the nicest moments they experienced in their lives," Zemmar said in the statement.

The case report was published online Feb. 22 in the journal Frontiers in Aging Neuroscience.

Live Science, 26 February 2022

https://livescience.com

First gene-editing treatment injected into the blood reduces toxic protein for up to 1 year

2022-03-01

The first team to disable a disease gene directly in a person through an infusion of the genome editor CRISPR reported yesterday that levels of the toxic protein made by the gene dropped as much as 93% for up to 1 year. The researchers hope the long-term reduction means patients in the clinical trial will soon show clear improvement in their nerve symptoms and that these benefits will persist for an extended period.

"It is quite remarkable that this first [intravenous] CRISPR-based gene-editing effort has been so successful," says gene therapy researcher Terence Flotte of the University of Massachusetts Medical School, who was not involved with the study. "This demonstrates great potential for the power of this platform clinically."

People who have inherited a gene mutation responsible for a condition known as transthyretin (TTR) amyloidosis can develop nerve pain, numbness, and heart failure as adults. The genetic defect results in buildup in nerves and organs of a misfolded version of TTR, a protein made by

The genetic defect results in buildup in nerves and organs of a misfolded version of TTR, a protein made by the liver.

CHEMWATCH
Bulletin Board
Gossip
MAR. 11, 2022

the liver. Last year, the companies Intellia Therapeutics and Regeneron Pharmaceuticals began to inject TTR patients with a fat particle carrying messenger RNA coding for CRISPR's DNA-cutting enzyme, Cas9, and an RNA strand that guides it to snip the TTR gene in the liver; cells then repair the break imperfectly, disabling the gene's production of the protein.

In June 2021, the companies reported that 1 month after six patients received an injection of this in vivo CRISPR treatment, their blood levels of TTR fell sharply. Although there wasn't yet documented improvement in the patients' symptoms, Science named those results, along with early data from a study using in vivo CRISPR to treat inherited blindness, one of the runners-up for its 2021 Breakthrough of the Year.

In a trial update yesterday the companies reported in a press release and data slides that the treatment has still led to no major safety problems. And the blood levels of TTR—on average just 7% to 59% of their pretreatment levels, depending on which of four CRISPR doses people received—remained stable in a total of 15 people treated between 2 and 12 months ago.

The durable reduction was what the companies expected based on earlier tests in mice and monkeys. Still, there remained a chance that as a person's edited liver cells turn over, which happens over 200 to 300 days, TTR levels would rebound, if young cells arose that the editing did not reach. "We've been waiting for the definitive answer," says Intellia President and CEO John Leonard.

The researchers don't yet know whether the patients, who already have nerve pain and numbness throughout their body, will improve on neurological tests or whether the treatment may just stabilize the disease. Because peripheral nerves involved in pain and sensation take time to recover from the buildup of TTR, those tests are usually done 1 year after treatment, says Intellia Chief Medical Officer David Lebwohl.

Approved drugs that knock down TTR levels by 80% lead to symptom improvements, spurring optimism that CRISPR will do the same with a one-time treatment. "I think people are generally assuming that the clinical outcomes will follow," says gene-editing researcher and cardiologist Kiran Musunuru of the University of Pennsylvania, who works on CRISPR treatments for heart disease that are also infused directly in a patient.

The companies continue to enroll TTR amyloidosis patients with widespread nerve pain or numbness as well as people with a cardiac form of the disease. Intellia is also using a similar CRISPR treatment to edit a liver

gene in people with hereditary angioedema, which causes severe swelling of limbs and airways.

Despite its progress in the clinic, the company faced a potential business setback yesterday when the University of California (UC), Berkeley, lost a legal battle over the patent rights to using CRISPR for medicines to the Broad Institute. Intellia had licensed the UC Berkeley technology and will now need to negotiate rights with the Broad Institute of MIT and Harvard.

Science, 1 March 2022

https://science.org

Researchers demonstrate how milk can trigger MS symptoms

2022-03-01

For decades those with multiple sclerosis have suggested dairy products can exacerbate the symptoms of their disease. Now researchers from the Universities of Bonn and Erlangen-Nuremberg have demonstrated exactly how this could be occurring, by finding a specific protein in cow milk can trigger the immune cells known to damage neurons in MS.

"We hear again and again from sufferers that they feel worse when they consume milk, cottage cheese or yogurt," said Stefanie Kürten, a researcher working on this study since 2018. "We are interested in the cause of this correlation."

The first step was homing in on the particular constituent in milk that could be enhancing MS symptoms. Across a number of mouse experiments the researchers discovered casein was the main culprit. But that observation only affirmed the correlation. The researchers were most interested in how this particular milk protein could be triggering MS-related neuronal damage.

Rittika Chunder, another researcher working on the project, explained the hypothesis was that casein triggers a misdirected immune response. It meant casein must resemble the same antigens that lead immune cells to incorrectly target healthy brain cells.

"We compared casein to different molecules that are important for myelin production," said Chunder. "In the process, we came across a protein called MAG. It looks markedly similar to casein in some respects – so much so that antibodies to casein were also active against MAG in the lab animals."

The first step was homing in on the particular constituent in milk that could be enhancing MS symptoms. Across a number of mouse experiments the researchers discovered casein was the main culprit.

CHEMWATCH
Bulletin Board
Gossip
MAR. 11, 2022

The final step was establishing that this casein-triggered autoimmune response actually occurs in humans. To investigate this the researchers looked at how these casein antibodies behaved in human brain tissue.

The hypothesis was verified, the casein antibodies did aggregate in brain cells responsible for myelin production. Plus, the researchers found immune B cells taken from MS patients were particularly sensitive to casein.

The study ultimately concludes the relationship between dairy and MS symptoms is due to the casein protein in milk triggering an influx of immune antibodies. These immune cells mistakenly attack certain cells in the brain due to the MAG protein's resemblance to casein.

The researchers are cautious to note this mechanism is only likely to occur in people with a pre-existing dairy allergy. Kürten said her team is already working on a test for MS patients that can identify their susceptibility to casein allergies.

"We are currently developing a self-test with which affected individuals can check whether they carry corresponding antibodies," said Kürten. "At least this subgroup should refrain from consuming milk, yogurt, or cottage cheese."

One question the new findings raise is what role sensitivity to casein could play in the development of MS in the first place?

Kürten does point out observational studies have detected higher rates of MS in populations known to consume large volumes of cow milk. So it is plausible that an allergic reaction to casein could lead to antibodies inadvertently damaging brain cells and beginning the cascade of reactions that lead to MS.

More research will be needed to investigate this hypothetical scenario, and Kürten does point out a casein allergy alone is not enough for someone to develop MS, as there are several other known risk factors that must coalesce for the disease to progress.

The new study was published in the journal PNAS.

New Atlas, 1 March 2022

https://newatlas.com

Discovered: An easier way to create 'flexible diamonds'

2022-03-02

As hard as diamond and as flexible as plastic, highly sought-after diamond nanothreads would be poised to revolutionize our world—if they weren't so difficult to make.

Recently, a team of scientists led by Carnegie's Samuel Dunning and Timothy Strobel developed an original technique that predicts and guides the ordered creation of strong, yet flexible, diamond nanothreads, surmounting several existing challenges. The innovation will make it easier for scientists to synthesize the nanothreads—an important step toward applying the material to practical problems in the future. The work was recently published in the Journal of the American Chemical Society.

Diamond nanothreads are ultra-thin, one-dimensional carbon chains, tens of thousands of times thinner than a human hair. They are often created by compressing smaller carbon-based rings together to form the same type of bond that makes diamonds the hardest mineral on our planet.

However, instead of the 3D-carbon lattice found in a normal diamond, the edges of these threads are "capped" with carbon-hydrogen bonds, which make the whole structure flexible.

Dunning explains, "Because the nanothreads only have these bonds in one direction, they can bend and flex in ways that normal diamonds can't."

Scientists predict that the unique properties of carbon nanothreads will have a range of useful applications from providing sci-fi-like scaffolding on space elevators to creating ultra-strong fabrics. However, scientists have had a hard time creating enough nanothread material to actually test their proposed superpowers.

"If we want to design materials for specific applications," says Dunning, "it's essential for us to precisely understand the structure and bonding of the nanothreads we're making. This thread directing method really allows us to do that."

One of the biggest challenges is getting the carbon atoms to react in a predictable way. In nanothreads made from benzene and other six-atom rings, each carbon atom can undergo chemical reactions with different neighbors. This leads to many possible reactions competing with one another and many different nanothread configurations. This uncertainty is one of the biggest hurdles scientists face to synthesize nanothreads where the precise chemical structure can be determined.

Diamond nanothreads are ultra-thin, one-dimensional carbon chains, tens of thousands of times thinner than a human hair.

Dunning's team determined that adding nitrogen to the ring in place of carbon might help guide the reaction down a predictable pathway. They chose to start their work with pyridazine—a six-atom ring made up of four carbons and two nitrogens—and began working on a computer model. Dunning worked with Bo Chen, Donostia International Physics Center, and Li Zhu, Assistant Professor at Rutgers and Carnegie Alum, to simulate how pyridazine molecules behave at high pressure.

"In our system, we use two nitrogen atoms to remove two possible reaction sites from the ring system. This dramatically reduces the number of possible reactions," says Dunning.

After running several computer simulations showing successful nanothread formation at high pressure, they were ready to take the experiment to the lab.

The team took a drop of pyridazine and loaded it into a diamond anvil cell—a device that allows scientists to produce extreme pressures by compressing samples between the tiny tips of more traditional diamonds. Using infrared spectroscopy and X-ray diffraction, they monitored changes in the pyridazine's chemical structure up to about 300,000 times normal atmospheric pressure looking for the creation of new bonds.

When they saw the bonds forming, they realized they had successfully predicted and created the first pyridazine diamond nanothread in the lab.

"Our reaction pathway produces an incredibly orderly nanothread," said Dunning. "The ability to incorporate other atoms into the nanothread backbone, guide the reaction, and understand the nanothread's chemical environment will save researchers invaluable time in developing nanothread technology."

This process of using these non-carbon atoms to guide the formation of nanothreads, which Dunning calls "thread directing," is a significant step towards a future where scientists can predictably create these materials and use them for advanced applications. Now that this synthetic strategy has been discovered, Dunning plans to identify and test the many possible nanothread precursors.

He also can't wait to start putting the pyridazine nanothreads through their paces.

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Dunning concluded, "Now that we know we can make this material, we need to start making enough to learn enough to determine mechanical, optical, and electronic properties."

Phys Org, 2 March 2022

https://phys.org

MicroRNA shown to regrow 90% of lost hair, research finds

2022-03-03

Researchers from North Carolina State University have identified a microRNA (miRNA) that could promote hair regeneration. This miRNA – miR-218-5p – plays an important role in regulating the pathway involved in follicle regeneration, and could be a candidate for future drug development.

Hair growth depends on the health of dermal papillae (DP) cells, which regulate the hair follicle growth cycle. Current treatments for hair loss can be costly and ineffective, ranging from invasive surgery to chemical treatments that don't produce the desired result. Recent hair loss research indicates that hair follicles don't disappear where balding occurs, they just shrink. If DP cells could be replenished at those sites, the thinking goes, then the follicles might recover.

Hair growth depends on the health of dermal papillae (DP) cells, which regulate the hair follicle growth cycle.

A research team led by Ke Cheng, Randall B. Terry, Jr. Distinguished Professor in Regenerative Medicine at NC State's College of Veterinary Medicine and professor in the NC State/UNC Joint Department of Biomedical Engineering, cultured DP cells both alone (2D) and in a 3D spheroid environment. A spheroid is a three-dimensional cellular structure that effectively recreates a cell's natural microenvironment.

In a mouse model of hair regeneration, Cheng looked at how quickly hair regrew on mice treated with 2D cultured DP cells, 3D spheroid-cultured DP cells in a keratin scaffolding, and the commercial hair loss treatment Minoxidil. In a 20-day trial, mice treated with the 3D DP cells had regained 90% of hair coverage at 15 days.

"The 3D cells in a keratin scaffold performed best, as the spheroid mimics the hair microenvironment and the keratin scaffold acts as an anchor to keep them at the site where they are needed," Cheng says. "But we were also interested in how DP cells regulate the follicle growth process, so we looked at the exosomes, specifically, exosomal miRNAs from that

CHEMWATCH
Bulletin Board
Gossip
MAR. 11, 2022

microenvironment." Exosomes are tiny sacs secreted by cells that play an important role in cell to cell communication. Those sacs contain miRNAs.

MiRNAs are small molecules that regulate gene expression. Cheng and his team measured miRNAs in exosomes derived from both 3D and 2D DP cells. In the 3D DP cell-derived exosomes, they pinpointed miR-218-5p, a miRNA that enhances the molecular pathway responsible for promoting hair follicle growth. They found that increasing miR-218-5p promoted hair follicle growth, while inhibiting it caused the follicles to lose function.

"Cell therapy with the 3D cells could be an effective treatment for baldness, but you have to grow, expand, preserve and inject those cells into the area," Cheng says. "MiRNAs, on the other hand, can be utilized in small molecule-based drugs. So potentially you could create a cream or lotion that has a similar effect with many fewer problems. Future studies will focus on using just this miRNA to promote hair growth."

The research appears in Science Advances, and was supported by the National Institutes of Health and the American Heart Association. Cheng is corresponding author. Postdoctoral researcher Shiqi Hu is first author.

The Brighter Side, 3 March 2022

https://thebrighterside.news

State-of-the-art "living" concrete alternative soaks up carbon and heals itself

2022-03-03

Cheap and easy to make, concrete is a favorite building material around the world, with 30 billion metric tons used each year. But the cement industry accounts for 7 percent of global carbon emissions, spurring a research race to design more sustainable building materials, be it more eco-friendly concrete or enhanced wood materials.

Now a team from the Worcester Polytechnic Institute has made a strong concrete-like material that soaks up carbon dioxide from the air when it is produced and later to heal itself if cracks form. Twenty-seven cubic feet of the new material stores 8 kilograms of carbon dioxide, while the same volume of concrete emits over 180 kilograms of the greenhouse gas, according to civil, environmental and architectural engineering professor Nima Rahbar, a co-author of a paper published in the journal Matter.

Several technologies exist for carbon-negative construction materials that can absorb more carbon dioxide than their production releases. One is

It's secret is an enzyme found in red blood cells that absorbs CO_2 from the air and produces calcium carbonate to build and later heal the material.

hempcrete, a carbon-negative composite of hemp fibers and a glue-like binder. Another is building materials infused with living bacteria that can absorb carbon dioxide and form chemical compounds that strengthen the material and even fill in tiny cracks.

The new work is an example of such an engineered living material. Except here, the researchers use a biological enzyme that drives chemical reactions inside red blood cells. They mix the enzyme, called carbonic anhydrase, into water along with sand and a polymer. The enzyme reacts with carbon dioxide and calcium ions in the water to form calcium carbonate crystals that bind the sand and polymer particles together to form the composite building material.

If cracks develop in the material, the enzyme kicks in and absorbs carbon dioxide from the air to produce more calcium carbonate and heal itself. The material could do this to restore its strength up to six times. The percentage of enzymes in the material is minimal, so it should be economical to produce on large scale.

Laboratory experiments showed that the material had a compressive strength—a measure of how much load it can bear—that was "more than twice that of the minimum acceptable for cement mortar and other alternative building materials," the researchers say in the paper.

Producing the material does not require high temperatures like cement and bricks do, which brings down its carbon footprint considerably. Plus, it does not need to be cured for days like concrete. The researchers say that the new material could someday be an environmentally friendly, low-cost alternative to concrete.

Source: Shuai Wang, Suzanne F. Scarlata, and Nima Rahbar. A self-healing enzymatic construction material, Matter, 2022.

Anthropocene Magazine, 3 March 2022

https://anthropocenemagazine.org

The future of data storage is double-helical, research indicates

2022-03-03

Imagine Bach's "Cello Suite No. 1" played on a strand of DNA.

CHEMWATCH
Bulletin Board
Gossip
MAR. 11, 2022

This scenario is not as impossible as it seems. Too small to withstand a rhythmic strum or sliding bowstring, DNA is a powerhouse for storing audio files and all kinds of other media.

"DNA is nature's original data storage system. We can use it to store any kind of data: images, video, music—anything," said Kasra Tabatabaei, a researcher at the Beckman Institute for Advanced Science and Technology and a co-author on this study.

Expanding DNA's molecular makeup and developing a precise new sequencing method enabled a multi-institutional team to transform the double helix into a robust, sustainable data storage platform.

The team's paper appeared in Nano Letters in February 2022.

In the age of digital information, anyone brave enough to navigate the daily news feels the global archive growing heavier by the day. Increasingly, paper files are being digitized to save space and protect information from natural disasters.

From scientists to social media influencers, anyone with information to store stands to benefit from a secure, sustainable data lock box—and the double helix fits the bill.

"DNA is one of the best options, if not the best option, to store archival data especially," said Chao Pan, a graduate student at the University of Illinois Urbana-Champaign and a co-author on this study.

Its longevity rivaled only by durability, DNA is designed to weather Earth's harshest conditions—sometimes for tens of thousands of years—and remain a viable data source. Scientists can sequence fossilized strands to uncover genetic histories and breathe life into long-lost landscapes.

Despite its diminutive stature, DNA is a bit like Dr. Who's infamous police box: bigger on the inside than it appears.

"Every day, several petabytes of data are generated on the internet. Only one gram of DNA would be sufficient to store that data. That's how dense DNA is as a storage medium," said Tabatabaei, who is also a fifth-year Ph.D. student.

Another important aspect of DNA is its natural abundance and near-infinite renewability, a trait not shared by the most advanced data storage system on the market today: silicon microchips, which often circulate for just decades before an unceremonious burial in a heap of landfilled e-waste.

Despite its diminutive stature, DNA is a bit like Dr. Who's infamous police box: bigger on the inside than it appears.

"At a time when we are facing unprecedented climate challenges, the importance of sustainable storage technologies cannot be overestimated. New, green technologies for DNA recording are emerging that will make molecular storage even more important in the future," said Olgica Milenkovic, the Franklin W. Woeltge Professor of Electrical and Computer Engineering and a co-PI on the study.

Envisioning the future of data storage, the interdisciplinary team examined DNA's millennia-old MO. Then, the researchers added their own 21st-century twist.

In nature, every strand of DNA contains four chemicals—adenine, guanine, cytosine, and thymine—often referred to by the initials A, G, C, and T. They arrange and rearrange themselves along the double helix into combinations that scientists can decode, or sequence, to make meaning.

The researchers expanded DNA's already broad capacity for information storage by adding seven synthetic nucleobases to the existing four-letter lineup.

"Imagine the English alphabet. If you only had four letters to use, you could only create so many words. If you had the full alphabet, you could produce limitless word combinations. That's the same with DNA. Instead of converting zeroes and ones to A, G, C, and T, we can convert zeroes and ones to A, G, C, T, and the seven new letters in the storage alphabet," Tabatabaei said.

Because this team is the first to use chemically modified nucleotides for information storage in DNA, members innovated around a unique challenge: Not all current technology is capable of interpreting chemically modified DNA strands. To solve this problem, they combined machine learning and artificial intelligence to develop a first-of-its-kind DNA sequence readout processing method.

Their solution can discern modified chemicals from natural ones, and differentiate each of the seven new molecules from one another.

"We tried 77 different combinations of the 11 nucleotides, and our method was able to differentiate each of them perfectly," Pan said. "The deep learning framework as part of our method to identify different nucleotides is universal, which enables the generalizability of our approach to many other applications."

This letter-perfect translation comes courtesy of nanopores: proteins with an opening in the middle through which a DNA strand can easily pass.

CHEMWATCH
Bulletin Board
Gossip
MAR. 11, 2022

Remarkably, the team found that nanopores can detect and distinguish each individual monomer unit along the DNA strand—whether the units have natural or chemical origins.

"This work provides an exciting proof-of-principle demonstration of extending macromolecular data storage to non-natural chemistries, which hold the potential to drastically increase storage density in non-traditional storage media," said Charles Schroeder, the James Economy Professor of Materials Science and Engineering and a co-PI on this study.

DNA literally made history by storing genetic information. By the looks of this study, the future of data storage is just as double-helical.

Phys Org, 3 March 2022

https://phys.org

Why Is Cancer-Linked Benzene in So Many Personal Care Products?

2022-02-24

Dozens of different spray products -- deodorants, shampoos, sunscreens, athlete's foot treatments -- have been recalled in recent months due to contamination with the cancer-causing chemical benzene.

Most recently, six Brut and Sure aerosol antiperspirants faced recall last week due to benzene contamination.

But that's just the latest in a string of benzene-related recalls that include:

- Pantene and Herbal Essence dry shampoo and hair conditioner sprays in December.
- Old Spice and Secret spray antiperspirants in November.
- Tinactin and Lotrimin antifungal sprays and Coppertone sunscreen sprays in October.
- Neutrogena and Aveeno spray sunscreens in July.

Benzene is classified a Group A known human carcinogen by the U.S. Environmental Protection Agency. It's been most closely linked to leukemia and other blood cancers.

Exposure to benzene can occur through the skin, as well as by inhalation or ingestion, according to the U.S. Food and Drug Administration.

"We know in particular very low concentrations of benzene have been associated with increased cancer risk," said David Andrews, a senior scientist with the Environmental Working Group. "Benzene is very detrimental to cells, and can lead to direct DNA damage, cell death and ultimately increase the risk for cancer."

Unfortunately, no one's sure what's causing the benzene contamination in these personal care products, Andrews said.

"Some of the hypothesis is that it's from petroleum-derived ingredients" used in the spray propellant, he explained.

"But it still hasn't fully been determined exactly what that source is in all these products and if it's consistent across all of them," Andrews continued. "There are a lot of petroleum-derived ingredients in some consumer products, so it could be coming from one or more different ingredient sources."

Benzene is classified a Group A known human carcinogen by the U.S. Environmental Protection Agency. It's been most closely linked to leukemia and other blood cancers.

CHEMWATCH
Bulletin Board
Curiosities
MAR. 11, 2022

The contamination isn't limited to one company's products: Johnson & Johnson, Bayer, Proctor & Gamble, and TCP HOT Acquisition LLC dba HRB Brands are among the manufacturers whose spray products have faced recall due to unexpected levels of benzene.

The Personal Care Products Council "is aware of recent studies reporting the presence of trace amounts of benzene in some personal care products," the industry trade group said in a statement.

"Benzene is a chemical that is ubiquitous in the environment and not an intentionally added ingredient in personal care products," the statement continued. "People worldwide are exposed daily to benzene from indoor and outdoor sources, including air, drinking water, and food and beverages."

The council added that "trace levels" of benzene "do not pose a safety concern for consumers."

"Based on exposure modeling and cancer risk assessments published by the U.S. Environmental Protection Agency, daily exposure to benzene in personal care products would not be expected to cause adverse health consequences," the council's statement said.

People who are concerned about benzene exposure should avoid spray products for personal care until more is known, Andrews said.

They also should call for more and better testing and regulation of these products, he added.

"Consumers who are aware of the issue should be asking the product manufacturers and sending their concerns to the Food and Drug Administration, because this is a place where there is not currently adequate oversight," Andrews said. "This is a piece of a larger issue in terms of the lack of FDA oversight and authority with respect to consumer personal care product manufacturing and regulation of contaminants."

US News, 24 February 2022

https://usnews.com

Clues to better batteries emerge from tracking lithium

2022-02-28

Pure lithium metal is a promising replacement for the graphite-based anodes currently used in electric vehicle batteries. It could tremendously reduce battery weights and dramatically extend the driving range of

electric vehicles relative to existing technologies. But before lithium metal batteries can be used in cars, scientists must first figure out how to extend their lifetimes.

A new study led by Peter Khalifah—a chemist at the U.S. Department of Energy's (DOE) Brookhaven National Laboratory and Stony Brook University—tracked lithium metal deposition and removal from a battery anode while it was cycling to find clues as to how failure occurs. The work is published in a special issue of the Journal of the Electrochemical Society honoring the contributions of Nobel Prize-winning battery researcher John Goodenough, who like Khalifah is a member of the Battery 500 Consortium research team.

"In a good battery, the rate of lithium plating (deposition) and stripping (removal) will be the same at all positions on the surface of electrodes," Khalifah said. "Our results show that it's harder to remove lithium at certain places, which means there are problems there. By identifying the cause of the problems, we can figure out how to get rid of them and make better batteries with higher capacities and longer lifetimes."

Khalifah and his collaborators conducted the study using intense x-rays at the Advanced Photon Source, a DOE Office of Science user facility at DOE's Argonne National Laboratory. They tracked lithium as it shuttled from cathode to anode and back during one complete charge and discharge cycle.

"The x-rays can see right through the battery and allow us to make many measurements very quickly to track what happens as the battery changes," Khalifah said. "To the best of our knowledge, no one has ever been able to use x-rays to map lithium shuttling while it happens."

One challenge: Lithium atoms are difficult to see using x-rays. The weak signal from the small number of lithium atoms that move between the cathode and anode can easily get obscured by stronger signals emitted by other materials that make up the battery—including the signal that would come from the large amount of lithium on a pure lithium metal anode.

To address that challenge, Khalifah's team designed a battery cell using a "bare" anode—at least bare with respect to the presence of pre-existing lithium. This makes the signal of the shuttling lithium ions easier to measure. They then did a study comparing two different anode materials—copper and molybdenum—on which lithium ions were deposited as pure lithium metal after being extracted from the cathode material during operation of these batteries. This allowed the researchers

"To the best of our knowledge, no one has ever been able to use x-rays to map lithium shuttling while it happens."

CHEMWATCH
Bulletin Board
Curiosities
MAR. 11, 2022

to follow how uniformly lithium metal was added to and removed from anode surfaces. Comparing this process using copper and molybdenum anodes also offered an opportunity to identify differences between these two metals that might prove fruitful in designing improved batteries. Using this setup, the team mapped out how much lithium was present across the electrode while the cell was maintained at various stages of charge and discharge.

It took about an hour to collect maps with hundreds of data points. That mapping data could be used to identify changes that had occurred as a result of charging and discharging the battery, but the process of data collection was too slow to be useful for following the changes as they occurred. So, to track changes as they happened, the scientists used a more rapid data collection procedure to scan a small subset of 10 pixel-specific locations over and over again during battery cycling.

"We made the maps while the battery was in a resting state, starting at zero capacity, then took pixel measurements as we charged to half capacity. Then we stopped charging and made another map, then resumed pixel-specific measurements while charging to full capacity. We then discharged the cell while continuing to alternate mapping and pixel scans, stopping to collect maps at half discharge and full discharge," Khalifah explained.

Results reveal variations

For the copper anode, all the points behaved as they should during charging: half the lithium capacity was deposited on the anode up to the half-charged state, and all possible lithium was deposited by the full charge state.

On discharge, large differences developed between pixels. In some pixels, the lithium was removed proportional to the discharge (half the lithium was stripped by the half discharge state, and all was gone by full discharge). Other pixels showed a lag in lithium removal, where stripping was slow during the first half of discharge, then sped up to complete the process by full discharge. In still other spots the lagging was so severe that most of the lithium remained on the anode even when the battery had been fully discharged.

"If the lithium is left behind, that reduces the capacity of the cell," Khalifah said. "Each lithium atom left behind means one less electron flowing through the external circuit powered by the battery. You can't extract all the capacity of the cell."

The finding that these irregularities arose due to incomplete stripping of lithium was somewhat surprising. Prior to this study, many scientists had believed that lithium plating was the source of the worst problems in lithium metal batteries.

"In general, one expects it is more difficult to deposit lithium metal as the atoms have to be organized in the specific arrangement of the crystal structure of this metal," Khalifah explained. "Removing lithium should be easier because any atom on the surface can be taken away without having to follow any specific pattern. Furthermore, if lithium is added more quickly than the atoms can be deposited homogenously across the surface, the growth tends to occur in the form of needle-like dendrites that can cause electrical shorts (and potentially fires) in the battery."

The molybdenum anode showed a bit more variation during plating than copper, but less variation during stripping.

"Since the lithium behavior was better during the stripping step that caused the most overall irregularities in the anode, it implies that batteries using molybdenum foil substrates instead of copper substrates might yield higher capacity batteries," Khalifah said.

However, it is not yet clear if the choice of metal is responsible for the better performance of the molybdenum anode. Another factor could be the distribution of electrolyte—the liquid through which the lithium ions travel as they shuttle back and forth between anode and cathode.

The mapping data showed that the regions of poor performance occurred in spots that were about five millimeters across. The size and shape of those spots and comparisons with other experiments suggest that poor spreading of the liquid electrolyte throughout the battery cell might be responsible for the local loss of capacity in those regions. If this is the case, Khalifah said, then the performance of the battery can likely be improved by finding a better method for distributing the electrolyte across the cathode.

"Follow-up experiments aimed at distinguishing between metal and solvent effects, and for testing the effectiveness of strategies for mitigating potential problems such as electrolyte inhomogeneity, will help advance the broader goal of developing high-capacity lithium metal anode batteries with long lifetimes," Khalifah said.

Tech Xplore, 28 February 2022

https://techxplore.com

CHEMWATCH
Bulletin Board
Curiosities
MAR. 11, 2022

Why do cats love boxes so much?

2022-02-28

It's a truism perhaps best exemplified by viral memes: Cats love to cram themselves into boxes or whatever other tight spaces they can find. But why do our feline friends do this? Why do cats love boxes so much?

The behavior comes from a simple animal desire, said Gabriella Smith, a doctoral candidate in comparative animal cognition at the University of Veterinary Medicine in Vienna.

"What we know is that it is a form of comfort," Smith told Live Science. "This makes sense from an evolutionary standpoint. Side pressure is comforting."

This sense of comfort is especially crucial in stressful situations, such as when a street cat is brought inside for the first time. In a 2019 paper published in the journal PLOS One, Dutch scientists noted that the ability to hide was crucial in lowering the stress levels of cats that had just arrived at an animal shelter. The researchers measured the stress levels of the cats using the non-invasive Cat-Stress-Score, which assesses stress levels in cats based on their posture, vocal behavior and activity level. The scientists also found that when the cats were deprived of shelter, they would flip over their litter boxes to hide underneath them.

Cats' love for boxes extends beyond three-dimensional structures. In 2021, Smith spearheaded a citizen science paper, meaning that she asked the public (and their cats) to contribute to the experiment. The study, published in the journal Applied Animal Behaviour Science, explored whether cats would sit inside a Kanizsa contour, a rectangle created by corners that are taped off on a floor.

Unlike a box, a Kanizsa contour doesn't have walls, making it two dimensional. "The 2D experiment, in particular, is a look into their visual cognition and the perception of borders," she said. In other words, cats love boxes so much, they'll even sit in fake, 2D ones.

So how would this behavior benefit cats? One theory is that it helps them avoid dangerous situations. "Why that would make sense from an evolutionary standpoint is, you don't want to walk into things; you don't want to fall off a cliff, you want to understand when two things have different color intensities," Smith said.

Another possible explanation, which has not been tested scientifically, is that cats like boxes because they are ambush predators. After all, as any cat owner can attest, house cats love to use boxes, corners and just

The behavior comes from a simple animal desire, said Gabriella Smith, a doctoral candidate in comparative animal cognition at the University of Veterinary Medicine in Vienna.

about any elevated surface to conceal themselves before pouncing on an unsuspecting toy — or human.

"My cat does it if we're playing — she'll hide behind something so that she can pounce," Smith said. "That all makes sense when we think about 3D enclosures, but there's even less known about why it translates to something 2D on the floor."

And our housebound felines aren't the only cats that love boxes. According to zoo observations, big cats — including pumas, lions and tigers — enjoy sitting in and playing with boxes of all sizes.

Live Science, 28 February 2022

https://livescience.com

Glitchy protein production may hasten aging

2022-03-02

Cells are continually cranking out new proteins, but like car factories, they produce some lemons. A study of mice now suggests these defective proteins speed aging, bolstering an idea first proposed 60 years ago. The new paper "fills a critical gap" and "allows us to say that protein damage is an accelerant of aging," says molecular biologist Richard Morimoto of Northwestern University, who wasn't connected to the study.

The mouse research focuses on the importance of ribosomes, the cell's protein assembly lines. When these organelles receive instructions from the nucleus to build a particular protein, they stitch together amino acids in a specific sequence. But the process, known as translation, isn't perfect. Every so often, a ribosome installs the wrong amino acid. Such mistakes can hamstring a protein or cause it to fold incorrectly and become toxic for the cell.

In 1963, chemist Leslie Orgel proposed that translation errors such as these promote aging. Orgel's hypothesis held that mistakes would accumulate at an accelerating rate until the cell dies, but researchers found scant support for this error explosion. Nonetheless, some recent evidence suggests translation miscues contribute to aging. For instance, lab mice, which typically don't live longer than 2 or 3 years, make more mistakes during protein synthesis than do the African rodents called naked mole rats, which can survive up to 30 years. And when researchers genetically tweaked yeast, fruit flies, and nematodes to greatly increase their ribosomes' accuracy, the modified organisms lived up to 23% longer than normal.

Mice with sloppy protein-making machinery grow old faster, study finds

To test whether slip-ups during protein synthesis propel aging in mammals, molecular biologist Erik Böttger of the University of Zurich and colleagues genetically engineered mice to have error-prone ribosomes. The change led to more mistakes during translation. One type of gaffe, in which cells manufacture proteins that are too long, was twice as common in the altered mice as in control rodents.

When mice with error-prone ribosomes were young, they appeared healthy. But by the time the animals were 9 months old, roughly equivalent to humans in their 30s, they started to look and act old. Their fur began to turn gray and fall out. They developed cataracts, hunched postures, and abnormally curved spines. Like older humans, the mice began to lose their body fat and muscle. Their physical performance also declined. Compared with their normal counterparts, the modified rodents couldn't swim as fast and were more sedentary.

Along with these failings, the animals showed molecular signs of faster aging. Their proteins carried more damage from reactive oxygen species, destructive byproducts of metabolism linked to aging. Their telomeres, the chromosome caps that shrink over time, also shortened faster than in normal rodents.

And reducing the accuracy of protein synthesis clearly cut the rodents' life span. The altered mice were about seven times more likely to die before they reached 18 months of age than their unmodified peers, the researchers report today in Science Advances.

The study indicates that inaccurate protein synthesis "is a key player in aging," Böttger says. Now, he adds, "You can think about strategies for healthy aging," including developing drugs that would increase the accuracy of translation.

The work "is the first to show that an increase in translation errors causes shortened life span and accelerated aging in mammals," says Jiqiang "Lanny" Ling, a molecular geneticist and biochemist at the University of Maryland, College Park, who wasn't connected to the study. But researchers still need to confirm that sloppy protein synthesis drives age-related problem in humans, such as gimpy knees and failing hearts. "The next burning question," he says, "is how does it lead to aging?"

Science, 2 March 2022

https://science.org

CHEMWATCH
Bulletin Board
Curiosities
MAR. 11, 2022

Should we kill every mosquito on Earth?

2022-02-28

Throughout human history, wars, battles and conflicts are thought to have resulted in the deaths of around 1 billion people. But that's nothing compared with the number of humans killed by mosquitoes. The journal Nature suggests that nearly half of all humans who have lived during the past 50,000 years owe their death to this deadly insect and its capacity to transmit one particular disease: malaria.

Mosquitoes are central to the spread of malaria — which is caused by a parasite that killed around 627,000 people in 2020 alone — as well as viruses such as Zika, West Nile and dengue. The Anopheles gambiae mosquito, which is common in rural parts of Africa, is often dubbed the "most dangerous animal species on Earth," according to a 2020 study published in the journal the Proceedings of the National Academy of Sciences.

So, given that mosquitoes are so deadly, should we just kill all of them? And if we were to take such a drastic measure, what would the consequences be?

Before you grab that can of bug spray, know this: While some mosquitoes are dangerous to us, not all are. Even those that are sometimes harmful tend not to feed on humans, preferring honeydew, plant sap and nectar, according to Mosquito Joe, a mosquito control company.

There are around 3,500 mosquito species, but "only around 100 will potentially bite and spread disease to humans," Steven Sinkins, a professor in microbiology and tropical medicine at the Centre for Virus Research at the University of Glasgow in Scotland, told Live Science in an email.

For instance, Culiseta mosquitoes often bite humans, but are not known to carry any debilitating diseases, while Toxorhynchites, which are common the world over and tend to live in forests, prefer nectar sugars to blood, according to Entomology Today.

Therefore, it probably wouldn't be necessary to get rid of every mosquito species. Instead, we could target the more problematic ones, such as Aedes aegypti, which carry diseases such as yellow fever and Zika. A. aegypti is now ubiquitous, but it wasn't always this way. The species first spread out of Africa during the slave trade between the 15th and 19th centuries, through trade with Asia in the 18th and 19th centuries, and via

Mosquitoes are central to the spread of malaria — which is caused by a parasite that killed around 627,000 people in 2020 alone

CHEMWATCH
Bulletin Board
Curiosities
MAR. 11, 2022

troop movements during World War II, according to the World Mosquito Program, a nonprofit based in Australia.

Other mosquitoes that are dangerous to humans include certain types of Anopheles and Culex, as these carry a host of diseases, including malaria, dengue, West Nile fever, yellow fever, Zika, chikungunya and lymphatic filariasis, according to Understanding Animal Research. The latter condition is often known as elephantiasis, which can cause painful swelling in the lymph system, especially in the legs, arms or genitalia.

Die, mosquitoes, die

If humans decide to selectively eliminate disease-carrying mosquitoes, there are a few options. One such targeted solution involves "releasing mosquitoes carrying Wolbachia bacteria," which, according to Sinkins, is a strategy already being used to control dengue. This involves breeding mosquitoes so that they carry Wolbachia, which is not dangerous to humans, and then placing them into disease-prone areas.

In mosquitoes such as Aedes aegypti that carry Wolbachia, the bacteria makes it difficult for viruses to reproduce, according to the World Mosquito Program. As a result, it's less likely that mosquitoes carrying Wolbachia will spread harmful viruses to people they bite for a blood meal.

This type of strategy could eventually "block the transmission of diseases," which could effectively make mosquitoes harmless, Sinkins said. Another method involves releasing genetically modified mosquitoes whose offspring do not survive, Live Science previously reported.

But, what if it weren't possible to target problematic species? Sinkins admitted that though focusing on select species "could" eventually become a viable and cost-effective solution, "a lot of research is still needed to determine how feasible this will be." Sinkins also noted that the approach would have to be tailored by continent, as "different mosquito species spread malaria in Africa, Asia and South America."

So, what if we instead chose the scorched-Earth approach, and killed them all? What would the consequences be? The simple answer is, we're not sure.

"We don't yet know what the knock-on impact on the ecosystem would be. Evidence is scarce," said Thomas Churcher, an epidemiologist, entomologist and mathematical modeler at Imperial College London who is working to understand the best way to kill mosquitoes.

However, given mosquitoes are a primary food source for numerous animals, including bats, birds, frogs, fish and dragonflies, it's likely there would be at least some ecological impacts, at least in the short term. Dragonflies, for example, are often known as mosquito hawks, owing to their ability to eat as many as 100 mosquitoes in a single day. It's likely they, as well as a host of other critters, would, at the very least, have to change their diets somewhat.

However, despite this lack of consequential clarity, Sinkins and Churcher agree that if it became possible to kill off every mosquito capable of transmitting malaria and other diseases, even if it also meant wiping out all mosquitoes that aren't dangerous to humans, they would support the idea.

Sinkins is confident that eradicating disease-transmitting mosquitoes would "prevent hundreds of thousands of malaria deaths every year," and would ultimately wipe out malaria entirely. Churcher agreed that, if such an opportunity were to present itself, it would "without doubt" be the right decision to kill all mosquitoes.

It is nice to dream about a world without mosquitoes — a phenomenon that Hawaii experienced until 1826, when a foreign ship introduced the mosquito *Culex quinquefasciatus* to the archipelago, according to the Hawaii Invasive Species Council. But for places where mosquitoes live and thrive — which is everywhere in the world aside from Antarctica and Iceland — their absence could cause a rift in the ecosystem — though to what extent, it's difficult to say.

"Many mosquito species are important components of ecological food webs and do not pose any threat to humans," said Churcher. "They are an impressively successful group."

However, if you are absolutely determined to live in a world without mosquitoes, your best bet is probably relocating to Iceland – just remember to keep your eyes peeled for polar bears when you get there.

Live Science, 28 February 2022

https://livescience.com

CHEMWATCH
Bulletin Board
Curiosities
MAR. 11, 2022

Stalled weather: how stuck air pressure systems drive floods and heatwaves

2022-03-03

Climate change – fuelled by increasing greenhouse gases – is causing more extreme weather events worldwide.

Many of these events, such as the "rain bomb" inundating Australia's east coast and the recent heatwave in Western Australia, are associated with "stalled" weather systems.

Normally, Australia's weather systems are driven from west to east by jet streams: narrow bands of fast-flowing air high up in the troposphere, the lowest layer of Earth's atmosphere.

But when weather systems stall in a particular place, usually because of "blocking" high-pressure systems that stop them moving on, they can produce devastating extended periods of heat, cold or rain. As the climate continues to change, these stalled weather systems are expected to get bigger.

Stalled weather systems

Blocking systems are persistent high-pressure systems combined with one or two low-pressure systems.

High-pressure systems (where air pressure is relatively high) are associated with clear and dry weather, while low-pressure systems are associated with rising air, cloudiness and rain

Blocking tends to be less persistent in the southern hemisphere than the northern as the westerly jet streams are stronger.

Blocking highs are mostly associated with a region of low pressure to the north of the system. Together, the two systems work against each other to effectively "stall" the weather.

Depending on where they occur, blocking systems may cause consistent heatwaves, cold spells, floods and dry spells. They are often associated with record-breaking weather events and human deaths – for example, the deadly heatwaves in France in 2003 and Russia in 2010.

In 2021, persistent blocking systems were responsible for the North America cold wave in February and the record-shattering Western North America heatwave in June and July. The latter event caused some of the

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highest temperatures ever recorded in the region, including the highest temperature ever measured in Canada at 49.6 .

Slowing jet streams

Blocking events in the northern hemisphere are often associated with slowing or meandering jet streams. This occurs when the polar vortex – a large region of low pressure and cold air around the pole – breaks down.

While the exact mechanisms driving the slowing of mid-latitude jet streams is debated, the consensus attributes it to "Arctic amplification".

The Arctic region is currently warming two to three times faster than the rest of the world. This different rate of atmospheric warming between the Arctic and tropics results in a weaker atmospheric pressure gradient and slows down the jet streams.

Stalled weather in Australia

Blocking highs in the Australian region usually occur in the Great Australian Bight and the Tasman Sea. These strong high-pressure systems typically form further south than usual.

These highs remain almost stationary for an extended period, blocking the normal easterly progression of weather systems across southern Australia. They can occur at any time of year, and usually stay in the Australian region for several days to several weeks.

A prolonged blocking high in the south Tasman Sea in January and February 2019 caused record heatwaves for many inland towns in Australia. Adelaide recorded the hottest day for any Australian capital city (46.6) on January 24.

The same blocking high prevented the movement of a deep monsoon low in North Queensland, resulting in the equivalent of a year's rain in a week over the Townsville area in early February 2019.

The rain bomb

In late February 2022, a stalled weather system caused heavy rain and flooding over large parts of Southeast Queensland and Northern NSW. A stubborn blocking high near New Zealand prevented it moving away to the east.

A region of low pressure in the upper atmosphere became cut off from the westerly air current further south, creating a trough of low pressure

CHEMWATCH
Bulletin Board
Curiosities
MAR. 11, 2022

at surface level. This created the perfect mix of upper and surface atmospheric conditions for what has been called a "rain bomb" or a "river in the sky".

The rain bomb caused extensive major flooding.

Brisbane, the country's third-largest city, smashed its three-day record with 677mm of rain. Over four days, the city recorded 741mm – almost three-quarters of its annual average rainfall!

The city endured flooding similar to the disastrous 2011 floods. More than 15,000 homes are estimated to have been inundated in Brisbane by the current event.

The Brisbane River peaked at 3.85 metres, below the 4.46 metres experienced in 2011. However, the two flood events are very different, and some suburbs experienced worse flooding than in 2011.

Gympie, north of Brisbane, and Lismore in northern NSW experienced catastrophic flooding of their central business districts. Gympie has endured its worst flood in 120 years and Lismore its highest ever recorded flood level, smashing the previous record by about 2 metres.

Future events

Recent research has shown extremely high rainfall, and flooding events, will become more likely as the atmosphere and oceans warm under climate change.

What does this mean for the future? Can we expect more rain bomb events? Will we continue to witness more rainfall and flood level records in Australia and globally?

The answer to all these questions is yes, and rising greenhouse gases and warming of the atmosphere and oceans are to blame.

The rise in average global temperatures has driven more extreme rainfall events since the 1950s. Australian land areas have warmed about 1.4 since 1910.

A warmer atmosphere can hold more water. For every 1 of extra warming, about 7% more water can be saved as water vapour. Given the right atmospheric triggers, vast amounts of stored water can be released as heavy rainfall over unsuspecting human communities.

The jury is out regarding the effects of global warming on high-pressure blocking systems.

Currently, climate models tend to underestimate both the frequency and duration of blocking events. Scientists continue to grapple with this problem in their models, and it forms the basis of ongoing research.

However, one study found climate change will increase the size of stalled high-pressure weather systems in the northern hemisphere by as much as 17% this century.

In the case of an extensive high-pressure system, this will cause impacts such as heat and cold waves over larger geographical areas, affecting more people.

The Conversation, 3 March 2022

https://theconversation.com

How do snakes hiss if they don't have front teeth?

2022-02-28

Dogs say "woof," cats say "meow" and snakes say "sss." To make this sound, humans have to position their tongues against their front teeth. Snakes don't have front teeth, so how can they make this sound — and sometimes even stick out their tongues at the same time?

It turns out that snakes make that hissing noise a bit farther back in the respiratory system than we do, in a structure called the glottis. The glottis is a tiny opening at the bottom of the snake's mouth that opens when the snake breathes.

The glottis is connected to the trachea, or windpipe, which itself is connected to the snake's lung. Snakes have only one functioning lung; the other is vestigial, meaning it's now a small remnant of a larger, functional organ that existed in the snake's evolutionary ancestors. The functioning lung is made up of two parts.

"There's the vascular lung; that's what our lungs do, so it absorbs oxygen and things like that," David Penning, an assistant professor of biology at Missouri Southern State University, told Live Science. "The back half of the lung is what's called the saccular lung, and it's basically like an old-timey fireplace bellow. It's just an empty balloon for nothing but just holding air."

"So when a snake goes to hiss, it will expand its ribs, take in a big deep breath and then just exhale for a really long period of time," Penning said.

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CHEMWATCH
Bulletin Board
Curiosities
MAR. 11, 2022

The hissing noise is a result of that fast-moving air passing through the glottis.

"It's literally just air passing through a small opening," Penning said. "They can change the volume of it, by squeezing their ribs harder and pushing out more air, but it's really just a result of air passing through a small tubular column that makes the hiss noise."

That means their tongues have nothing to do with it. "They're two unrelated things," Penning said.

"When their tongue comes out, they're trying to capture volatile organic compounds in the air," he said, referring to chemicals that float on air and are often aromatic. "The two forks give them directional senses of chemicals, so if they pick up more of a coyote smell on the left side than the right, they know that perhaps that's where the chemical is coming from.

"The tongue flick is for them to gather information," Penning added. "The hiss is just to keep that distance or maintain being intimidating and things like that."

Unlike other animals, snakes make just one sound for one purpose: defense. The hiss doesn't convey information or even vary much from situation to situation, Penning said. "It comes out almost no different than white noise."

Still, that sound can come out differently from species to species. The king cobra (*Ophiophagus hannah*), for example, can "growl."

"In the trachea, they have extra air sacs, and they can slowly release air from those," Penning said. "And it sounds different — a kind of guttural, lower hum sound. Definitely more vibrational bass sound than a traditional hiss."

"Then the bull snake [*Pituophis catenifer sayi*] in North America, it hisses, but it has some ridges in its esophagus that make it kind of rattly sounding, like something's tinkering around in there."

But no matter the sound, the message is the same: Stay away. Heeding that warning is as good for you as it is for the snake.

"If you hear a hiss, you're hearing an animal in distress," Penning said. "And so backing away or leaving it alone would be the [right] move."

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https://livescience.com

5 signs of how climate change is unraveling Earth's ecosystems

2022-03-01

By now, many symptoms of climate change, from heat-fueled superstorms to rising sea levels, are impossible to ignore. But there's another, less-visible consequence of global warming that is just as disturbing: the staggering loss of plants and animals and the countless benefits they provide.

In a new report from the UN's Intergovernmental Panel on Climate Change (IPCC), researchers from 67 countries warned that warming is putting a large portion of the world's biodiversity and ecosystems at risk of extinction, even under relatively conservative estimates. Never before has an IPCC report — considered the gold standard for climate science — revealed in such stark detail how climate change is harming nature.

What ails wildlife ails us, the authors wrote. Humans are inextricably dependent on many species that are in jeopardy from rising temperatures, whether they're animals that pollinate crops, filter rivers and streams, or feed us. In the US alone, for example, more than 150 crops depend on pollinators, including nearly all fruits and grains, and climate change puts them at risk.

Humans have warmed the planet by an average of 1.1 degrees Celsius (2 degrees Fahrenheit) since the 19th century. While the landmark Paris agreement aims to limit warming to 1.5 to 2 degrees Celsius, global temperatures are on track to grow to between 2 and 3 degrees C by the end of the century.

The IPCC's lengthy report is packed with evidence of how rising temperatures are putting biodiversity and ecosystems at risk — but the following five figures stand out. Each is a reminder of what we have to lose and how much we can gain if governments and companies dramatically cut their carbon emissions.

14 percent of all species living on land are at risk of going extinct

Global warming is taking a bigger toll on wildlife than we previously thought, a new IPCC report shows.

CHEMWATCH
Bulletin Board
Curiosities
MAR. 11, 2022

If the planet warms by 1.5 degrees Celsius — which is almost certain — up to 14 percent of all plants and animals on land will likely face a high risk of extinction, according to the report. The outlook becomes graver if temperatures rise even further; with 3 degrees of warming, for example, up to 29 percent of species on land could face extinction.

In the next few decades, some plants and animals will likely experience temperatures "beyond their historical experience," especially those that live in polar regions, the authors wrote. Even 1.2 degrees Celsius of warming — just above current levels — puts many ecosystems at risk from heatwaves, drought, and other climate extremes, they added.

Climate change is likely to take a greater toll on animals that are found only in one location, known as endemic species.

47 percent of species have already lost some of their populations due to climate change

Global warming has already extinguished local populations of many creatures — roughly half of the 976 species that one researcher studied in 2016. The American pika, for example, has disappeared from a large swath of its former habitat in the Sierra Nevada mountains in California, likely due to climate change, according to a 2017 study. Adapted to cool weather, these small mammals are especially vulnerable to unusually warm weather.

In 2005, heatwaves decimated a subspecies of lemuroid ringtail possum, a rare marsupial, in Queensland, Australia, according to the report. And rising seas and storm surges were likely behind the recent extinction of an Australian rodent called the Bramble Cay melomys.

Just last summer, scorching temperatures killed hundreds of millions of marine animals in the Pacific Northwest, from sea stars to mussels. They also threatened millions of young salmon — fish with intricate and important ties to Indigenous tribes. These kinds of species losses are worse in the tropics and in freshwater ecosystems, the authors write.

Half of all species have moved toward the poles or up mountains

Climate change is also reorganizing entire ecosystems. To escape deadly temperatures, plants and animals are moving to (once) colder climates — that is, toward the poles, up mountainsides, or into deeper water.

Roughly half of all species studied have moved toward the poles or to a higher elevation, according to the report. Those shifts are especially

noticeable at sea, where they've traveled on average 59 kilometers (37 miles) per decade poleward, according to the report. Large numbers of Atlantic mackerel, for example, have moved from waters near the UK and Scandinavia to Iceland, spurring geopolitical tensions related to fishing rights.

The warming climate is changing animals in other ways, too. A large number of studies, for example, suggests that it's making many species smaller.

Coral reefs could decline by 90 percent

Climate scientists have an especially grim prognosis for coral reefs: Just 1.5 degrees Celsius of warming could destroy up to 90 percent of tropical coral reefs, which are home to an incredible diversity of organisms and form the basis of many fisheries.

Global warming hits reefs with a double-punch. Oceans absorb a third or more of the carbon dioxide that enters the atmosphere, which makes them more acidic over time. That's bad news for reefs — as is unusually warm water. Rising ocean temperatures can cause coral to eject the algae that live harmoniously with them, in a process known as bleaching. Bleached coral is more likely to die.

"Almost all coral reefs will degrade from their current state, even if global warming remains below 2 degrees C," the researchers wrote. "Their global decline shows that we don't need to look into the future to recognize the urgency of climate action."

Climate change will make 8 percent of the world's farmland "unsuitable" by 2100

The impact of climate change on food production is equally troubling. According to the report, just 1.6 degrees C of warming this century will make 8 percent of today's farmland "climatically unsuitable." And by 2100, there will be more, not fewer, mouths to feed globally.

The decline of fish caused by climate change also puts food security at risk, because so many coastal communities worldwide depend on fisheries. Scientists project that in tropical Africa, people will lose up to 41 percent of their fisheries' yield by the end of the century "due to local extinctions of marine fish," under 1.6 degrees Celsius of warming. "Declining fish harvests could leave millions of people vulnerable to malnutrition," the authors wrote.

CHEMWATCH
Bulletin Board
Curiosities
MAR. 11, 2022

Climate change is also threatening varieties of coffee, chocolate, and other foods we love.

How to slow the extinction crisis

Later this year, government officials from around the world will meet to hammer out a global deal to prevent the loss of biodiversity. The deal — which is part of an international treaty called the Convention on Biological Diversity — is likely to include a commitment to conserve at least 30 percent of all land and seas by 2030.

According to the IPCC authors, reaching that target would make ecosystems healthier and offset much of the damage that climate change is causing. "Healthy ecosystems are more resilient to climate change and provide life-critical services such as food and clean water," said Hans-Otto Pörtner, who co-chairs IPCC's Working Group II, which published the report.

But ultimately, to protect nature, companies and governments — and, to a lesser extent, individuals — will have to reduce their emissions, and fast. "Any further delay in concerted global action," Pörtner said, "will miss a brief and rapidly closing window to secure a livable future."

Vox, 1 March 2022

https://vox.com

How can computer engineering predict the future of gene synthesis?

2022-03-03

Computer programming and gene synthesis appear to share little in common. But according to University of Cincinnati professor Andrew Steckl, an Ohio Eminent Scholar, leaps forward in technology in the former make him optimistic that wide scale gene manufacture is achievable.

Steckl and his student, Joseph Riolo, used the history of microchip development and large scale computer software platforms as a predictive model to understand another complex system, synthetic biology. Steckl said the project was inspired by comments by another student in his group, Eliot Gomez.

"No analogy is perfect. DNA doesn't meet certain definitions of digital code," Riolo said, "but there are a lot of ways the genome and software code are comparable."

"No analogy is perfect. DNA doesn't meet certain definitions of digital code," Riolo said, "but there are a lot of ways the genome and software code are comparable."

Their analysis was published in the journal *Scientific Reports*.

According to the UC study, synthetic biology has the potential to be "the next epochal technological human advancement following microelectronics and the internet." Its applications are boundless, from creating new biofuels to developing new medical treatments.

Scientists at the J. Craig Venter Institute created the first synthetic organism in 2010 when they transplanted an artificial genome of Mycoplasma mycoides into another bacterial cell. This relatively simple artificial genome took 15 years to develop at a cost of more than $40 million.

But by using computer chip development as a guide, Steckl said we can infer the speed and costs of producing similar synthetic life might follow a similar trajectory as the performance and cost of electronics over time.

The article highlights the comparison and similarities between biological and digital coding languages in terms of alphabet, words and sentences. However, the authors underline that DNA coding—the combinations of adenine, guanine, thymine and cytosine that make up a genome—only tells part of the complex story of genes and omits things like epigenetics.

"Second, the functionality of bio-organisms can be described as bottom-up, distributed, self-replicating and nondeterministic; whereas, computer system design and functionality is top-down, concentrated, not (yet) self-replicating and deterministic," the study said.

"There are all kinds of caveats, but we need a zero-order comparison to start down this road," said Steckl, a distinguished research professor who holds joint appointments in electrical engineering, biomedical engineering and materials engineering in UC's College of Engineering and Applied Science.

"Can we compare the complexity of programming a fighter plane or Mars rover to the complexity associated with creating a genome of a bacterium?" Steckl asked. "Are they of the same order or are they significantly more complicated?

"Either biological organisms are way more complicated and represent the most complicated 'programming' that has ever been done—so there's no way you can duplicate it artificially—or perhaps they're of the same order as creating the coding for an F-35 fighter plane or a luxury car, so maybe it is possible."

CHEMWATCH
Bulletin Board
Curiosities
MAR. 11, 2022

Moore's Law is a predictive model for the advancement of computer chips. Named for computer scientist Gordon Moore, co-founder of Intel, it suggests that advances in technology allow for exponential growth of transistors on a single computer chip.

And 55 years since Moore drafted his theory, we're still seeing it at work in three-dimensional microchips, even if the advances provide smaller benefits in performance and power reduction than previous leaps forward.

Since 2010, the study said, the price of editing genes and synthesizing genomes has roughly halved every two years in much the way Moore's Law suggests.

"This would mean that synthesizing an artificial human genome could cost approximately 1 million dollars and simpler applications like a custom bacterium could be synthesized for as little as $4,000," the authors said in the study.

"This combination of surmountable complexity and moderate cost justifies the academic enthusiasm for synthetic biology and will continue to inspire interest in the rules of life," the study concluded.

Likewise, Steckl said bio-engineering could become integral to virtually every industry and science in much the same way computer science evolved from a niche discipline to a critical component of most every science.

"I see a correlation between how computing has evolved as a discipline. Now you see heavy-duty computing in every science discipline," Steckl said. "I see something similar happening in the world of biology and bio-engineering. Biology is everywhere. It will be interesting to see how these things evolve."

Both Steckl and Riolo agree that the ability to create artificial life does not necessarily carry the burden or moral authority to do so.

"It's not something to be taken lightly," Steckl said. "It's not as simple as we should do it because we can do it. One should also consider the philosophical or even religious implications."

Phys Org, 3 March 2022

https://phys.org

What explains our lower back pain? Anthropologists turn to Neandertals for answers

2022-03-03

Examining the spines of Neandertals, an extinct human relative, may explain back-related ailments experienced by humans today, a team of anthropologists has concluded in a new comparative study.

The analysis centers on the spine's curvature, which is caused, in part, by a wedging, or angling, of vertebrae and the intervertebral discs—the softer material between the vertebrae.

"Neandertals are not distinct from modern humans in lumbar wedging and therefore likely possessed curved lower backs like we do," explains Scott Williams, an associate professor in New York University's Department of Anthropology and one of the authors of the paper, which appears in the journal PNAS Nexus. "However, over time, specifically after the onset of industrialization in the late 19th century, we see increased wedging in the lower back bones of today's humans—a change that may relate to higher instances of back pain, and other afflictions, in postindustrial societies."

Neandertals have long been thought to have a different posture than modern humans.

"A good part of this perspective derives from the wedging of Neandertals' lumbar, or lower, vertebrae—their spines in this region curve less than those of modern humans studied in the U.S. or Europe," explains Williams.

However, much of this view was based on an analysis of modern humans beginning in the late 19th century—well after the onset of industrialization, which significantly altered our daily lives. Furniture, for instance, became more widely available and desk jobs more prevalent—both of which encouraged sitting and, with it, changes in posture. These changes were coupled with a reduction in high-activity occupations, such as agriculture. In addition, specific afflictions became associated with working conditions that elicit poor posture.

"Past research has shown that higher rates of low back pain are associated with urban areas and especially in 'enclosed workshop' settings where employees maintain tedious and painful work postures, such as constantly sitting on stools in a forward leaning position," Williams observes.

In other words, by examining spines from humans who lived in the post-industrial era, past researchers may have mistakenly concluded that spine

The analysis centers on the spine's curvature, which is caused, in part, by a wedging, or angling, of vertebrae and the intervertebral discs—the softer material between the vertebrae.

CHEMWATCH
Bulletin Board
Curiosities
MAR. 11, 2022

formation is due to evolutionary development rather than changed living and working conditions.

To address this possibility, Williams and his colleagues examined both pre-industrial and post-industrial spines of male and female modern humans from around the world—a sample that included more than 300 spines, totaling more than 1,600 vertebrae—along with samples of Neandertal spines.

Overall, they found that spines in post-industrial people showed more lumbar wedging than did those in pre-industrial people. Moreover, Neandertals' spines were significantly different from those in post-industrial people but not from pre-industrial people. Notably, the scientists found no differences linked to geography within samples from the same era.

"A pre-industrial vs. post-industrial lifestyle is the important factor," explains Williams, who acknowledges that because lower back curvature is made up of soft tissues (i.e., intervertebral discs), not just bones, it cannot be ascertained that Neandertals' lumbar lordosis differed from modern humans.

"The bones are often all that is preserved in fossils, so it's all we have to work with," he adds.

Nonetheless, the distinctions in spine formation between pre-industrial and post-industrial humans offer new insights into back conditions facing many today.

"Diminished physical activity levels, bad posture, and the use of furniture, among other changes in lifestyle that accompanied industrialization, resulted, over time, in inadequate soft tissue structures to support lumbar lordosis during development," Williams says. "To compensate, our lower-back bones have taken on more wedging than our pre-industrial and Neandertal predecessors, potentially contributing to the frequency of lower back pain we find in post-industrial societies."

The study also included researchers from the University of Johannesburg, Texas A&M University, the New York Institute of Technology, Arizona State University, and Chaffey College, along with Monica Alivez, an NYU doctoral student, and Saul Shukman, an NYU undergraduate student.

Phys Org, 3 March 2022

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CHEMWATCH

Bulletin Board

Technical Notes

MAR. 11, 2022

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

CHEMICAL EFFECTS

In vivo neurophysiological assessment of in silico predictions of neurotoxicity: Citronellal, 3,4-dichloro-1-butene, and benzyl bromoacetate

Impact of Contaminants on Microbiota: Linking the Gut-Brain Axis with Neurotoxicity

The abundance of endocrine-disrupting chemicals (EDCs) in downstream of the Bengawan Solo and Brantas rivers located in Indonesia

Aggregating exposures and toxicity equivalence approach into an integrated probabilistic dietary risk assessment for perchlorate, nitrate, and thiocyanate: Results from the National food monitoring study and National Food Consumption Database

ENVIRONMENTAL RESEARCH

Effects of African BaP emission from wildfire biomass burning on regional and global environment and human health

Environmental disruption of reproductive rhythms

Towards a toxic-free environment: perspectives for chemical risk assessment approaches

PHARMACEUTICAL/TOXICOLOGY

The influences of perfluoroalkyl substances on the rheumatoid arthritis clinic

OCCUPATIONAL

Occupational exposure in the work process of radiology technologists with 68 Ga-labeled radiopharmaceuticals

Perceptions of Occupational Cancer Risk and Prevention Among Dominican Republic Firefighters: A Qualitative Study