CHEMWATCH

Bulletin Board

Contents

DEC. 10, 2021

(click on page numbers for links)

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Contents

DEC. 10, 2021

CHEMWATCH
Bulletin Board
Contents
DEC. 10, 2021

ASIA PACIFIC

Rules amendments and regulatory changes from 23 November 2021

2021-11-22

Outcome of consultation on proposed amendments to the Rules

Between 23 August 2021 and 17 September 2021, we asked for your feedback regarding proposed amendments to the Industrial Chemicals (General) Rules 2019 and the Industrial Chemicals (Consequential Amendments and Transitional Provisions) Rules 2019.

After considering stakeholder feedback, the General and Transitional Rules were amended by the Minister – the Industrial Chemicals (General) Legislation Amendment (2021 Measures No. 1) Rules 2021 **(referred to as 'amending rules')**.

This document summarises:

- feedback that we received during public consultation
- outcome of each proposed amendment after considering stakeholder feedback
- the resultant changes that are prescribed in the amending rules

Download:

Summary of feedback on Rules amendments - 22 November 2021 [646 KB PDF]

Read More

Outcome of consultation on proposed amend-ments to the Rules .

AICIS, 22 November 2021

https://www.industrialchemicals.gov.au/news-and-notices/rules-amendments-and-regulatory-changes-23-november-2021

CHEMWATCH
Bulletin Board
Regulatory Update
DEC. 10, 2021

Guide to categorising your chemical importation and manufacture

2021-11-23

All industrial chemical importers and manufacturers must categorise their chemical introduction. This step-by-step guide takes you through the process of categorisation.

Drawing on information in the IC Act, General Rules and the Industrial Chemicals Categorisation Guidelines, this practical step-by-step guide with supporting self-guided decision tools helps you categorise your chemical introduction as **listed** or **exempted** or **reported** or **assessed**.

In this guide

- Before you start categorising your introduction
- Step 0: Introductions that are in the listed category
- Step 1: Introductions that cannot be exempted or reported
- Step 2: Introductions that are automatically categorised as exempted
- Step 3: Introductions that are automatically categorised as reported
- Step 4: Work out your introduction's risk to human health
- Step 5: Work out your introduction's risk to the environment
- Step 6: Complete your categorisation
- Appendix - In silico predictions for categorisation
- Appendix - acceptable test guidelines for categorisation

Read More

This step-by-step guide takes you through the process of categorisation.

AICIS, 23 November 2021

https://www.industrialchemicals.gov.au/help-and-guides/guide-categorising-your-chemical-importation-and-manufacture

Evaluation notice for DBDPE – 22 November 2021

2021-11-22

We have completed an evaluation about the environmental risks associated with the introduction and use of Benzene, 1,1′-(1,2-ethanediyl) bis[2,3,4,5,6-pentabromo- (also known as decabromodiphenylethane or DBDPE), which is currently under an assessment certificate (Certificate No.: 9258).

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: Benzene, 1,1′-(1,2-ethanediyl)bis[2,3,4,5,6-pentabromo- (also known as decabromodiphenylethane or DBDPE)

CAS number: 84852-53-9

Evaluation outcomes: Recommendation to cancel the assessment certificate; recommendation to review the categorisation criteria in the Industrial Chemicals (General) Rules 2019 and the definitions in the Industrial Chemicals Categorisation Guidelines 2020.

Download:

EVA00072 Evaluation statement 18 November 2021 [394 KB].pdf

Read More

AICIS, 22 November 2021

https://www.industrialchemicals.gov.au/news-and-notices/evaluations-notice-dbdpe-22-november-2021

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

CHEMWATCH
Bulletin Board
Regulatory Update
DEC. 10, 2021

AMERICA

EPA announces extension of emerging viral pathogens guidance for COVID-19

2021-11-25

On November 19, 2021, the U.S. Environmental Protection Agency (EPA) announced that it is extending COVID-19 activation of the emerging viral pathogens (EVP) guidance for antimicrobial pesticides indefinitely. EPA states that its EVP guidance for antimicrobial pesticides is a part of the federal government's pandemic preparedness, allowing manufacturers to provide EPA with data, even in advance of an outbreak, demonstrating that their products are effective against hard-to-kill viruses.

EPA activated its EVP guidance for antimicrobial pesticides for the first time in January 2020 in response to the emergence of SARS-CoV-2. EPA has allowed for expedited review and approval of surface disinfectant products for use against SARS-CoV-2 for more than 12 months, including accelerated review for products seeking to add EVP claims to product labels. To date, EPA has added 591 products with emerging viral pathogens claims to its list of Disinfectants for Coronavirus (List N).

EPA states that registrants must remove EVP claims from consumer messaging no later than 24 months after the original notification of the outbreak, unless directed otherwise by EPA. With this extension, EPA will now provide a notification at least six months before inactivating the EVP guidance for SARS-CoV-2 to allow registrants time to adjust product marketing materials as required.

Read More

National Law Review, 25 November 2021

https://www.natlawreview.com/article/epa-announces-extension-emerging-viral-pathogens-guidance-covid-19

ICYMI: EPA takes a big science step towards setting a drinking water standard for PFOA and PFOS and the implications are much broader

2021-11-23

Last week, EPA transmitted four important documents to the EPA Science Advisory Board (SAB) for peer review that included updated health assessments for perfluorooctanoic acid (PFOA) and perfluorooctane

The transmitted documents propose new (and lower) allowable levels for ingestion of PFOA and PFOS.

sulfonic acid (PFOS). This peer review, which will start on December 16, will inform EPA's development of a Maximum Contaminant Level (MCL) Goal and a future, legally enforceable National Primary Drinking Water Regulation for PFOA and PFOS under the Safe Drinking Water Act. As noted in the PFAS Strategic Roadmap: EPA's Commitments to Action 2021-2024, EPA intends to release a proposed drinking water regulation for PFOA and PFOS in fall 2022. These scientific documents will provide the underpinnings for that important regulation.

The transmitted documents propose new (and lower) allowable levels for ingestion of PFOA and PFOS. Once the peer review is complete, these assessments will also inform updated health advisories for PFOA and PFOS, which will be used to inform EPAs preliminary remediation goals (PRGs) for contaminated groundwater that is a current or potential source of drinking water. This can include sites being evaluated and addressed under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA or Superfund) and the Resource Conservation and Recovery Act (RCRA) corrective action program. Thus, the implications are broad and this review will be one worth watching.

Read More

The National Law Review, 23 November 2021

https://www.natlawreview.com/article/icymi-epa-takes-big-science-step-towards-setting-drinking-water-standard-pfoa-and

Sea level rise could threaten hundreds of toxic sites in California

2021-11-30

What worries him most are the three power plants looming over the Oxnard coast, and the toxic waste site that has languished there for decades. There are also two naval bases, unknown military dumps and a smog-spewing port. Just one flood could unleash a flow of industrial chemicals and overwhelm his working-class, mostly Latino community.

"The coast of California is marked by massive inequality. People don't realize that because they go to Malibu, they go to Santa Barbara. Those are the beaches that people see and are familiar with," said Zucker, a longtime advocate for environmental justice. "They don't think of places like Wilmington, West Long Beach, Barrio Logan, West Oakland, Richmond,

Just one flood could unleash a flow of industrial chemicals and overwhelm his working-class, mostly Latino community.

CHEMWATCH
Bulletin Board
Regulatory Update
DEC. 10, 2021

Bayview-Hunters Point. You can name all these communities, and it's the same story."

These predominately Black and brown communities, in fact, are five times more likely than the general population to live within half a mile of a toxic site that could flood by 2050, according to a new statewide mapping project led by environmental health professors at UC Berkeley and UCLA. All told, the ocean could inundate more than 400 hazardous facilities by the end of the century — exposing nearby residents to dangerous chemicals and polluted water.

Read More

KTLA, 30 November 2021

https://ktla.com/news/california/sea-level-rise-could-threaten-hundreds-of-toxic-sites-in-california/

Miami to deplot network of air quality monitoring sensors

2021-11-30

The information gathered will be used to detect pollution hotspots and provide a database of environmental analytics to help protect the health of Miami's inhabitants.

The City of Miami, Florida, has partnered with PlanetWatch to deploy an air quality monitoring network across the city.

This deployment will be the company's first large-scale project in the US and follows the integration of its technology in several European cities.

Green data

PlanetWatch's decentralised indoor and outdoor air quality monitoring network is built on the Algorand blockchain. So-called 'PlanetWatchers'

This deployment will be the company's first large-scale project in the US and follows the integration of its technology in several European cities.

will host the air quality sensors to collect green data that will be transcribed onto the Algorand blockchain.

Contributors will then receive 'Planets' tokens as compensation. The information will be used to detect pollution hotspots and provide a database of environmental analytics to help protect the health of Miami's inhabitants.

The project will build upon the City's commitments made as part of its "Miami Forever Climate Ready" initiative.

"Miami is striving to become a green city through policies like the 'Miami Forever Climate Ready' initiative, and it is hugely exciting that innovators like PlanetWatch and Algorand are coming here to implement major sustainable technology in the US," said Francis Suarez, mayor.

Read More

Smart Cities World, 30 November 2021

https://www.smartcitiesworld.net/news/news/miami-to-deploy-network-of-air-quality-monitoring-sensors-7188

EUROPE

Publications of BG mandatory classification and labelling (GB MCL) technical reports

2021-12-01

A GB MCL technical report is an independent scientific evaluation of the information submitted under the stand-alone GB MCL process or as part of the EU harmonised classification and labelling process.

It sets out whether there is adequate scientific evidence to support a new or revised GB MCL of a substance and what that GB MCL should be.

A new batch of ten GB MCL technical reports is now available for download at the end of the GB MCL publication table.

CHEMWATCH
Bulletin Board
Regulatory Update
DEC. 10, 2021

A new batch of ten GB MCL technical reports is now available for download at the end of the GB MCL publication table.

These GB MCL technical reports relate to substances for which the Committee for Risk Assessment (RAC) published a RAC Opinion under Article 37(4) of EU CLP during 2021, based on information submitted under the EU CLP Regulation. The scientific information supporting the RAC Opinion is evaluated under the GB MCL system.

At the time of publication, the classification and labelling proposed in these technical reports has not been agreed and/or adopted in Great Britain.

For information on the next steps in the process, please see our webpage on the GB MCL system.

We expect to publish our next batch of technical reports in January 2022. CLP eBulletin alerts will be issued when technical reports are published on the HSE website.

Read More

HSE, 1 December 2021

https://www.hse.gov.uk/chemical-classification/index.htm

SCCS considers HAA299 (Nano) safe when used as a UV filter in dermally applied cosmetic products up to ten percent

2021-11-30

The Scientific Committee on Consumer Safety (SCCS) published its final opinion on HAA299 (nano) on November 25, 2021. The European Commission (EC) asked SCCS whether HAA299 (nano) is considered safe when used as an ultraviolet (UV) filter in cosmetic products up to a maximum concentration of ten percent. According to the final opinion,

The European Commission (EC) asked SCCS whether HAA299 (nano) is considered safe when used as an ultraviolet (UV) filter in cosmetic products up to a maximum concentration of ten percent.

SCCS considers that HAA299 (nano) as covered within the provided characteristics "is safe when used as a UV-filter in dermally-applied cosmetic products up to a maximum concentration of 10%." The final opinion states that based on the inflammatory effects on the lung after acute inhalation exposure, SCCS has concerns regarding the repeated use of products containing HAA299 (nano) in applications that could lead to inhalation exposure and does not recommend the use of HAA299 (nano) in applications that could lead to exposure of consumers' lungs via inhalation. SCCS based its opinion on the currently available data that show "an overall very low or lack of dermal absorption of HAA299 (nano) in human skin." If any new evidence shows that HAA299 (nano) used as a UV filter in cosmetic products can penetrate human skin (healthy, compromised, sunburned, or damaged) to reach viable cells in higher levels than demonstrated in this submission, SCCS may consider revising the assessment.

Read More

Nano and Other Emerging Chemical Technologies Blog

https://nanotech.lawbc.com/2021/11/sccs-considers-haa299-nano-safe-when-used-as-a-uv-filter-in-dermally-applied-cosmetic-products-up-to-ten-percent/

EU's greenhouse gases rise by nearly a fifth on economic rebound - Eurostat

2021-11-30

Greenhouse gas emissions from European Union countries jumped 18% last spring, according to data from the bloc's statistics office, as all economic sectors released more harmful gases into the atmosphere as they recovered from pandemic shutdowns.

Eurostat said emissions totalled 867 million tonnes of CO2 equivalents from April to June, up sharply from the same period last year when lockdowns across the region brought emissions to their lowest levels ever recorded.

…[E]missions totalled 867 million tonnes of CO2 equivalents from April to June[.]

However, it added that levels remained below any pre-pandemic quarter and continued a long-term trend of steady reduction.

The manufacturing and construction sector - responsible for more than a third of emissions, the largest share - saw levels jump 22% from 2020,

CHEMWATCH
Bulletin Board
Regulatory Update
DEC. 10, 2021

while the electricity supply sector rose 17% and agriculture remained steady.

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highlighting, single space unless double space needed)

Reuters, 30 November 2021

https://www.reuters.com/markets/europe/eus-greenhouse-gases-rise-by-nearly-fifth-economic-rebound-eurostat-2021-11-29/

INTERNATIONAL

Determination of PFAS in the environment

2021-11-21

A new ASTM International standard will help laboratories to better determine the presence of polyfluoroalkyl substances (PFAS) in environmental samples. ASTM's committee on environmental assessment, risk management and corrective action (E50) developed the new standard.

PFAS are a large, complex group of compounds found in water, air, fish, and soil throughout the world. Additionally, some consumer, commercial, and industrial products contain PFAS. These widely used chemicals persist, breaking down slowly. The ongoing, expanding nature of PFAS environmental awareness and the need for more comprehensive investigations have caused increased demand for PFAS environmental sampling and analysis.

"The new guide will assist users in navigating environmental sample analytical test methods for both targeted and non-targeted analytical approaches, as well as additional protocols applicable to PFAS," says ASTM International member Eileen Snyder.

According to Snyder, the new standard (E3302) will assist a wide range of users, including testing laboratories, remediation professionals, data reviewers, state and federal regulators, tribes, international organizations, water treatment systems, industrial dischargers, and more.

PFAS are a large, complex group of compounds found in water, air, fish, and soil throughout the world.

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ASTM International, 21 November 2021

https://sn.astm.org/?q=update/determination-pfas-environment-jf22.html

Evidence of climate change is all around us. But when presented in data and graphs, it can feel disconnected from real life.

2021-11-30

"It's hard to understand exactly what a degree of temperature change or a few millimeters of sea-level rise might mean to someone's lived experience," says journalist Devi Lockwood.

So she spent five years traveling the world, talking to people about how rising seas and extreme weather affect their lives.

An elder in the Arctic Canadian community of Igloolik told Lockwood that melting sea ice makes it harder to hunt walrus and seal.

A mother on the island of Tuvalu described how, during a drought, she had to choose between using her water rations for drinking or bathing her baby.

And the son of farmers in Thailand explained that he moved to the city to find work because erratic rainfall has made rice farming less reliable.

Lockwood collected these and other stories in her new book, "1,001 Voices on Climate Change."

"My hope is that reading this book makes people feel more connected to the issues and better able to understand how climate change is impacting people's daily lives around the world," she says.

And she hopes that humanizing the issue can help inspire people to get engaged and take action.

Read More

Yale Climate Connections, 30 November 2021

https://yaleclimateconnections.org/2021/11/1001-firsthand-stories-of-climate-change-from-around-the-world/

An elder in the Arctic Canadian community of Igloolik told Lockwood that melting sea ice makes it harder to hunt walrus and seal.

ECHA: New substance evaluation conclusions published

2021-11-30

Under ECHA, there is a Substance Evaluation table associated with the Community rolling action plan (CoRAP). If a substance is on this list, it means that a Member State has evaluated or will evaluate the substance in the coming years. CoRAP was last updated November 22, 2021 and contains 384 unique substances/entries.

Germany completed the evaluations for the three substances below.

The three substances were originally added to the CoRAP list in 2015.

New documents are now available for:

- m-xylene (EC 203-576-3, CAS 108-38-3);
- o-xylene (EC 202-422-2, CAS 95-47-6); and
- p-xylene (EC 203-396-5, CAS 106-42-3).

CoRAP was last updated November 22, 2021 and contains 384 unique substances/entries.

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SCHC Monthly Newsletter, 30 November 2021

https://schc.memberclicks.net/assets/news_items/newsletters/newsletter_2021/SCHC_NOV_2021_NEWSLETTER.pdf

UK REACH – PFAS RMOA – Call for evidence

2021-12-03

Overview

The UK, Welsh and Scottish Governments have asked HSE and the Environment Agency to prepare a regulatory management options analysis (RMOA) for per- and polyfluoroalkyl substances (PFAS). This RMOA will investigate the risks posed by PFAS and recommend the best approach to protect human health and the environment from any identified risks. This call for evidence aims to gather information and evidence

that will support HSE and the Environment Agency with the preparation of the RMOA. We are interested in all aspects of the manufacture, import, hazard profile, use and exposure; these include environmental fate, waste and its disposal requirements, recycling opportunities for these substances and products that contain these substances, and any legislation and standards that apply, including product-specific legislation and standards.

UK REACH came into force at the end of the EU exit transition period (31st December 2020) and regulates the access of chemicals to the GB market. Under the Northern Ireland Protocol, EU REACH continues to regulate the access of chemicals to the Northern Ireland market.

Please support your contribution with references and reliable data (facts and figures).

Background note

PFAS have a wide range of industrial, professional and consumer uses including:

- As chemical intermediates and processing aids for fluoropolymer production
- In surface coatings for textiles, food contact materials and packaging
- In cleaning agents, paints, varnishes, polishes and waxes
- In lubricants
- In pharmaceuticals, cosmetics, medical devices and products
- In the electronics and energy production sectors
- In construction materials, including as polymers
- In heat exchange systems
- In fire suppression systems and in fire-fighting foams
- In mist suppressants for metal plating

All articles, mixtures or substances that intentionally contain PFAS and that are used or marketed in Great Britain are within the scope of this call for evidence. We ask respondents to follow the OECD definition of PFAS:

Fluorinated substances that contain at least one fully fluorinated methyl or methylene carbon atom (without any H/Cl/Br/I atom attached to it), i.e., with the noted exceptions, any chemical with at least a perfluorinated methyl group (–CF3) or a perfluorinated methylene group (–CF2–) is a PFAS.

CHEMWATCH
Bulletin Board
REACH Update
DEC. 10, 2021

If you are unsure whether the substance you are providing information for is a PFAS, please submit your information anyway.

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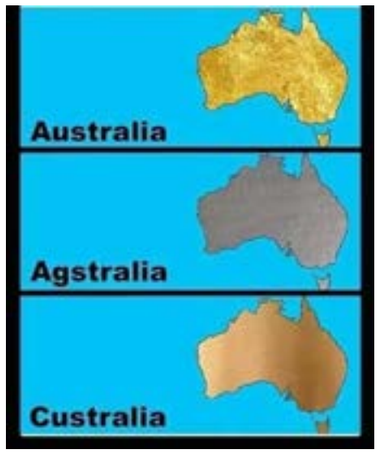
HSE, 3 December 2021

https://consultations.hse.gov.uk/crd-reach/pfas-rmoa-001

AUstralia

2021-12-10



https://www.instagram.com/p/B5_UB1qHtbG/?hl=en

Acrylonitrile

2021-12-10

Acrylonitrile is the chemical compound with the formula C_3H_3N. This pungent-smelling colourless liquid often appears yellow due to impurities. It is an important monomer for the manufacture of useful plastics. In terms of its molecular structure, it consists of a vinyl group linked to a nitrile. [1] Acrylonitrile is soluble in water and most common organic solvents such as acetone, benzene, carbon tetrachloride, ethyl acetate, and toluene. It is a reactive chemical that polymerises spontaneously when heated, or in the presence of a strong alkali, and can explode when exposed to flame. Technical grade acrylonitrile is more than 99% pure and always contains a polymerisation inhibitor, usually methylhydroquinone. It is incompatible and reactive with strong oxidisers, acids and alkalis; bromine; and amines. It attacks copper. [2]

USES [2]

Acrylonitrile is used in manufacturing acrylic fabrics and carpets. It is used extensively in the manufacture of synthetic fibres, resins, plastics, elastomers, and rubber for a variety of consumer goods such as textiles, dinnerware, food containers, toys, luggage, automotive parts, small appliances, and telephones. It is also used in fumigants. [2]

Acrylonitrile is the chemical compound with the formula C3H3N.

ACRYLONITRILE IN THE ENVIRONMENT [3]

- Acrylonitrile may be found in the soil, water, or air near industrial sites where it is made, or at hazardous waste sites where it has been disposed of.
- Because acrylonitrile evaporates easily, most of it is released to the air from facilities where it is produced and used.
- In air, acrylonitrile breaks down quickly (about half will disappear within 5 to 50 hours) by reacting with other chemicals and sunlight.
- Acrylonitrile can enter groundwater by filtering through the soil, but it is not commonly found in groundwater.
- It is broken down by bacteria in surface water.
- When it is released to soil, some of it will be broken down by bacteria, but most of it will evaporate to the air or filter to groundwater.
- Acrylonitrile does not build up in the food chain.

SOURCES OF EMISSION & ROUTES OF EXPOSURE

Sources of Emission [2]

- Industry sources: The primary stationary sources are likely to be synthetics, paint, and furniture and fixtures manufacturing facilities where this chemical is used.
- Diffuse sources: Sub-threshold facilities. Acrylonitrile is present in cigarette smoke.
- Natural sources: Acrylonitrile is not known to occur as a natural product.
- Transport sources: Acrylonitrile can be found in car exhaust.
- Consumer products: Acrylonitrile is used as an intermediate in the manufacture of a wide range of consumer products, but undergoes chemical reaction to different substances during the manufacturing process.

Routes of Exposure [3,4]

Exposure routes for acrylonitrile include: inhalation, skin absorption, ingestion, skin and/or eye contact.

Exposure can occur via the following:

- Breathing contaminated air near hazardous waste sites that contain acrylonitrile.
- Working in, or living near, industries where it is manufactured or used.
- Swallowing food and water that contains small amounts of acrylonitrile.

HEALTH EFFECTS [5]

Acute Effects

- Workers exposed via inhalation to high levels of acrylonitrile for less than an hour experienced mucous membrane irritation, headaches, nausea, feelings of apprehension and nervous irritability; low grade anaemia, leukocytosis, kidney irritation, and mild jaundice were also observed in the workers, with these effects subsiding with the ending of exposure. Symptoms associated with acrylonitrile poisoning include limb weakness, laboured and irregular breathing, dizziness and impaired judgment, cyanosis, nausea, collapse, and convulsions. (1-4)

CHEMWATCH
Bulletin Board
Hazard Alert
DEC. 10, 2021

- A child died after being exposed to acrylonitrile by inhalation, suffering from respiratory malfunction, lip cyanosis, and tachycardia before death. Several adults exposed to the same concentration of acrylonitrile exhibited eye irritation, but no toxic effects. (1,4)
- Acute dermal exposure may cause severe burns to the skin in humans. (3)
- Acute animal tests in rats, mice, rabbits, and guinea pigs have demonstrated acrylonitrile to have high acute toxicity from inhalation and high to extreme acute toxicity from oral or dermal exposure. (5)

Chronic Effects

- In one study, headaches, fatigue, nausea, and weakness were frequently reported in chronically (long-term) exposed workers.
- In rats chronically exposed by inhalation, degenerative and inflammatory changes in the respiratory epithelium of the nasal turbinates and effects on brain cells have been observed.
- The Reference Concentration (RfC) for acrylonitrile is 0.002 milligrams per cubic metre (mg/m^3) based on degeneration and inflammation of nasal respiratory epithelium in rats.
- EPA has calculated a provisional Reference Dose (RfD) of 0.001 milligrams per kilogram body weight per day (mg/kg/d) for acrylonitrile based on decreased sperm counts in mice. The provisional RfD is a value that has had some form of Agency review, but it does not appear on IRIS.

Reproductive/Developmental Effects

- No information is available on the reproductive or developmental effects of acrylonitrile in humans.
- Foetal malformations (including short tail, missing vertebrae, short trunk, omphalocele, and hemivertebra) have been reported in rats exposed to acrylonitrile by inhalation.
- In mice orally exposed to acrylonitrile, degenerative changes in testicular tubules and decreased sperm count were observed.

Cancer Risk

- A statistically significant increase in the incidence of lung cancer has been reported in several studies of chronically exposed workers. However, some of these studies contain deficiencies such as lack of exposure information, short follow-up, and confounding factors.

- In several studies, an increased incidence of tumours has been observed in rats exposed by inhalation, drinking water, and gavage. Astrocytomas in the brain and spinal cord and tumours of the Zymbal gland (in the ear canal) have been most frequently reported, as well as tumours of the stomach, tongue, small intestine in males and females, and mammary gland in females.
- EPA has classified acrylonitrile as a Group B1, probable human carcinogen (cancer-causing agent).
- EPA uses mathematical models, based on human and animal studies, to estimate the probability of a person developing cancer from breathing air containing a specified concentration of a chemical. EPA calculated an inhalation unit risk estimate of 6.8 × 10-5 (µg/m3)-1.
- EPA has calculated an oral cancer slope factor of 0.54 (mg/kg/d)-1.

SAFETY [6]

First Aid Measures

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

CHEMWATCH
Bulletin Board
Hazard Alert
DEC. 10, 2021

unconscious person. Loosen tight clothing such as a collar, tie, belt or waistband. Get medical attention immediately.

Fire & Explosion Information

Acylonitrile is flammable. It has an auto-ignition temperature of 481.11°C (898°F). Its flash points are as follows: Closed Cup = -1.1111°C (30°F) and Open Cup is 0°C (32°F).

Acrylonitrile is highly flammable in presence of open flames and sparks, of heat and slightly flammable-to-flammable in presence of shocks. It is explosive in presence of oxidising materials, acids and alkalis. Dry chemical powder should be used to extinguish small fires and alcohol foam, water spray or fog should be used for large fires. In the presences of catalysts, or when the substance is confined, the polymerisation rate may be accelerated leading to explosion. Acrylonitrile forms explosive mixtures with air based on its low flash point. It easily forms violently explosive polymerides when exposed to heat, light, strong bases, strong acids, strong oxidisers, azoisobuytronitrile, dibenzoyl peroxide, di-tert-butylperoxide, bromine or silver nitrate. Acrylonitrile may explosive reactions with benzyltrimethylammonium hydroxide + pyrrole. It may also have explosive reactions with tetrahydrocarbazole + benzyltrimethylammonium hydroxide.

Exposure Controls & Personal Protection

Engineering Controls

- Provide exhaust ventilation or other engineering controls to keep the airborne concentrations of vapours below their respective threshold limit value.
- Ensure that eyewash stations and safety showers are proximal to the workstation location.

Personal Protective Equipment

The following personal protective equipment is recommended when handling acrylonitrile:

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

Personal Protection in Case of a Large Spill:

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

REGULATION

United States [3]

OSHA: The Occupational Safety and Health Administration has set a limit of 2 ppm over an 8-hour workday, 40-hour workweek.

NIOSH: The National Institute of Occupational Safety and Health (NIOSH) recommends that average workplace air should not exceed 1 part per million (1 ppm) acrylonitrile averaged over a 10-hour period.

EPA: The Environmental Protection Agency recommends that levels in lakes and streams should be limited to 0.058 parts of acrylonitrile per billion parts of water (0.058 ppb) to prevent possible health effects from drinking water or eating fish contaminated with acrylonitrile. Any release to the environment greater than 100 pounds of acrylonitrile must be reported to the EPA.

Australia [2]

Safe Work Australia: Safe Work Australia recommends an 8-hour time weighted average (TWA) exposure limit of 2 ppm (4.3 mg/m^3)

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Ancient footprints suggest famed human ancestor 'Lucy' had company

2021-12-01

Some 3.6 million years ago, an upright walking creature trudged through layers of freshly fallen volcanic ash in what today is northern Tanzania. When anthropologists uncovered five of its fossilized footprints nearly 50 years ago, they couldn't say whether this ancient biped was a hominin, a bear, or some other ape. Now, a new team claims to have solved this paleontological cold case, identifying the mystery walker as an unknown species of hominin. If true, this creature lived in the same place at the same time as the famed human ancestor, "Lucy." It would also offer a window into the early day of our distant ancestors' evolutionary forays into bipedalism.

Back in 1976, paleoanthropologists were combing a site called Laetoli in northern Tanzania's hill country for fossils. Two members of the team began playfully flinging dried elephant dung at each other. In the fracas, one jumped into a gully and spotted what appeared to be an animal footprint preserved in hardened volcanic ash. The team, led by famed paleoanthropologist Mary Leakey, eventually found tracks left by ancient elephants, hippopotamuses, and more, all later dated to 3.6 million years ago.

Five consecutive footprints stood out. They were semitriangular in shape, with a wide sole that narrowed toward the heel. Whatever left them walked on two legs, "somewhat shambling, with one foot crossing in front of the other," Leakey wrote.

At the time, nobody knew what to make of the impressions at what came to be called Site A, says Jeremy DeSilva, a paleoanthropologist at Dartmouth College and senior author of the new study. "They looked strange," DeSilva says. Leakey suggested they might have been made by a hominin, but other experts suggested they were bear prints. Bears do sometimes walk on two legs, and their feet strike the ground heel first, similar to humans.

Then in 1978, Leakey's team discovered dozens of fossil prints left by multiple individuals, about 1 kilometer away but in the same layer of volcanic ash. They bore little resemblance to the previously discovered tracks. In fact, these Site G tracks were "very similar to the kinds of footprints that you or I would make on a beach," DeSilva says. Many speculated they were left by close kin of the famous fossil hominin known

It would also offer a window into the early day of our distant ancestors' evolutionary forays into bipedalism.

as Lucy, a member of Australopithecus afarensis, a human ancestor that lived between 3.9 and 3 million years ago.

As for Site A tracks? "The field kind of forgot about them," DeSilva says.

One of DeSilva's former graduate students, Ellison McNutt, picked up the thread while working on her doctoral dissertation in the late 2010s. McNutt, now a medical anatomist at Ohio University's Heritage College of Osteopathic Medicine, had read about the bizarre Laetoli footprints and their proposed bear origin. A few miles up the road from Dartmouth lies the Kilham Bear Center, which rehabilitates orphaned black bear cubs. Why not compare the Laetoli Site A tracks to some actual bear tracks?

Working with the center's staff, McNutt built a mud-covered trackway and enticed four juvenile black bears—whose paws were approximately the same size as the Laetoli tracks—to walk upright across it to get either applesauce or a maple syrup treat. Then she measured the muddy bear prints, including stride length, gait pattern, and feet dimensions. Next, McNutt and colleagues compared those characteristics with a digital reconstruction of the Laetoli prints—the original casts made in 1976 were lost—and to previously collected data on human and chimpanzee feet and gait.

When the analysis was done, McNutt was confident a bear didn't leave the Laetoli Site A tracks. Bears have narrow heels and nearly equally sized toes, with exterior toes just slightly bigger than the others. The Laetoli tracks had broad heels and a prominent big toe. Bears also lack the hip or knee flexibility to cross their feet in front of one another, McNutt says. Chimps, too, lack that cross-stepping ability. The closest match, she says, is humans. Whatever left the Laetoli prints had feet "a little bit wider, with a little bit more extended big toe, than what we see in humans now."

DeSilva was convinced, but he knew others in the field would want more evidence. So, he and colleagues, including a researcher from Tanzania's Department of Cultural Heritage, returned to Laetoli and consulted Leakey's old maps to find and re-excavate Site A, which had been covered over the years by sediment washing down a hill. After digging through a few inches of debris, they found the footprints "beautifully preserved," DeSilva says.

New casts of the footprints reveal a prominent big toe adjacent to a smaller second toe. That's another strong indication it belonged to a bipedal hominin, DeSilva says. Because the Site A and Site G footprints sit within the same layer of volcanic ash—and because the two sets of

CHEMWATCH
Bulletin Board
Gossip
DEC. 10, 2021

prints are so different from each other—the find suggests that 3.6 million years ago, two different species of bipedal hominins at Laetoli were walking within 1 kilometer of each other within the span of a few days, the researchers report today in Nature. "It's showing there were these different experiments in bipedalism occurring at this time," DeSilva says.

Although DeSilva agrees with many in the field that the Site G tracks were made by A. afarensis, the identity of Site A's footprint maker remains a mystery. Candidates living in the region include Kenyanthropus platyops and A. deyiremeda. Researchers haven't uncovered foot fossils for the former, but they have for the latter, and they share some suggestive similarities with the Site A tracks, DeSilva notes. "That one, to me, is really intriguing as a possible candidate for the hominin that would have made these footprints, but we're not going to know for certain until we do some more work at that site."

The idea that bears may have made the Site A tracks "was always a little bit of an odd explanation," says William Harcourt-Smith, a paleoanthropologist at Lehman College and the American Museum of Natural History, and the researchers here have convincingly debunked it.

But he's not completely convinced they're homininmade, either. "I think it's entirely possible—not likely, but possible—that one of the options for who made these prints could be a nonhominin ape," Harcourt-Smith says. "Without more prints, it's quite hard to know."

That's exactly what DeSilva and McNutt hope to find as soon as it's safe to travel again given COVID-19 concerns. "We'd like to go back and continue excavating and try to extend this trackway," McNutt says.

science.org, 1 December 2021

https://www.science.org

'Deluge of plastic waste': US is world's biggest plastic polluter

2021-12-02

The US is the world's biggest culprit in generating plastic waste and the country urgently needs a new strategy to curb the vast amount of plastic that ends up in the oceans, a new report submitted to the federal government has found.

The advent of cheap, versatile plastics has created "a global scale deluge of plastic waste seemingly everywhere we look", the report states, with the

The overall amount of municipal waste created in the US is also two to eight times greater than comparable countries around the world, the report found.

US a leading contributor of disposable plastics that ends up entangling and choking marine life, harming ecosystems and bringing harmful pollution up through the food chain.

Plastic waste has increased sharply in the US since 1960, with the country now generating about 42m metric tons of plastic waste a year, amounting to about 130kg of waste for every person in America. This total is more than all European Union member countries combined. The overall amount of municipal waste created in the US is also two to eight times greater than comparable countries around the world, the report found.

Recycling infrastructure has failed to keep pace with the huge growth in American plastic production. Littering, dumping and inefficient waste disposal in landfills has caused up to 2.2m tons of plastic – including everything from plastic bottles and straws to packaging – to "leak" into the environment each year. The total waste may be even greater than this due to data gaps in tracking it.

Much of this plastic ends up, via rivers and streams, in the world's oceans.

Worldwide, at least 8.8m tons of plastic waste enters the marine environment each year, the equivalent of dumping a garbage truck filled with plastic into the ocean every single minute. If current trends continue, scientists have estimated this total could leap to 53m tons annually by 2030, which is roughly half of the weight of all fish caught from the oceans globally each year.

"Plastic waste is an environmental and social crisis that the US needs to affirmatively address from source to sea," said Margaret Spring, chief conservation and science officer at Monterey Bay Aquarium. Spring chaired a committee of experts who compiled the congressionally mandated report for the National Academies of Sciences, Engineering, and Medicine.

Spring added: "Plastic waste generated by the US has so many consequences, impacting inland and coastal communities, polluting our rivers, lakes, beaches, bays, and waterways, placing social and economic burdens on vulnerable populations, endangering marine habitats and wildlife and contaminating waters upon which humans depend for food and livelihoods."

The committee's report recommends that a new national strategy is required by the end of next year to stem the flow of plastics into the ocean. The strategy, the report states, should aim to slash plastic

CHEMWATCH
Bulletin Board
Gossip
DEC. 10, 2021

production, particularly for plastics not reusable or recyclable, help promote alternative materials that can be reused and set better standards for waste collection and capture.

Broader international and industrial trends will influence any effort to cut plastic pollution. The US, along with many other developed countries, used to outsource its waste problem by shipping plastics to China but these imports were halted by the Chinese in 2018. This has led to an increase in plastic waste sent to other countries, such as Vietnam and Thailand, as well as "recycled" plastic being burned in domestic landfills unable to cope with the sheer volume of waste.

The fossil fuel industry, meanwhile, is considering a huge expansion in plastic production as it sees its primary business squeezed due to concerns over the climate crisis. Plastic polymers can be formed from a feedstock of crude oil and the industry is pinning its hopes on a glut of new plastic to flood the market and therefore waterways, beaches and oceans, in the coming years.

"There is an urgency to the issue because production is increasing, waste generation is increasing and therefore leakage impacts have the potential to increase too," said Jenna Jambeck, a member of the scientific committee behind the report.

theguardian.com, 2 December 2021

https://www.theguardian.com

Scientists are running out of salmon to study

2021-12-01

For years, Steven Cooke, a biologist at Carleton University in Ottawa, has been traveling to British Columbia to research Pacific salmon migrations. But on the west coast, salmon populations are in dire straits. Several of the populations Cooke studies, including those in the Fraser River, have crashed to the point that even taking a small number of fish for research would be more than they can afford to lose. "We're at the point with some populations where we have to be hands off," says Cooke. "We don't want to study them to extinction."

"We don't want to study them to extinction."

Through years of precipitous declines, Cooke has found it increasingly difficult to study the fish in their native habitat. Now, he's been all but forced to shift his team's focus thousands of kilometers east, to Ontario's Great Lakes.

More and more frequently, says Cooke, salmon numbers have been so low that his research permits have been canceled by the federal government or shifted to other watersheds at the last minute. A sudden move can be just as difficult as a cancellation, since the research team does not have any experience, contacts with local Indigenous communities, or even hotel reservations in the new location. This is particularly disruptive for his students, who may only have one or two field seasons in which to collect the data needed for their projects.

"If you're a master's student or [postdoctoral researcher], having a year where you plan to do research and then there are no fish is a big problem," says Cooke. "It's gotten to the point where it's not worth it. There's too much uncertainty."

Jason Hwang, vice president of the conservation organization Pacific Salmon Foundation, says that marine heatwaves, droughts, wildfires, and habitat loss from urban and agricultural development all make life difficult for west coast salmon. "It's always a complicated story, and not every population is doing poorly, but the general trend is one of decline," he says.

To avoid the uncertainty on the west coast, Cooke has resorted to studying the migrations of Pacific salmon in southern Ontario. The Great Lakes used to be home to a native population of Atlantic salmon, but it was extirpated more than 100 years ago. In the 1960s, however, hatchery-raised Pacific salmon, mostly chinook with some coho, were introduced to help control invasive species such as alewife. To this day, the lakes are stocked with tens of thousands of Pacific salmon annually to support a thriving sport fishery.

Trevor Pitcher, a biologist at the University of Windsor in Ontario, has studied Pacific salmon in the Great Lakes for the past 20 years, mainly in the Credit River in Mississauga. He says there is almost no distinguishable difference between the fish from the west coast and those in the lakes. "The fish are the same," he says. "Same size, same behavior; they just don't migrate as far, and they use the lake instead of the ocean."

Pitcher's work focuses on improving the fitness of hatchery-raised fish, which can benefit hatchery and stocking programs in Ontario and on the west coast. He says the Great Lakes fish, which are adapted to living their whole lives in fresh water, could also be ideal candidates for terrestrial aquaculture programs that grow fish in tanks on land.

Cooke says the downside of working with the Great Lakes salmon is that they don't have the same specific adaptations to the local habitat as fish

CHEMWATCH
Bulletin Board
Gossip
DEC. 10, 2021

on the west coast. For instance, he can't address questions about the population-level variation in traits like heat tolerance. And the migrations of Great Lakes fish pale in comparison* to the 600-to-900-kilometer migrations salmon undertake in the Fraser River. "The distance and difficulty is just a fraction of what they have to do in the mighty Fraser," he says.

But from Cooke's perspective, the disadvantages are balanced by the fact that the Great Lakes provide a reliable supply of fish to study. "It gives us the certainty that we can pull the research off without putting the salmon population or student projects at risk, and without wasting valuable research dollars." He and his colleagues will continue to work in British Columbia when they can, but Cooke says they will be more tactical and focus on populations that are less at risk.

Hopefully, says Cooke, the research done in the Great Lakes can lead to insights that can help Pacific salmon recover in their native habitat. "The salmon are resilient," says Hwang. "If we give them a chance, they have a powerful potential to recover."

hakaimagazine.com, 1 December 2021

https://www.hakaimagazine.com

Pac-Man-shaped blobs become world's first self-replicating biological robots

2021-12-03

Tiny groups of cells shaped like Pac-Man are the world's first self-replicating biological robots.

The tiny bots are made from the skin cells of frogs, but they don't reproduce by mitosis or meiosis or any of the other ways cells divide and replicate in normal circumstances. Instead, they build more of themselves from raw materials — free-floating frog skin cells — creating multiple generations of nearly identical organisms.

In action, the bots (dubbed "xenobots" by their inventors), even look like Pac-Man. They move in wild corkscrews and spirals, their open "mouths" scooping the free-floating skin cells into piles. The cells tend to adhere, or stick together, once put in contact with one another, so these piles gradually meld into new, spiraling xenobots.

In action, the bots (dubbed "xenobots" by their inventors), even look like Pac-Man.

Though this self-replication is a fairly delicate process, so far possible only in a carefully controlled lab dish, researchers hope it offers new promise for biologically based robots.

"The ability to make a copy of yourself is the ultimate way to make sure you keep doing whatever it is you do," said Sam Kriegman, a computer scientist and postdoctoral scholar at the Wyss Institute at Harvard University and the Allen Discovery Center at Tufts University.PLAY SOUND

Bio-bots

Kriegman and his colleagues, including computer scientist Joshua Bongard of the University of Vermont, have been developing the xenobots for years. The bots are made from stem cells taken from frog eggs and are 0.04 inches (1 millimeter) wide or less. When put in contact with each other, the stem cells naturally form spherical blobs covered with tiny, beating cilia, or hairlike structures that can propel the blobs around.

"They're neither a traditional robot nor a known species of animal," Bongard said in a statement when the invention of xenobots was first announced in 2020, Live Science reported at the time. "It's a new class of artifact: a living, programmable organism."

Programming an organism isn't as easy as entering commands into code, though, Kriegman told Live Science. "It's difficult to program something that doesn't have software," he said.

Ultimately, control of the xenobots comes down to control of their shapes. That's where artificial intelligence comes into play. It's not always intuitive what a xenobot will do when you alter its shape, or how to get a desired outcome by sculpting the shape. But computer simulations can run through billions of shape and size options in days or weeks. Researchers can even vary the environment around the simulated xenobots. Promising shapes, sizes and environments can then be tested in the real world.

Biological robots are promising, Kriegman said, because they can self-repair. They're also biodegradable. Left to their own devices, the xenobots run out of energy and begin to degrade within 10 to 14 days. They don't leave microplastics or toxic metals behind, just tiny specks of organic decay. The researchers are working on designs that might allow the xenobots to carry small amounts of material. Potential uses include delivering drugs inside the body or cleaning up toxic chemicals in the environment.

Self-replication

CHEMWATCH
Bulletin Board
Gossip
DEC. 10, 2021

In their typical spherical shape, the xenobots are capable of a limited version of self-replication, the researchers found. When put in a dish full of independently floating frog stem cells, the blobs circle merrily, randomly pushing the free-floating cells into clumps, some of which stick together to form new xenobots. These tend to be smaller than their parents, however, and typically they aren't capable of moving around enough single cells to create yet another generation.

After computer simulations suggested that a Pac-Man shape might be more effective, the researchers tested these C-shaped xenobots in a soup of stem cells. They found that the diameter of the offspring of Pac-Man xenobots was 149% larger than the offspring of spherical xenobots. Thanks to the size improvements, the baby xenobots were able to create their own offspring. Instead of just one generation of xenobot replication, the researchers found they were able to reach three or four.

The system is still quite fragile, and the process of growing the cells and making sure their growth substrate is clean and fresh is tedious, Kriegman said. And not to worry, as there's no concern that these biological robots will replicate out of control and take over the world: "If you sneeze on the dish, you'll ruin the experiment," Kriegman said.

That also means the xenobots aren't quite ready to become working robots. The researchers are still working on testing different shapes for different tasks. Their AI simulation also suggested that varying the shape of the lab dishes the xenobots replicate in might lead to better results, but that still needs to be tested in the real world.

However, there are lessons from the xenobots that could be incorporated into robotics right away, Kriegman said. One is that artificial intelligence can be used to design robots, even robots that can self-replicate. Another is that it makes sense to create robots from intelligent components. Biological organisms are smart all the way down to their component parts, he said: Organisms are made of self-organizing cells, which are made of self-organizing organelles, which are made of self-assembling proteins and molecules. Current metal-and-plastic robots don't work in that way.

"If we could build robots out of intelligent modules, maybe we could create more robust machines," Kriegman said. "Maybe we could create robots in the real world that could self-repair or self-replicate."

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https://www.livescience.com

Plastic additive increases breast cancer relapse, mortality: New science

2021-12-02

A plastic additive used to make IV bags and tubing pliable interferes with breast cancer treatment, increasing mortality and the likelihood the cancer will return.

Resistance to chemotherapy and hormonal therapy is a major clinical problem in breast cancer medicine, especially for cancer metastasis and recurrence, according to scientists writing in the journal Biomedicine & Pharmacotherapy.

The additive DEHP is a member of the family of chemicals known as phthalates. Phthalates have a host of handy industrial uses, from softening plastic and binding makeup to making ink stick to plastic bags. Scientists have recorded nearly as many adverse health impacts, from cancer and diabetes to infertility. The additives became part of the national conversation earlier this year with the publication of Dr. Shanna Swan's Count Down, linking phthalates to global declines in male fertility.

In a study published earlier this month, researchers found DEHP also increases drug resistance, interfering with breast cancer treatment and increasing the likelihood of relapse.

DEHP and breast cancer

The research was stimulated by earlier results from the same research group indicating that DEHP interfered with the actions of two of the common chemotherapies for breast cancer. Only they didn't know how the apparent effect was caused.

This new research confirmed and extended the earlier results. They found that patients with higher levels of DEHP were more likely to develop breast cancer again, and they were also more likely to die.

The research also provided detailed insight into why that was happening, using a combination of studies of the mechanisms of DEHP action in human breast cancer cell lines, zebra fish, and mice. One of the most

Phthalates have a host of handy industrial uses, from softening plastic and binding makeup to making ink stick to plastic bags.

CHEMWATCH
Bulletin Board
Gossip
DEC. 10, 2021

interesting results was that DEHP turned on a gene that is known "to promote proliferation, invasion, metastasis and drug resistance" in human breast cancer cell lines.

DEHP is used abundantly in medical equipment such as IV bags and plastic tubing, including delivery of chemotherapeutic agents to women with breast cancer. If these results are confirmed, it means that the very act of delivering the medicine weakens the treatments.

"Regulators have long turned a blind eye toward the serious and harmful effect that phthalates have on our health," said Pete Myers, chief scientist at Environmental Health Sciences, publisher of EHN.org. "This paper shows yet again what researchers worldwide are finding: We need safer chemistry in our products. No one knows how many women with breast cancer are dying because of these effects of DEHP."

Hormone hijackers

There's more: Given the effects indicated in this study, it's very plausible that DEHP, other phthalates and other "hormone hijackers" known as endocrine disrupting compounds are interfering with medicinal treatments for other diseases. This has already been suggested for the ability of perfluorinated compounds – the so-called "forever chemicals" – to undermine vaccinations in children and for bisphenol A to interfere with breast cancer treatment.

In other words, this study could be the tip of the iceberg for EDCs' effects on human health.

Read the study...

2021-1118 DEHP and breast cancer.pdf

ehn.org, 2 December 2021

https://www.ehn.org

Fossils of 400-million-year-old 'Excalibur worm' discovered in Australia

2021-12-03

According to the old English legend, Excalibur is a magical sword wielded by the legendary King Arthur — purveyor of round tables and protector of Britain in the fifth and sixth centuries. Today, the legend of that enchanted

Today, the legend of that enchanted blade lives on… in the name of a prehistoric worm that you could crush between two fingers.

blade lives on… in the name of a prehistoric worm that you could crush between two fingers.

Meet Lepidocoleus caliburnus. Measuring just a fraction of an inch long), this ancient, sea-dwelling creepy-crawler may not reach the stature of its Arthurian namesake — but, as a new study in the journal Papers in Palaeontology points out, it did at least look the part of a heavily-armored knight, covered in overlapping plates of calcite crystals that ran along the entire length of the creature's body.

Along with its cousin species L. shurikenus — named for the shuriken (a pointed ninja throwing star) and also described for the first time in the new study — L. caliburnus lived about 400 million years ago, during the Devonian period, in what is now Australia. Both worms probably lived on coral reefs in shallow waters that are now part of the Australian mainland, the study authors wrote. They likely fed on organic waste and used their armor plates for defense from predators.

To learn just how well-protected these creatures were, the study authors took micro-CT scans of the worm fossils to create digital 3D models of their armor plates.

"By using micro-CT, we can virtually separate the individual components of the armor," lead study author Sarah Jacquet, an assistant professor of geological sciences at the University of Missouri, said in a statement. "We are able to manipulate the virtual models to determine how the individual armor pieces moved relative to each other, as well as determine the degree of overlap between them."

The researchers found that the worms had two overlapping armor systems: one running down the length of each worm's skeleton, and the other covering both sides of the creatures. The worms may have been able to curl into a ball to better fend off predators — but ultimately, these impressive defenses did not save them from disappearing in a "major extinction event," Jacquet said. The imminent mass extinction at the end of the Devonian period wiped out 75% of life on Earth, starting 365 million years ago.

No longer lost to history, these two worms — Excalibur and Shuriken — can perhaps rest easier now knowing that tales of their dangerous and daring lives are still being told 400 million years later. King Arthur would kill for the same.

CHEMWATCH
Bulletin Board
Gossip
DEC. 10, 2021

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Watch this magic plastic instant-coffee package disappear in your drink

2021-12-07

With a typical single-serve packet of instant coffee—the ready-to-brew kind that Starbucks and other brands sell for home and office use—the plastic wrapper ends up in the trash. In a prototype of a new seaweed-based packaging design, the wrapper dissolves into the drink, adding nutrients.

The design is from London-based Notpla (short for "not plastic"), which just raised $13 million in a Series A round of financing led by Horizons Ventures. The coffee packaging is one example of the company's work to scale up sustainable packaging that can replace materials that are particularly hard to recycle—like thin plastic films—with packaging that can literally disappear. But the idea isn't just to replace plastic with something less bad: The Notpla team believes it's possible to improve on its performance.

But the idea isn't just to replace plastic with something less bad: The Notpla team believes it's possible to improve on its performance.

"We're leveraging the natural attributes of seaweed and things you find in nature and not only replacing things that have been made out of plastic, but rethinking the format," says Pierre-Yves Paslier, co-CEO of Notpla. "One of the things that is quite exciting about seaweed is that it can do things that plastic cannot do. You create new behaviors that we wouldn't be able to do with polyethylene or polypropylene."

As the company's team of chemists and designers started exploring new versions of seaweed-based film, Paslier says they "started to see a bunch of interesting formats and applications where solubility could be a big advantage." Tea bags are often made with plastic, and a single bag can release as much as 11 billion microsize pieces of plastic and 3 billion nanosize particles into hot water, one study found. A tea bag made from seaweed can be safely stirred into the water instead, adding some fiber and antioxidants. The seaweed is processed so it doesn't add any flavor.

The material can also be used for something like a pack of ramen noodles or a serving of rice so that the whole package can be dropped into hot water during preparation. "For people who go on a hike and want to bring

back their packaging, it could be literally consumed within the meal," Paslier says. Laundry detergent or dishwasher detergent pods could use the material instead of PVA plastic that ends up adding plastic pollution to waterways because it doesn't fully dissolve.

Clothing, which is typically shipped in thin plastic bags, could be shipped in the seaweed-based material instead, and the material could be made with built-in detergent so that the whole package could be thrown into the laundry machine for the first wash. "We're trying to think of how we can make a slightly more interesting and delightful experience while leveraging what plastic cannot do," Paslier explains.

The company, which originally started with a design for an edible or biodegradable blob-like water bottle—something that it still produced for events like the London Marathon and music festivals—has been making prototypes of the new packaging for the past few months, working with large companies to partner on the designs. Now it's beginning to scale up production, making rolls of film that can be used in the same industrial equipment that manufacturers currently use to make packaging from plastic. The new round of investment will help speed up industrialization.

"We're really excited to see the response that the industry is having," Paslier says. "With their minds broadening, and [the new investment] for putting a team and efforts together, I think we can go quite fast. Obviously, the scale of plastic is gigantic, and plastic has had, like, 100 years to be built itself. So it's going to take a little bit of time for us to really challenge it in a global way. But I think that we can do that in a much shorter time than plastic took, because everyone is very committed to exploring these advances."

fastcompany.com, 7 December 2021

https://www.fastcompany.com

Toxic cane toads are invading Taiwan. Conservationists race to contain warty amphibians.

2021-12-08

Conservationists in Taiwan are racing to contain an invasion of non-native and highly toxic toads before the warty amphibians cause widespread damage to their new ecosystem.

The cane toad (Rhinella marina) is a highly toxic species of toad native to the Americas, from the Central Amazon in Peru to the Rio Grande Valley in Texas. However, the species was also introduced across the globe in the

CHEMWATCH
Bulletin Board
Gossip
DEC. 10, 2021

early 20th century to various places, including the Caribbean, Australia and large parts of the Pacific, according to Amphibia Web. Adult cane toads range from 3.5 to 5.9 inches (9 to 15 centimeters) in length and have yellow and brown skin covered with irregular warts. When threatened, cane toads release a milky-white toxin from their skin known as bufotoxin, which oozes from glands behind their eyes and is lethal to most animals.

Researchers in Taiwan learned of a possible cane toad invasion at a farm in a small town in Taiwan's central mountain range, after a local resident shared photos of a cane toad online. After seeing the photo, researchers from the Taiwan Amphibian Conservation Society immediately came to the farm to investigate.PLAY SOUND

"A speedy and massive search operation is crucial when cane toads are first discovered," Lin Chun-fu, an amphibian scientist at Taiwan's Endemic Species Research Institute, told French news agency AFP. They reproduce rapidly, and "they have no natural enemies here in Taiwan," he added.

They reproduce rapidly, and "they have no natural enemies here in Taiwan," he added.

When the researchers arrived at the farm, they found 27 toads in the immediate vicinity. Since then, they have captured more than 200 cane toads in the area surrounding the town, according to AFP.

"I was shocked and worried when they found more than 20 [right away]," Yang Yi-ju, a toad expert at National Dong Hwa University who organized the search, told AFP. Cane toads are an extremely successful invasive species. They are only native to 14 countries but are now found in more than 40 countries, which has landed them a spot on the list of the 100 Worst Invasive Species overseen by the Invasive Species Specialist Group, an international advisory body of scientists and policy experts.

Female cane toads can lay up to 30,000 eggs at a time and can mate year-round, Live Science previously reported. Unlike other toads, which are exclusively predators, cane toads can also act as scavengers, so they always have plenty of food to eat. Without natural predators, their numbers quickly explode, and they can seriously damage ecosystems where they're introduced.

In the past, people deliberately released these toads in countries that were suffering from pest problems. For instance, in 1935, Australia introduced the toads to eat cane beetles (Dermolepida albohirtum) that were ravaging sugarcane fields. But while the toads successfully squelched the beetle infestations, the toad population quickly grew out of control.

Researchers believe that a black market pet trade could have caused the recent Taiwan cane toad invasion. Cane toads have long been a popular pet in Taiwan and are also used in traditional medicines, according to AFP. But in 2016, the Taiwanese government banned the import of cane toads, which led people to breed and sell them illegally. The leading theory is that the invasive cane toads either escaped or were abandoned by one of these black market traders.

The researchers also think the invasion may have started months ago and gone unnoticed until now. "Taiwanese farmers generally ignore toads and even look favorably at toads when they find them, because they help rid the land of pests and are also a good luck symbol," Yang told AFP. "It never occurred to them that this is an invasive species from a foreign land."

The researchers are now hopeful that they have contained the invasion, but it is too early to tell for certain. "Next spring during mating season is when we [will] truly know for sure if we have contained it," Yang told AFP.

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DeepMind crack 'knot' conjecture that bedeviled mathematicians for decades

2021-12-09

The artificial intelligence (AI) program DeepMind has gotten closer to proving a math conjecture that's bedeviled mathematicians for decades and revealed another new conjecture that may unravel how mathematicians understand knots.

The two pure math conjectures are the first-ever important advances in pure mathematics (or math not directly linked to any non-math application) generated by artificial intelligence, the researchers reported Dec. 1 in the journal Nature. Conjectures are mathematical ideas that are suspected to be true but have yet to be proven in all circumstances. Machine-learning algorithms have previously been used to generate such theoretical ideas in mathematics, but thus far these algorithms have tackled problems smaller than the ones DeepMind has cracked.

"What hasn't happened before is using [machine learning] to make significant new discoveries in pure mathematics," said Alex Davies, a

Conjectures are mathematical ideas that are suspected to be true but have yet to be proven in all circumstances.

CHEMWATCH
Bulletin Board
Gossip
DEC. 10, 2021

machine-learning specialist at DeepMind and one of the authors of the new paper. PLAY SOUND

Math and machine learning

Much of pure mathematics is noticing patterns in numbers and then doing painstaking numerical work to prove whether those intuitive hunches represent real relationships. This can get quite complicated when working with elaborate equations in multiple dimensions.

However, "the kind of thing that machine learning is very good at, is spotting patterns," Davies told Live Science.

The first challenge was setting DeepMind onto a useful path. Davies and his colleagues at DeepMind worked with mathematicians Geordie Williamson of the University of Sydney, Marc Lackenby of the University of Oxford, and András Juhász, also of the University of Oxford, to determine what problems AI might be useful for solving.

They focused on two fields: knot theory, which is the mathematical study of knots; and representation theory, which is a field that focuses on abstract algebraic structures, such as rings and lattices, and relates those abstract structures to linear algebraic equations, or the familiar equations with Xs, Ys, pluses and minuses that might be found in a high-school math class.

Knotty problems

In understanding knots, mathematicians rely on something called invariants, which are algebraic, geometric or numerical quantities that are the same. In this case, they looked at invariants that were the same in equivalent knots; equivalence can be defined in several ways, but knots can be considered equivalent if you can distort one into another without breaking the knot. Geometric invariants are essentially measurements of a knot's overall shape, whereas algebraic invariants describe how the knots twist in and around each other.

"Up until now, there was no proven connection between those two things," Davies said, referring to geometric and algebraic invariants. But mathematicians thought there might be some kind of relationship between the two, so the researchers decided to use DeepMind to find it.

With the help of the AI program, they were able to identify a new geometric measurement, which they dubbed the "natural slope" of a

knot. This measurement was mathematically related to a known algebraic invariant called the signature, which describes certain surfaces on knots.

The new conjecture — that these two types of invariants are related — will open up new theorizing in the mathematics of knots, the researchers wrote in Nature.

In the second case, DeepMind took a conjecture generated by mathematicians in the late 1970s and helped reveal why that conjecture works.

For 40 years, mathematicians have conjectured that it's possible to look at a specific kind of very complex, multidimensional graph and figure out a particular kind of equation to represent it. But they haven't quite worked out how to do it. Now, DeepMind has come closer by linking specific features of the graphs to predictions about these equations, which are called Kazhdan–Lusztig (KL) polynomials, named after the mathematicians who first proposed them.

"What we were able to do is train some machine-learning models that were able to predict what the polynomial was, very accurately, from the graph," Davies said. The team also analyzed what features of the graph DeepMind was using to make those predictions, which got them closer to a general rule about how the two map to each other. This means DeepMind has made significant progress on solving this conjecture, known as the combinatorial invariance conjecture.

There are no immediate practical applications for these pure math conjectures, but the mathematicians plan to build on the new discoveries to uncover more relationships in these fields. The research team is also hopeful that their successes will encourage other mathematicians to turn to artificial intelligence as a new tool.

"The first thing we'd like to do is go out there into the mathematical community a little bit more and hopefully encourage people to use this technique and go out there and find new and exciting things," Davies said.

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CHEMWATCH
Bulletin Board
Gossip
DEC. 10, 2021

An unexpected giant planet is orbiting a massive pair of stars

2021-12-08

A gas giant planet orbiting two stars with a combined mass of at least six times that of our sun is the largest planet-hosting star system ever detected, and may challenge our currents ideas of planetary formation.

Previous studies of planets in close orbit to high-mass stars have suggested that planets orbiting stars of more than three times the mass of the sun may be rare or even non-existent. This is because higher-mass stars emit larger amounts of radiation, which should cause the dense discs of material like gas and dust around such stars to evaporate before they can coalesce into planets.

However, Markus Janson at Stockholm University in Sweden wondered whether giant planets would still form around massive stars as long as they orbited at a great enough distance.

Now, Janson and his colleagues have found such a planet: a gas giant orbiting a young binary star system called b Centauri (b Cen) that is between six and 10 times the mass of our sun.

The researchers first directly imaged the system in March 2019 using the Very Large Telescope in Chile and then conducted follow-up observations in April 2021. They found that the planet, known as b Cen (AB)b, is 10.9 times the mass of Jupiter and orbits the two stars at 560 times the distance between Earth and the sun.

"We know for the first time that planets really can exist about really quite massive stars," says Janson.

"We know for the first time that planets really can exist about really quite massive stars," says Janson.

The researchers suggest that the planet must have formed relatively rapidly through gravitational instability, which is when massive clumps of gas and dust cool and contract into a planet. This method is much faster than the traditional core accretion model, which is when solid particles collide and slowly snowball into a planet. Even at the distance it lies from the stars, the disc of material this planet formed from would have been likely to evaporate quickly.

They also found the planet to have a reasonably circular orbit. This suggests that b Cen (AB)b was formed close to its current orbit, because planets that have been knocked off their original orbits typically follow an elliptical path around their star.

These are important insights for our limited understanding of planet formation around high-mass stars.

"This is a major breakthrough because it establishes that finding wide-separation exoplanets around a massive host star is possible," says Meiji Nguyen at the University of California, Berkeley. "Though I don't think the study can conclusively prove any of the leading theories we have on how exoplanets like this form, it does provide an exciting new piece of evidence to support some of our current understanding."

Read more: https://www.newscientist.com/article/2300742-an-unexpected-giant-planet-is-orbiting-a-massive-pair-of-stars/#ixzz7EVbvq52c

newscientist.com, 8 December 2021

https://www.newscientist.com

CHEMWATCH
Bulletin Board

I counted every bit of my trash for one month on the PCT

2021-12-01

Walking from Mexico to Canada, I suppose, simply wasn't tedious enough for me. So in late July, just as I reached the northern edge of California during a 2,653-mile thru-hike of the Pacific Crest Trail, I decided to start counting every single scrap of trash I created for an entire month. I carried it all for days on end in a disgusting Ziploc bag stuffed into my backpack—always gross, sometimes embarrassing, permanently revealing.

For the first three months of my trek, I'd seen trashcans at almost every trailhead or convenience store my fellow Hiker Trash friends frequented, overflowing with our collective refuse. There were snapped trekking poles and overspent hiking shoes, empty pouches of dehydrated food and crumpled vestiges of instant coffee. The sheer quantity was impressive in a Mad Max prequel kind of way. How much stuff, I wondered, was I wasting?

So from Oregon's enchanting Crater Lake to the faux Bavarian burg of Leavenworth, Washington, I catalogued every bit of my waste, chronicling each outgoing parcel in a single cellphone note that grew so long scanning it began to feel like a personal doomscroll. I trashed nine hummus containers and 30 Ziploc bags, two shoes and 34 cans of stove fuel, beer, and soda water. There were 17 ketchup packets, almost as much hot sauce, and one plastic pint of Southern Comfort. I discarded so many compostable coffee pouches that I could not compost that I now cannot bear to type the number.

How much stuff, I wondered, was I wasting?

On and on it went, from pizza boxes to joint containers, red pepper pouches to two garlic bulbs. By the start of September, I'd somehow discarded 686 separate items, or more than 20 each day. And those were only the ones I remembered to count during a month when I tried to curb my waste. That was less than a quarter of my hike, meaning I'd likely tossed an excess of 3,000 bits of junk overall, more than one per mile. I reached the Canadian border a week later, toting more than a twinge of guilt.

If we hikers, who live outdoors and ostensibly for it, aren't obsessive stewards of shared resources, how can we expect anyone else to be? We must do better.

Like much of the outdoors industry, hiking has a waste problem. In our dauntless quests to achieve ultralight enlightenment, make four-day food carries less burdensome, or have the latest gear with the most Reddit cred, we have created a slash-and-burn superstructure, where the fulfillment of

our goals or ideals trumps their environmental impacts. We purchase the tiniest portions of food. We bail on gear that isn't perfect or, back home, stockpile things we never again need. We buy more than our bellies can handle in trail towns, gorging until we toss what remains. I confess to it all.

Much of this happens for the sake of convenience, for making a difficult endeavor that much easier. Some of it stems from a deference to apathy, since, as we often shrug, our footprint is so much smaller in the woods than when we're back in "the real world."

But if we hikers, who live outdoors and ostensibly for it, aren't obsessive stewards of shared resources, how can we expect anyone else to be? We must do better. Good news: with a little inconvenience, expense, and planning, we can.

In the waning days of my experiment, I was delighted to learn about another PCT hiker who was paying even more attention to her trash—or, really, her near-complete lack of it. In mid-April, Ana Lucía departed the trail's southern end, bound north with an unprecedented mission: to hike to Canada without generating any refuse. "Waste-Free PCT," she dubbed it.

"For me, waste-free means trying not to have a lot going into landfills," Lucía said in mid-September, less than a month before she reached the trail's northern terminus. "It's impossible to be 100 percent waste-free if you're on a trail, but it's about being more mindful of the trash you are producing and asking, 'What can I do better?'"

A 26-year-old native of Mexico City, Lucía fell for hiking and environmental causes in tandem half a decade ago. After learning about the exploitation involved in unsustainable tropical palm oil production, she began changing her habits as a consumer. Vegetarianism and veganism soon followed, as did stints at animal-rehabilitation centers. After reading about "Plastic Free July," a decade-old international movement involving a month-long pause on plastic, she decided to curb her overall waste dramatically, too.

Meanwhile, Lucía daydreamed about the PCT since she first saw Reese Witherspoon lug her overstuffed bag to the Bridge of the Gods at the end of Wild, soon after the movie's 2014 release. For years, earning her psychology degree at the Universidad Nacional Autónoma de México and a subsequent teaching stint put that ambition on hold. She decided to

CHEMWATCH
Bulletin Board
Curiosities
DEC. 10, 2021

make her attempt at last in 2021, before beginning a doctorate program in neuroscience.

Another obstacle appeared. She couldn't find anyone who had documented such a waste-free long haul, let alone explained its pragmatic complications. On message boards and blogs, fellow hikers scoffed at the notion—too much work, they concurred, in a world that would go on making waste with or without her. Lucía was torn between hiking the PCT and trying to remain as waste-free as she had learned to become at home. "It felt like doing this dream meant having to renounce my values," she said.

Rather than give up, she dug in, shaping schemes that would let her pursue both goals. She found a family friend in California who was willing to buy trail mix, peas, and gummy bears in bulk for six months and mail them to isolated trail towns. He even used compostable BioBags and paper tape. She emailed niche brands like Gossamer Gear and Katabatic to inquire about used packs and quilts they could sell her to assist the mission. (Both said yes.) She scoured Reddit boards in search of secondhand supplies, insisting on buying as little new as possible; when she couldn't find the exact model she wanted, she settled for her second choice.

To offset the expenses of these impracticalities, she also launched a crowdfunding campaign, pledging 26 percent—that is, one percent for every 100 miles she intended to hike—of it to the Mexican Center for Environmental Law. "I wanted to balance out the impact of doing the trail and shipping these boxes by giving," said Lucía. She ultimately raised more than $4,000.

Lucía couldn't hike on bulk trail mixes alone. Same as other hikers, she wanted energy bars and dehydrated meals, simply housed in compostable packaging. She found one supplier for each: LivBar, a solar-powered vegan bar maker in Salem, Oregon, and Fernweh Food, a tiny startup in Portland, Oregon, that might just be making the best dehydrated meals on the market right now.

She hauled her used wrappers into trail towns, found coffee shops that composted their grounds, and asked if they would do the same for her packaging. In Northern California, where towns with coffee shops are either limited or very far from trail, she mailed her wrappers to Fernweh founder Ashley Lance back in Portland, reckoning the energy spent doing so meant less waste than throwing them away. Lance composted them in her backyard, then offered the same service to other hikers.

"If you were a guest in your friend's house, you wouldn't leave your trash everywhere. Taking care of the trail and making less waste is like paying rent."

Both Lance and LivBar CEO Wade Brooks admitted to me that the battle to make compostable wrappers common is an uphill one. Brooks, for instance, repeatedly raved about a new machine that would allow LivBar to package its goods with less labor, eventually lowering the price point to be more competitive with the plastic-clad likes of Kind or Clif. Fernweh spends more than a dollar on every meal's compostable label and wrapper. Despite a price point between $9.50 and $15, Lance still earns only 10 cents per bag.

But they both sensed a mutual momentum, a feeling that the behemoths were paying attention. "Small companies make a change, and big companies see that people are choosing them," Lance said. "Those companies eventually acquire those habits in their own way."

Lucía hoped her own journey would inspire similar shifts among hikers. Now that someone had done the work of figuring it out, she suggested, others could more easily follow. Future thru-hikers have already told her she altered the way they will plan their walks. She wondered if trail towns or the Pacific Crest Trail Association might someday install roadside compost or recycling stations.

"Nature is free. It's not asking anything of you," said Lucía, who rightly adopted the trail name "Eco" on the PCT. "If you were a guest in your friend's house, you wouldn't leave your trash everywhere. Taking care of the trail and making less waste is like paying rent."

I am neither naïve nor conceited enough to think that hikers eating out of compostable wrappers or frequenting gear exchanges more often will make an appreciable difference in our ballooning environmental calamity. Among our society's possible causes of death, the inability to find a composting center in some trail town of Southern Appalachia won't rank at all.

Meanwhile, the picture just gets grimmer: A 2020 study published in Science estimated that the world dropped 5.3 million metric tons of plastic into the ocean in 2016, a number that could increase nearly sixfold in just two decades. The political ambitions of 52 U.S. Senators seem again poised to cripple long-overdue climate reform, even after the United Nations

CHEMWATCH
Bulletin Board
Curiosities
DEC. 10, 2021

gathered again to fret over our folly. And Saudi Arabia now intends to convert an expired oil rig into an "extreme park," a seabound monument to our collective ostrich effect.

Why should you care about tampons or toilet paper in the woods or how much plastic you route to landfills when that's happening? Or when pipelines crisscross the Appalachian Trail and interstate systems, our country's collective arteries of disposable goods, cleave the Pacific Crest Trail in pieces? I get it.

But in his rambling autobiography, Theodore Roosevelt—the problematic godhead of our public lands, with all their blessings and faults—gets to the essence of why this all matters, even when it's frustrating or inconvenient or expensive. "The greatest happiness is the happiness that comes as a by-product of striving to do what must be done, even though sorrow is met in the doing," he writes. He goes on to quote a friend who ran a mill just north of Damascus, Virginia, arguably the epicenter of Appalachian Trail culture for its legendary hiker hostels and annual Trail Days celebration: "Do what you can, with what you've got, where you are."

I choose Roosevelt's advice. I will find ways to reduce my environmental impact while on trail, though I know my efforts will cost me and will amount to less than a candle's flicker in a consumerist gale.

I will mail myself bits of bulk toiletries. I will use Ziplocs or BioBags not until they look like a septic tank but instead until the seams split. I will lug a little extra food weight from one stop to the next if it means using a little less plastic and, gradually, reducing what I toss. And I will buy, as best I can, products from manufacturers that agree they can't change everything but are at least, per Roosevelt, "striving to do what must be done."

None of this will be perfect. But when I count my trash and scraps on the next trail, I want to feel empowered by what I have fixed, not embarrassed by what I ignored simply for the sake of convenience.

outsideonline.com, 1 December 2021

https://www.outsideonline.com

Nuts and fruit may even have been cooked with meat fats to make "a great energy bar, full of calories," Greaney said.

Was Stonehenge constructed by builders fueled on 'energy bars'?

2021-12-03

Stonehenge's builders may have kept up their strength during cold winter months by gulping down sweet, meat-infused "energy bars," historians in the United Kingdom recently proposed.

The iconic ring of standing stones in Salisbury, England was erected between 4,000 and 5,000 years ago, and people in the region at the time — including those who constructed Stonehenge — ate mostly beef, pork and dairy. However, recently excavated evidence at Durrington Walls, a nearby settlement where the monument's builders may have lived, showed that seasonally foraged sweet and savory snacks were also part of the local winter diet.

Archaeologists with the Stonehenge Riverside Project uncovered clues that Neolithic, or New Stone Age people were collecting and cooking hazelnuts, crab apples, sloes (a blue-black berry), and other fruits, Susan Greaney, an archaeologist and senior properties historian at English Heritage (a charity that manages historic monuments in the U.K.), said in a statement. Nuts and fruit may even have been cooked with meat fats to make "a great energy bar, full of calories," Greaney said.

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"We know that midwinter and feasting were really important to the builders of Stonehenge," Greaney said in the statement. "We're lucky to have evidence which tells us that they had access to nutritious fruit and nuts."

Stonehenge's builders may have also mixed savory fat with sweet fruit and nuts and baked them into a pastry like a mince pie, a British seasonal favorite that includes beef suet, fruits, sugar and sometimes alcohol, according to the statement. The earliest records of mince pies date to medieval times and there's no direct evidence of Neolithic baked goods, but cereal crops were farmed thousands of years ago in England and could have been used for baking, according to the statement.

During the time when Stonehenge construction was underway, around 2500 B.C., Neolithic builders and their communities may have enjoyed such delicacies "for celebration as well as sustenance, with the sharing of food helping the community to bond, encouraging people to travel from far and wide to help build Stonehenge," Greaney said.

CHEMWATCH
Bulletin Board
Curiosities
DEC. 10, 2021

"We'll never know for certain what recipes they favoured, but it's fun to imagine travellers being greeted with a tray of mince pies!" she said. To recreate what that might have been like, English Heritage will be baking and selling Neolithic-style mince pies at Stonehenge through the month of December, according to the statement.

Even if Stonehenge's builders were fueled by mince pies — or meat-flavored energy bars — moving such enormous stones would have been a daunting task. Two types of stones make up the colossal monument's outer circle and inner horseshoe: the larger of these stones are called "sarsens" and the smaller are "bluestones," according to England's Bournemouth University. Sarsens measure up to 30 feet (9 meters) tall and weigh 25 tons (22.6 metric tons) on average, while bluestones (which are so named for their bluish tinge) weigh up to 5 tons (4.5 metric tons).

Scientists still don't know for sure how Neolithic builders managed to transport the giant stones from quarries 180 miles (290 kilometers) away and assemble them into a ring, but in 2016, a group of university students in the U.K. tested one possible method. They dragged a sled carrying a 1-ton (0.9 metric tons) stone block over wooden tracks, with an average hauling speed of about 1 mph (1.6 km/h), Live Science previously reported. And moving the slab required just 10 students — fewer than the researchers expected — which meant the construction work on Stonehenge could have progressed faster than previously calculated, the scientists told Live Science.

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How to design a city for sloths

2021-11-30

It's hard to think of an animal less suited for jaywalking than a sloth.

As pedestrians, sloths do not walk as much as ooze, inching forward commando-style with their bellies to the ground, as if trying to dodge a museum's laser-security system. From a distance, the 10 long minutes it takes an average sloth to walk across the street might look more like the end of a yoga class.

It's not their fault that sloths are so bad at crossing the street. Far from a symptom of the deadly sin from which they get their name, the mammals'

It's not their fault that sloths are so bad at crossing the street.

molasses-slow movement is adaptive: Sloths are leisurely digesters, and by conserving energy they can survive on an extremely low-calorie diet of plants. Their ideal habitat is a dense forest canopy, which well-camouflaged animals can navigate without drawing attention to themselves or running into ground-dwelling predators.

But humans have been encroaching on these habitats. And with their urbanizing ways have come fast cars, humming electrical wires, a thinning canopy — and a dangerous new world for sloths.

The Sloth Conservation Foundation, based in southern Costa Rica, is trying to help sloths adapt to this changing environment, by stringing rope above roads that sloths can traverse by their signature crawl in just three minutes flat. So far, the foundation has built more than 130 such sloth crossings, which cost $200 each to install. They've also worked with the local electric company and with nearby property owners to sloth-proof their power lines, which sloths sometimes cling to when trees are scarce.

"If you're putting up safe ways for them to travel from tree to tree, then they're not getting attacked by dogs because they're up in the canopy; they're not getting electrocuted, because they're using the ropes instead of the cables; they're not being hit by cars," says Rebecca Cliffe, the founder of the foundation. "Nobody bothers them up there."

Six species of sloths live in Central and South America, but they face increasing pressure from development, deforestation and illegal pet-trade trafficking in counties like Venezuela, Panama and Brazil. Costa Rica, too, has experienced rapid urbanization, growing in population by almost five times between 1950 and 2000; by 2016, more than 70% of Costa Ricans lived in cities. Though widespread deforestation has slowed, Costa Rican cities, especially San José, have continued to sprawl.

"The growth of the metropolitan built-up area encroached on the rural spaces that formerly separated cities and towns in the region, with a resulting loss of environmental quality," wrote researchers Rosendo Pujol-Mesalles and Eduardo Pérez Molina in a 2013 report for the Lincoln Institute of Land Policy.

The South Caribbean coast of Costa Rica was slower to modernize. When Cliffe arrived there a dozen years ago, the roads were still unpaved, cars traveled carefully, and there was at least a sloth in every tree. But in the years since, tourism has grown substantially. "I've seen it explode into this massively developed region," she says. "Now there's a highway, and there are traffic jams for miles down the road every night."

CHEMWATCH
Bulletin Board
Curiosities
DEC. 10, 2021

In other parts of Costa Rica, the sloth population has already been all but eliminated, Cliffe says. But she's hopeful that it's not too late to protect the creatures. "We've got such a good opportunity in this region to try and achieve this coexistence and balance, because it's an area that has undergone development so recently," she says. "There's still a chance to reverse the damage and do things the right way."

When it comes to adapting to the pace and disruption of urbanization, sloths are just about the most vulnerable imaginable form of wildlife — which means that interventions designed to help them can end up benefiting other members of the animal kingdom. More than 20 other rainforest-dwelling species have also been seen traversing the sloth crossings, including red-eyed tree frogs who jump across the ropes, and primates who swing on them like monkey bars.

Wildlife crossings like these have sprung up across the world, in an effort to help wildlife negotiate the human-altered landscape, facilitate mating and migration, and connect surviving fragments of animal habitat. There are red crab bridges on Australia's Christmas Island, a salamander tunnel in Massachusetts, and turtle underpasses on some train tracks in Japan.

Car collisions with wildlife cost the U.S. an estimated $8 billion a year in repairs and injuries. A study published in Biological Conservation found that between mid-March 2020 and mid-April 2020 — when car traffic thinned during pandemic lockdowns — highway mortality of large wild animals like deer and coyotes fell 34% in four U.S. states. Vehicular movement has swiftly returned to normal, and though helping animals cross the street is only one part of a larger conservation puzzle, the effort has gained traction and political support. The U.S.'s recently passed infrastructure bill includes $350 million for such interventions, like wildlife crossings and underpasses.

"It's not a lost cause that humans and wildlife can coexist," says Cliffe.

Navigating the rope bridges is not exactly intuitive for sloths, she admits. They're creatures of habit, reluctant to change their ways when faced with new elements in their environment. When they approach the structures, they don't always know exactly what to do. But "once they use it the first time, they'll use it very, very frequently after that."

Stringing up several kilometers of rope can't entirely make up for widespread habitat destruction. To that end, the foundation is also trying to plant more trees. But it can put more space between sloths and their new, unnatural automobile predators.

"People look at them and think that they're so poorly equipped to survive because you see them crossing roads and trying to to move around and they look so awkward and useless," says Cliffe. "But if you put them in a well-connected rainforest, then they are masters of survival."

bloomberg.com, 30 November 2021

https://www.bloomberg.com

The Southern Ocean is still swallowing large amounts of humans' carbon dioxide emissions

2021-12-02

The Southern Ocean is still busily absorbing large amounts of the carbon dioxide emitted by humans' fossil fuel burning, a study based on airborne observations of the gas suggests. The new results counter a 2018 report that had found that the ocean surrounding Antarctica might not be taking up as much of the emissions as previously thought, and in some regions may actually be adding CO_2 back to the atmosphere.

It's not exactly a relief to say that the oceans, which are already becoming more acidic and storing record-breaking amounts of heat due to global warming, might be able to bear a little more of the climate change burden (SN: 4/28/17; SN: 1/13/21). But "in many ways, [the conclusion] was reassuring," says Matthew Long, an oceanographer at the National Center for Atmospheric Research in Boulder, Colo.

That's because the Southern Ocean alone has been thought to be responsible for nearly half of the global ocean uptake of humans' CO_2 emissions each year. That means it plays an outsize role in modulating some of the immediate impacts of those emissions. However, the float-based estimates had suggested that, over the course of a year, the Southern Ocean was actually a net source of carbon dioxide rather than a sink, ultimately emitting about 0.3 billion metric tons of the gas back to the atmosphere each year.

In contrast, the new findings, published in the Dec. 3 Science, suggest that from 2009 through 2018, the Southern Ocean was still a net sink, taking up a total of about 0.55 billion metric tons of carbon dioxide each year.

The 2018 study had used newly deployed deep-diving ocean floats, now numbering almost 200, that are part of a project called Southern Ocean Carbon and Climate Observations and Modeling, or SOCCOM. Calculations based on data collected from 2014 through 2017 by 35 of the floats

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CHEMWATCH
Bulletin Board
Curiosities
DEC. 10, 2021

suggested that parts of the ocean were actually releasing a great deal of carbon dioxide back into the atmosphere during winter (SN: 6/2/19). That sparked concerns that the Southern Ocean's role in buffering the impacts of climate change on Earth might not be so robust as once thought.

Long says he and other researchers were somewhat skeptical about that takeaway, however. The floats measure temperature, salinity and pH in the water down to about 2,000 meters, and scientists use those data to calculate the carbon dioxide concentration in the water. But those calculations rest on several assumptions about the ocean water properties, as actual data are still very scarce. That may be skewing the data a bit, leading to calculations of higher carbon dioxide emitted from the water than is actually occurring, Long suggests.

Another way to measure how much carbon dioxide is moving between air and sea is by taking airborne measurements. In the new study, the team amassed previously collected carbon dioxide data over large swaths of the Southern Ocean during three separate series of aircraft flights — one series lasting from 2009 to 2011, one in the winter of 2016 and a third in several periods from 2016 to 2018 (SN: 9/8/11). Then, the researchers used those data to create simulations of how much carbon dioxide could possibly be moving between ocean and atmosphere each year.

The float-based and aircraft-based studies estimate different overall amounts of carbon dioxide moving out of the ocean, but both identified a seasonal pattern of less carbon dioxide absorbed by the ocean during winter. That indicates that both types of data are picking up a real trend, says Ken Johnson, an ocean chemist at the Monterey Bay Aquarium Research Institute in Moss Landing, Calif., who was not involved in the research. "We all go up and down together."

It's not yet clear whether the SOCCOM data were off. But to better understand what sorts of biases might affect the pH calculations, researchers must compare direct measurements of carbon dioxide in the water taken from ships with pH-based estimates at the same location. Such studies are under way right now off the coast of California, Johnson says.

The big takeaway, Johnson says, is that both datasets — as well as direct shipboard measurements in the Southern Ocean, which are few and far between — are going to be essential for understanding what role these waters play in the planet's carbon cycle. While the airborne studies can help constrain the big picture of carbon dioxide emissions data from the Southern Ocean, the floats are much more widely distributed, and so are

able to identify local and regional variability in carbon dioxide, which the atmospheric data can't do.

"The Southern Ocean is the flywheel of the climate system," the part of an engine's machinery that keeps things chugging smoothly along, Johnson says. "If we don't get our understanding of the Southern Ocean right, we don't have much hope for understanding the rest of the world."

sciencenews.org, 2 December 2021

https://www.sciencenews.org

IKEA assebles a future without plastic packaging

2021-12-03

Thanks to tiny pieces and convoluted instructions, putting together a bookshelf from IKEA can be a maddening experience. But there's a payoff: What's stressful is stylish—and also sustainable.

The Swedish retailer has been a champion of the environment for years. In 2018, for instance, it announced plans to use only renewable and recycled materials in its products by 2030 and to complete all last-mile deliveries via electric vehicle by 2025. As of 2020, it no longer uses single-use plastics in its stores or restaurants. And earlier this year it pledged to sell solar panels and renewable energy to customers in all of its markets within the next four years.

But IKEA's environmental commitment isn't yet fully assembled. Like a piece of the company's furniture hours after a customer brings it home, it's still coming together. The newest piece to the puzzle: IKEA announced it would begin phasing out the use of plastic packaging for its products.

The company will wean itself off of plastic packaging in stages. First, it will eliminate plastic packaging from all new products by 2025. Then, by 2028, it will do the same with all existing products. The only place where plastic will remain beyond 2028 is in select food products, where plastic is needed to ensure food quality and safety.

"Phasing out plastic in consumer packaging is the next big step on our journey to make packaging solutions more sustainable and support the overall commitment to reduce plastic pollution and develop packaging from renewable and recycled materials," IKEA Packaging & Identification Manager Erik Olsen said in a press release. "The shift will happen progressively over the coming years, and mainly be focusing on paper as it is both recyclable, renewable, and widely recycled across the world."

But IKEA's environmental commitment isn't yet fully assembled.

CHEMWATCH
Bulletin Board
Curiosities
DEC. 10, 2021

IKEA, which every year spends over $1 billion on approximately 920,000 tons of packaging material, already has significantly decreased the amount of plastic used in its packaging. As of today, less than 10% of its packaging is made of plastic. To eliminate plastic completely, the company says, it will have to partner with product development teams and suppliers around the world. It might even have to engineer entirely new solutions.

"Ingenuity is part of the IKEA heritage, and packaging is by no means an exception in that regard," said IKEA Packaging Development Leader Maja Kjellberg. "Shifting away from plastic in our consumer packaging solutions will doubtlessly be a challenging task in the coming years. With this movement we aim to spur packaging innovation and use our size and reach to have a positive impact on the wider industry beyond our supply chain."

IKEA wants to lead by example. But not all companies are so proactive. Some U.S. states have therefore decided to give plastic-addicted corporations a push toward sustainable packaging. Two states, in particular: Maine and Oregon, both of which have enacted first-of-their-kind laws that require makers of consumer packaging to pay for the recycling and disposal of their products.

"The Maine and Oregon laws are the latest applications of a concept called extended producer responsibility, or EPR," authors Jessica Heiges and Kate O'Neill—researchers who study waste and ways to reduce it—explain in an article for The Conversation. "Swedish academic Thomas Lindhqvist framed this idea in 1990 as a strategy to decrease products' environmental impacts by making manufacturers responsible for the goods' entire life cycles."

Maine's law, which takes effect in 2024, requires manufacturers to pay into a fund based on the amount and the recyclability of packaging associated with their products. These funds will then be used to reimburse municipalities for eligible recycling and waste management costs, to make investments in recycling infrastructure, and to help citizens understand how to recycle.

Oregon's law, which takes effect in 2025, will require manufacturers to join stewardship organizations and pay fees that will be used to modernize Oregon's recycling system.

"Producers don't always literally take back their goods under EPR schemes. Instead, they often make payments to an intermediary organization or agency, which uses the money to help cover the products' recycling and

disposal costs," write Heiges and O'Neill. "Making producers cover these costs is intended to give them an incentive to redesign their products to be less wasteful."

Whether EPR laws actually work is a subject of much debate. Going forward, however, a mix of voluntary and regulatory measures might be the best way to incentivize a low-waste economy.

treehugger.com, 3 December 2021

https://www.treehugger.com

Real-life Moby Dick spotted off the coast of Jamaica

2021-12-04

A rare white sperm whale, like the one depicted in the literary classic "Moby Dick," has been spotted off the coast of Jamaica.

Sailors aboard the Dutch oil tanker Coral EnergICE glimpsed the ghostly cetacean on Nov. 29, when Capt. Leo van Toly recorded a short video highlighting a brief look at the white sperm whale near the water's surface. He sent the video to his sailing partner, Annemarie van den Berg, director of the whale conservation charity SOS Dolfijn in the Netherlands. After confirming with experts that the whale was indeed a sperm whale, SOS Dolfijn shared the video on the organization's Facebook page.

In Herman Melville's famous novel, Moby Dick is a monstrous white sperm whale hunted by the vengeful Captain Ahab, who lost his leg to the toothed whale. The book is narrated by the sailor Ishmael, who famously said, "It was the whiteness of the whale that appalled me," when referring to its paleness. Although Moby Dick was fictional, white sperm whales are real. Their whiteness is the result of either albinism or leucism; both conditions impact the whales' ability to produce the pigment melanin, which is responsible for their normal gray color. PLAY SOUND

"We don't know how rare white sperm whales are," Shane Gero, a sperm whale expert at Dalhousie University in Canada and founder of the Dominica Sperm Whale Project, told Live Science in an email. "But they do get seen from time to time."

Because the ocean is so expansive, scientists are unsure how many white sperm whales exist, Gero said. Sperm whales (Physeter macrocephalus) are also extremely elusive and hard to study because of their ability to dive deep into the ocean for long periods of time.

Although Moby Dick was fictional, white sperm whales are real.

CHEMWATCH
Bulletin Board
Curiosities
DEC. 10, 2021

"It's easy for a whale to hide, even one that is as long as a school bus," Gero said. "So even if there were many white sperm whales, we just wouldn't see them very often."

The last documented sighting of a white sperm whale occurred in 2015 off the Italian island of Sardinia. However, there have also been sightings in Dominica (in the Caribbean) and the Azores (in the Atlantic) in recent years, Gero said. It is possible that the one sighted in Jamaica is the same one from Dominica, but that is unclear, he added.

There are also occasional sightings of white whales among other species (other than belugas, whose normal color is white). An albino humpback whale named Migaloo has been sighted frequently in Australian waters since 1991, according to the Pacific Whale Foundation. And in July, whale watchers in Japan spotted a pair of white killer whales, which were most likely albinos, Live Science reported at the time.

White whales have either albinism or leucism. Albinism is a genetic condition in which an animal cannot produce melanin, a pigment that gives color to skin and hair, resulting in a total lack of color in the affected individual. Leucism is similar but affects melanin production in individual pigment cells, which can cause total or partial color loss. Therefore, whales with leucism can be totally white or have white patches.

Despite potential differences in coloration between albinism and leucism, "there is no way to conclusively tell them apart without genetics," Gero said. Some researchers believe eye color can also distinguish the two conditions, because most albino whales have red eyes, but this is not a guarantee, Gero said.

"The whale in Jamaica is very white, and my guess is it's an albino — but that's just my guess," Gero said.

Critics have long debated the significance of Melville's decision to make Moby Dick white. Some people believe he was criticizing the slave trade, while others claim it was done purely for theatrics, according to The Guardian. However, to Gero, the significance of Moby Dick was not the whale's coloration but the way the book depicts the relationship between humans and sperm whales.

Around the time the book was written in 1851, sperm whales were being hunted across the globe for the highly valuable fats and oils in their blubber, Live Science previously reported. This not only drove the species to the brink of extinction but also pushed humans to develop new

sources of energy and the technology associated with them. "If it were not for sperm whales, our industrial age would be very different," Gero said. "Before fossil fuels, these whales powered our economy by making our machines run and lighting up our nights."

Whaling is no longer a serious threat to sperm whales, Gero said, but humans still introduce dangers such as ship strikes, noise pollution, oil spills, plastic pollution and entanglement in fishing gear.

Sperm whales are currently listed as vulnerable to extinction, but their exact numbers and global population trends are poorly understood because of a lack of data, according to the International Union for Conservation of Nature (IUCN).

Originally published on Live Science.

livescience.com, 4 December 2021

https://www.livescience.com

Paris has a new plan to make the Seine swimmable

2021-12-05

A new project launched in Paris might help the city finally achieve a long-held but elusive goal: making the River Seine clean enough to swim in.

Paris may have one of the most beautiful urban rivers in the world, but attempts to render the Seine safe to enough to plunge into have been falling short since as far back as 1988, when then-Mayor Jacques Chirac made a never-fulfilled promise to swim in it within five years. More recently, in 2017, the city opened swimming facilities along the more sheltered Canal Saint Martin, which runs through eastern Paris before opening onto the Seine. But even this smaller, more manageable waterway has had to be closed at times when bacteria levels in the water rose too high.

Now, however, the city has a plan that might be able to curb pollution more permanently, making it swimmable — and usable as a competition venue — in time for the 2024 Summer Olympics. Under a public garden near the Left Bank's Gare D'Austerlitz, Paris is now building a vast subterranean water tank that will store stormwater to prevent sewage spilling into the river when the city's drains overflow during heavy rain.

The problem the tank seeks to deal with is by no means unique to Paris. The city's 19th century sewer system mixes sewage with rainwater, and

Over 2 million cubic meters (528 million U.S. gallons) of sewage-contaminated water finds its way into the river this way, leaving the river infested with a host of harmful bacteria.

CHEMWATCH
Bulletin Board
Curiosities
DEC. 10, 2021

during heavy downpours can be overwhelmed by the volume of liquid it needs to channel. On such occasions, the mixed water and waste discharges into the Seine through 44 storm drains. Over 2 million cubic meters (528 million U.S. gallons) of sewage-contaminated water finds its way into the river this way, leaving the river infested with a host of harmful bacteria.

This is still an improvement on levels in the 1990s, which were 10 times as bad. To be fair to Chirac, his rash promise preceded a program of major sewer system improvements that did indeed reduce pollution significantly. Today, the number of species of fish living in the river has increased markedly. But while the water is now clean enough for occasional sporting use — current mayor Anne Hidalgo's son, professional swimmer Arthur Germain, swam the Seine from sea to source this past summer — swimming is still illegal in the river's urban stretches, thanks to bacteriological and boat-traffic risks. And sewage overflows are only likely to become more frequent due to the more intense rain events heralded by climate change.

That's where the new stormwater holding tank comes in. With a capacity of 46,000 cubic meters — sufficient to hold over 12 million U.S. gallons — it could comfortably swallow enough water to fill an Olympic-sized swimming pool about 30 times over. The tank is an "extraordinary project of exceptional size unprecedented in a city as dense and constrained as Paris," the city's chief water engineer told newspaper Journal Du Dimanche. It will cost 1.4 billion euros ($1.6 billion) and remain entirely invisible at the surface level and there will be enough space for trees to grow in the topsoil of the garden above. Connected by underground tubes to sewers on both sides of the Seine, the tank will pump its contents back into the system over 24 hours once the heavy rain has passed.

It is still not completely guaranteed that the tank will be able to keep the Seine free of sewage. While the amount of discharge into the river will be slashed, the city estimates that 100,000 cubic meters of waste water will enter the river annually — a volume that might still make the river worth avoiding after heavy rain. Nevertheless, the fact that Paris is prepared to invest so heavily in cleaning the river is a sign of just how much symbolic power the concept of a pristine urban river has.

Paris is far from alone among European cities that are trying to clean up their waterways. Berlin has had a longstanding plan, still going through the process of official approval, to make one central arm of the River Spree suitable for swimming by installing an stretch of reed beds to filter the

water before it reached the swimming basin. A vision for London called the Thames Baths would deploy floating freshwater swimming pools along the river. Along with its new storm tank, Paris is also conducting a similar micro-experiment with water purification. It is installing some reed beds in the Bois de Boulogne park to see if they could be used to filter rainwater polluted by contact with roadways.

Paris will not just get a cleaner environment. It will be able to use the Seine for the Olympic triathlon, and plans to mark out three swimming basins within the water's flow to use for other swimming events. While the pools may not stay, the city will maintain swimming access after the games have departed, improving a river that is already the site of pedestrian walks and temporary summertime beaches. The infrastructure investment required to make this happen is considerable, but in a city that prizes itself both on its beauty and its drive to create a cleaner, greener environment, the idea that one day soon, people could just slip into crystal waters and paddle past the Louvre seems too good to pass up.

bloomberg.com, 5 December 2021

https://www.bloomberg.com

Light-colored feathers may help migrating birds stay cool on long flights

2021-12-06

From teeny hummingbirds to giant whooping cranes, roughly half of the world's more than 10,000 bird species migrate. Longer wings and beefed-up flying muscles often help these birds crisscross vast expanses of air. But a study of nearly all bird species suggests many migrators share another unexpected flight aid: lighter-colored feathers.

Being a tad more lightly colored than non-migrating birds may help these long-distance fliers stay cool as they work hard under the hot sun to fly, researchers report December 6 in Current Biology.

It's known that color can help birds hide from predators by blending in, or attract mates by standing out. But color has subtler effects too, including regulating temperature by absorbing or reflecting light, says Kaspar Delhey, an ornithologist at the Max Planck Institute for Ornithology in Seewiesen, Germany. For example, bird eggs laid in colder climates tend to be darker, which may help keep them warm (SN: 10/28/19).

But a study of nearly all bird species suggests many migrators share another unexpected flight aid: lighter-colored feathers.

CHEMWATCH
Bulletin Board
Curiosities
DEC. 10, 2021

Migrating birds push their bodies to the physiological limit, which creates excess heat. Some species cope by ascending to cooler air during daytime. "If overheating is a problem in migratory birds, another way of dealing with that would be to evolve lighter colors" that absorb less heat, Delhey says.

Delhey and his colleagues analyzed over 20,000 illustrations of 10,618 bird species, ranking plumage lightness for each species and comparing that with how far the birds fly. On average, lightness slightly increased with migratory distance, the team found. The longest-distance migrators were about 4 percent lighter than non-migrators, an effect that wasn't explained by size, climate or habitat type for different species.

"It's not a big difference," Delhey says, noting that many migrators are darkly colored, perhaps for reasons unrelated to flight. But the trend was remarkably consistent.

"Very different groups with very different biologies show this pattern," Delhey says. "That surprised us."

sciencenews.org, 6 December 2021

https://www.sciencenews.org

All that glitters isn't litter

2021-12-06

COMEDIAN DMITRI MARTIN once dubbed glitter the herpes of the craft world thanks to its virus-like ability to stick around forever. It's also the litter of the rest of the world. Like other microplastics ground down from bags and bottles, those tiny, shiny pieces get swept down drains and blown around by the wind. Microplastics wind up in the air and in raindrops. They are scattered across the Arctic wilderness and buried deep in sediment at the bottom of the ocean. Studies show babies ingest them at alarmingly high rates, and the rest of us are consuming plenty, too.

Now, researchers think they may have a solution, at least to the glitter part of the problem: a version that's biodegradable, could be produced using less energy, and even grows on trees. It's cellulose: teeny bits of the same substance that makes up the cell walls of plants. When cellulose is assembled into crystals, it reflects light, so those same bits of cellulose not only provide structure to plants but also give butterflies their bright, iridescent wings and make peacocks' colorful tails so luminous. The plant version can be easily extracted from materials that would otherwise be trash, like wood pulp, mango skins, and coffee grounds.

Now, researchers think they may have a solution, at least to the glitter part of the problem: a version that's biodegradable, could be produced using less energy, and even grows on trees. It's

Researchers at the University of Cambridge are figuring out how to produce these nanocrystals on a larger scale than ever, although the process remains painfully slow. "We can make them in different sizes and, depending on the size, we think the particles that we make can replace different products," says Benjamin Drouget, a PhD student in chemistry and first author on the paper describing his team's process, published in November in Nature Materials. Large pieces could be used in place of ordinary craft glitter, while smaller particles could be mixed into cosmetics.

Even though these glittery pieces of plastic are tiny, the European cosmetics industry uses up to 5,500 tons of microplastics every year. And other plastic glitter replacements have proved to be problematic. One popular mineral, titanium, is a carcinogen which will be banned in Europe next year. Mica, another option, is often mined using child labor and can be toxic to acquatic environments.

Some kinds of color are created by using pigments. Grind up a rock like lapis lazuli and mix it with water or egg yolk and you've got blue dye or tempera paint. To change the color, you have to change the material, says Silvia Vignolini, a chemistry professor at Cambridge and the head of Droguet's research group. But there's another way to create color: structural coloration. This means that the color is an artifact of the material's microscopic shape, rather than a characteristic of the material itself. Vignolini gives the example of a soap bubble. "You start with something that is water, it's transparent," she says. "But as soon as you have the structure, then you get the coloration."

For cellulose nanocrystals to create color, they need to stack on top of each other, making 360-degree spirals, like steps in winding staircases. Depending on the difference in height between the steps, and on the angle of the staircase, the crystals will refract different wavelengths of light, creating different colors. A peacock's feather, for example, is studded with tiny, hairlike structures filled with photonic crystals whose different structures reflect green, blue, yellow, and brown.

Yet while none of this information is new, it's been hard to use in a lab. Figuring out how to get these microscopic crystals to reliably assemble into vibrant colors is tricky. So is producing them in large quantities. A petri dish of glitter is far from the 10-pound minimum order required by major manufacturers.

This is the problem Droguet's team set out to solve using cellulose derived from commercially-available wood pulp. First, they had to figure out how to get the crystals to set up in the right way. They will automatically form

CHEMWATCH
Bulletin Board
Curiosities
DEC. 10, 2021

a structure, but which structure depends on the ionic composition of the water they're in. To change that composition, "you just add salt, really," says Vignolini. The salt changes how the molecules are attracted to each other, and dictates the shape they form and subsequently the color of the glitter they make. Just adding five milligrams will change the color of an entire kilogram of cellulose, making the crystals refract shorter wavelengths, like greens and blues. With less salt, they refract longer wavelengths, like red.

The team also figured out how to control the production process carefully so that they can now create meter-long sheets of glitter using a roll-to-roll machine, a common piece of industrial equipment. The machine rolls skeins of a polymer base, or "web," while a dispenser squirts out even amounts of the nanocrystal solution. The mixture has to be thin enough that it's easy to deposit on the roll, but viscous enough to leave a deep, even color.

At this point, the mixture is clear, so the team can't tell if they've successfully produced a good batch until they run the web through a hot air dryer. After the water evaporates, only a film of the nanocrystals remains. The color suddenly emerges and deepens. "At the last moment, it's really fast," says Droguet, who has made green, blue, red, and gold glitters. The film can then be peeled off the web and ground into craft glitter or mixed into paint. The process requires less energy than manufacturing plastic glitter, and the final product keeps its sparkle even when it's mixed in soapy water, ethanol, and oil which means it could be used in makeup and even in food. "I think now we have demonstrated that the principles work at a large scale," Droguet says.

But they haven't yet tried making industrial quantities. Using the equipment at Cambridge, it currently takes Droguet about two months to make a kilogram of glitter. To increase production, he'll need funding and access to commercial venues that have bigger roll-to-roll machines. So far it's been challenging to get companies onboard; Vignolini says manufacturers have been excited but hesitant because this material is so different from the ones they currently use. "It's radically new," she says, and companies want to make sure it works.

Vignolini and Droguet also want to run tests to understand how this material breaks down over its lifecycle and how that decomposition could affect the environment. They've partnered with Dannielle Green, an ecologist at Anglia Ruskin University in the United Kingdom, who has studied other cellulose-based glitters to see how they affect the growth of algae.

One of the overall problems with glitter, Green says, is that it's a material that's meant to be scattered in large quantities at events like festivals and parades. "Where you're throwing handfuls of the stuff around, then that is going to have a big impact on the environment locally," she says. Those effects can include things like stunting plant growth, getting into animals' bodies, and working its way into the food chain. If cellulose nanocrystals break down more quickly than plastic, and without needing certain ideal conditions to decompose, they could keep one source of plastic out of that chain.

But even adding organic matter like cellulose can influence an ecosystem, Green says. As the crystals degrade, they can add biomass to the environment, which can lead to an increase in chemicals like inorganic nitrogen. If present in large quantities, these chemicals can decrease the oxygen available to plants and algae. "I imagine we would need a heavy load for this to happen, so it is unlikely to occur with a small amount of cellulose-based glitter," she says.

So far, the team hasn't discovered any problems with their prototype glitter, but they'll need to keep testing longer before they'll understand how it ages, and if it produces long-term effects. "We hope that our material is a solution, but at the same time, I think it's important people understand that we are also thinking about what are the other problems that our material can cause and take them into account," says Vignolini.

Given the vast scale of microplastics contamination, Green worries that solutions focused on tiny sources of pollution, like glitter, can be a distraction from much bigger contributors, like car tires and synthetic fabrics. But she also says there is a utility to making change where you can. "If you can easily stop a form of litter going into the environment," she asks, "then why not do it?"

wired.com, 6 December 2021

https://www.wired.com

Earth is getting a black box to record our climate change actions, and it's already started listening

2021-12-06

On a granite-strewn plain, surrounded by gnarled mountains, sits a giant steel box.

This is Earth's Black Box.

CHEMWATCH
Bulletin Board
Curiosities
DEC. 10, 2021

Incongruous in the landscape, much like Kubrick's black monolith of 2001: A Space Odyssey fame, its alien presence suggests it was put there with intent.

And if those that discover it can decipher the messages it contains, they could get a glimpse of what caused the fall of the civilisation that was there before.

This is Earth's Black Box.

'First and foremost, it's a tool'

When an aeroplane crashes, it's left to investigators to sift through the wreckage to recover the black box.

It's hoped the recorded contents can be used to help others avoid the same fate.

And so it is with Earth's Black Box: a 10-metre-by-4-metre-by-3-metre steel monolith that's about to be built on a remote outcrop on Tasmania's west coast.

Chosen for its geopolitical and geological stability, ahead of other candidates like Malta, Norway and Qatar, the idea is that the Tasmanian site can cradle the black box for the benefit of a future civilisation, should catastrophic climate change cause the downfall of ours.

If that sounds unhinged, it's worth remembering that we're currently on track for as much as 2.7C of warming this century.

Ask any climate scientist what happens when warming breaches 2C, and they'll almost invariably tell you it's not worth thinking about.

Plenty of past civilisations and empires have collapsed in the face of less.

So what is this black box? Artistic installation? Academic experiment? Or something else?

The project is completely non-commercial, and the guiding design principle is functionality, according to Jim Curtis from Clemenger BBDO.

"Obviously it's really a powerful concept when you say to someone, 'Earth's got a black box'. Because they're like, 'Why does it need a black box?'" said Mr Curtis, who's collaborating on the project with University of Tasmania researchers, among others.

"But first and foremost, it's a tool."

It's designed to record our actions

The box will be made from 7.5-centimetre-thick steel, cantilevered off granite, according to Jonathan Kneebone, co-founder of artistic collective the Glue Society, which is also involved.

"It's built to outlive us all," he said.

"If the worst does happen, just because the power grids go down, this thing will still be there."

The box will be filled with a mass of storage drives and have internet connectivity, all powered by solar panels on the structure's roof.

Batteries will provide backup power storage.

When the sun is shining, the black box will be downloading scientific data and an algorithm will be gleaning climate-change-related material from the internet.

Broadly, it will be collecting two types of data:

- It will collect measurements of land and sea temperatures, ocean acidification, atmospheric CO2, species extinction, land-use changes, as well as things like human population, military spending and energy consumption.
- And it will collect contextual data such as newspaper headlines, social media posts, and news from key events like Conference of the Parties (COP) climate change meetings.

"The idea is if the Earth does crash as a result of climate change, this indestructible recording device will be there for whoever's left to learn from that," Mr Curtis says.

"It's also there to hold leaders to account — to make sure their action or inaction is recorded."

Recordings have already started

The black box will record backwards, as well as forwards in time, to document how we got to where we are — pulling any available historical climate change data off the internet.

And although construction of the housing structure itself will only begin mid next year, the hard drives have already begun recording, beginning with the COP26 climate conference in Glasgow in November this year.

CHEMWATCH
Bulletin Board
Curiosities
DEC. 10, 2021

Using compression and archiving, the developers estimate there will be enough capacity to store data for the next 30 to 50 years.

In the meantime, they're investigating ways to expand that capacity, and more long-term storage methods including inscribing to "steel plates".

"This will enable us to be far more efficient with how each tier of storage is used and make it possible to store data for hundreds, if not thousands of years," they said.

The worst has happened. Now what?

Mad Max envisioned a post-apocalyptic world fighting over scarce resources.(Gfycat)

So let's say we go the full Mad Max; climate change causes crops to fail year on year; ocean food-webs collapse; it becomes impossible to feed eight, nine, 10(?) billion people; hundreds of millions are displaced by rising seas; economies shrink and society as we know it goes over the falls.

Those who have discovered the black box — now the colour of rust, its solar panels long since dead — have got no frame of reference for what they find inside or how to decipher it.

So now what?

"That is a [question] that we are still working on ourselves," the developers say.

"It is impossible to anticipate who or what will find [it].

"But it can be assumed that it will not be of any use unless it is discovered by someone or something ... with the capability of understanding and interpreting basic symbolism."

Gaining access to the box's interior through its three-inch-thick steel casing will already require some ingenuity.

The developers presume whoever is capable of that will also be able to interpret basic symbols.

"Like the Rosetta Stone, we would look to use multiple formats of encoding," they said.

"We are exploring the possibility of including an electronic reader that stays within the box and will be activated upon exposure to sunlight, also

reactivating the box if it has entered a long-term dormant state as a result of catastrophe."

I'm impatient for the apocalypse, what good is it to me now?

Once the black box is up and running, the growing data bank will be accessible via a digital platform, and the plan is that people will also be able to connect wirelessly with it, if they're to visit the site.

"There are other features we are playing with such as transmitting summary stats in longer intervals into space, and having [a] "heartbeat" that communicates that the box is on and actively recording to on-site visitors," the developers said.

The location, between Strahan and Queenstown, is remote enough to offer some insulation from sabotage, but accessible enough for those who want to see it.

"It takes a good four hours from Hobart, [but] it is something you'd be able to stop your car and go look at," Mr Kneebone said.

And while it's intended as a blueprint for a post-apocalyptic society of what not to do, it's also hoped that a complete recording of political and business leaders' actions on climate change might have an impact right now.

"When people know they're being recorded, it does have an influence on what they do and say," Mr Kneebone said.

"That's our role if anything, to be something in the back of everyone's mind."

It's tempting to write this project off as an indulgence in climate alarmism.

But while most people don't get onto an aeroplane thinking it's going to crash, that's not a reason to forgo a black box.

abc.net.au, 6 December 2021

https://www.abc.net.au

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

CHEMICAL EFFECTS

Dietary application of Lactococcus lactis alleviates toxicity and regulates gut microbiota in Cyprinus carpio on exposure to heavy metals mixture

Structures of Endocrine-Disrupting Chemicals Correlate with the Activation of 12 Classic Nuclear Receptors

UV-aging of microplastics increases proximal ARG donor-recipient adsorption and leaching of chemicals that synergistically enhance antibiotic resistance propagation

In utero exposure to endocrine-disrupting chemicals, maternal factors and alterations in the epigenetic landscape underlying later-life health effects

ENVIRONMENTAL RESEARCH

Towards understanding the impact of plastics on freshwater and marine microalgae: A review of the mechanisms and toxicity endpoints

New insights into submarine tailing disposal for a reduced environmental footprint: Lessons learnt from Norwegian fjords

Mass Spectrometry in Wastewater-Based Epidemiology for the Determination of Small and Large Molecules as Biomarkers of Exposure: Toward a Global View of Environment and Human Health under the COVID-19 Outbreak

OCCUPATIONAL

Association of occupational exposure to pesticides with overweight and abdominal obesity in family farmers in southern Brazil

National and subnational burden of disease attributable to occupational exposure to solar ultraviolet radiation (SUVR) in Iran, 2005-2019

PHARAMACEUTICAL/TOXICOLOGY

Levels and risks of surface contamination by thirteen antineoplastic drugs in the Czech and Slovak hospitals and pharmacies