CHEMWATCH

Bulletin Board

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CONTACT US

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

1227 Glen Huntly Rd
Glen Huntly
Victoria 3163 Australia

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ASIA PACIFIC

Research into backyard soil contaminants

2022-03-25

The benefits of growing produce in your own backyard are well recognised – fresh, seasonal food that hasn't travelled miles to get to you and is available when you need it.

However, less well known is the effect soil contaminants can have on backyard produce and human health. Macquarie University is focusing in on potential metal contaminants in garden soils through their soil testing program VegeSafe.

VegeSafe provides Australians the opportunity to submit soil samples for analysis and get advice for remedial action if contamination is present at unacceptable levels.For more information, including how to get involved, visit the VegeSafe website.

In New Zealand, the University of Auckland has partnered with GNS Science to run a similar testing program for New Zealand soils. To learn more about the Soilsafe program, visit the Soilsafe website.

Read More

Food Standards Australia New Zealand, 25-03-22

https://mailchi.mp/c74fbb88fc8f/food-standard-news-1300241?e=%5bUNIQID%5d

Public consultations

2022-03-22

Proposal P1053 – Food Safety Management tools

FSANZ invites written submissions for the assessment of its review of food safety management tools. Submissions close 6pm 11 April 2022.

Application A1215– Cetylpyridinium chloride (CPC) as a processing aid

FSANZ invites written submissions on the addition of Cetylpyridinium chloride (CPC) to Schedule 18 of the Food Standards Code. Submissions close 6pm 13 April 2022.

Proposal M1020 – Maximum Residue Limits (2021)

The benefits of growing produce in your own backyard are well recognised – fresh, seasonal food that hasn't travelled miles to get to you and is available when you need it.

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FSANZ invites written submissions on varying Schedule 20 in the Food Standards Code to align Maximum Residue Levels with those established by the Australian Pesticides and Veterinary Medicines Authority, Codex or trading partner standards for the requested agvet chemicals for food import purposes. Submissions close 6pm 27 April 2022.

Read More

Food Standards Australia New Zealand, 25-03-22

https://mailchi.mp/c74fbb88fc8f/food-standard-news-1300241?e=%5bUNIQID%5d

AMERICA

PFAS Air Regulations Proposed By House

2022-03-31

In the latest federal legislative move to try to force the EPA to take quicker action than contemplated by the agency's PFAS Roadmap of 2021, a bill was recently introduced in the House that would require the EPA to set air emission limits for all PFAS under the Clean Air Act. PFAS air regulations are something that advocates concerned about PFAS pollution issues beyond just drinking water have advocated for in the past few years. There are barriers, though, to achieving the desired results even if the legislation passes. Nevertheless, the federal legislative activity underscores the need for all companies that are currently using PFAS in their manufacturing or industrial processes to understand the full scope of compliance needs when and if PFAS air regulations become a reality.

House Bill For PFAS Air Regulations

On March 17, 2022, a bipartisan group in the House introduced the "Prevent Release Of Toxics Emissions, Contamination, and Transfer Act of 2022" (also known as the PROTECT Act of 2022 or HR 7142). The aim of the bill is to require the EPA to list all PFAS as hazardous air pollutants (HAPs) under the Clean Air Act. If passed, the designation as HAPs would require the EPA to develop regulatory limits for the emission of PFAS into the air.

The proposed steps, however, go well beyond the EPA's own plan for potential PFAS air regulations as detailed in the EPA's PFAS Strategic Roadmap 2021. In the PFAS Roadmap, the EPA indicates that it commits to performing ongoing investigation to:

A bill was recently introduced in the House that would require the EPA to set air emission limits for all PFAS under the Clean Air Act.

- Identify sources of PFAS air emissions;
- Develop and finalize monitoring approaches for measuring stack emissions and ambient concentrations of PFAS;
- Develop information on cost-effective mitigation technologies; and
- Increase understanding of the fate and transport of PFAS air emissions to assess their potential for impacting human health via contaminated groundwater and other media pathways.

The EPA committed to using this information and data in order to, by the Fall of 2022, "evaluate mitigation options", which could include listing "certain PFAS" as HAPs. However, the EPA also indicated that it might use other regulatory or non-regulatory tools to achieve results similar to formal PFAS air regulations under the Clean Air Act.

Read More

The National Law Review, 31-03-22

https://www.natlawreview.com/article/pfas-air-regulations-proposed-house

After 5-month delay, NYC health department adopts new federal rules on childhood lead exposure

2022-03-28

A prick of the fingertip is a rite of passage for most New York children. During their first six years of life, state law mandates that their blood must be regularly screened for lead exposure.

Widely used in paint, plumbing and gasoline in centuries past, lead is a neurotoxin that can cause irreversible learning impairments and behavioral problems. The Centers for Disease Control and Prevention has determined that no amount of exposure is safe. But one of the lingering debates within public health circles has asked what level should merit a response from a pediatrician or a health department.

In 2019, the City Council passed legislation requiring the city's health department to follow any changes in what the CDC calls its "blood lead reference value" — essentially an indicator for when local health departments should intervene to provide treatment and cut off the source of exposure. That shift came in October, when the CDC lowered its reference value from 5 micrograms per deciliter of blood to 3.5 micrograms.

A prick of the fingertip is a rite of passage for most New York children. During their first six years of life, state law mandates that their blood must be regularly screened for lead exposure.

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But New York City officials did not immediately adopt the new guidance, despite the legal requirement from the City Council. After nearly five months of public pressure by public health advocates, the New York City Health Department moved to adopt the CDC's new reference level of 3.5 micrograms, according to a department spokesperson.

Any test results at or above that level will now automatically trigger an investigation by the department. According to data obtained by Gothamist via a Freedom Of Information Law request, the shift in policy means hundreds of additional children will now be eligible for city-funded services each year, amounting to a 50% increase in the city's annual caseloads.

Read More

Gothamist, 28-03-22

https://gothamist.com/news/after-5-month-delay-nyc-health-department-adopts-new-federal-rules-on-childhood-lead-exposure

EUROPE

France - Results of the annual control of chemicals, biocides and detergents

2022-03-16

On 21st January 2021, the Direction Générale de la Concurrence, de la Consommation et de la Répression des Fraudes (DGCCRF) published its annual control plan for chemicals, biocides and detergents 2020.

The annual control plan had to be adapted during 2020 to take into account the situation with COVID-19. The main products checked in 2020 were therefore hydro-alcoholic gels and solutions, disinfectants and detergents. The rate of non-compliance noted on the hydro-alcoholic gels and solutions sampled was particularly high.

Read More

Eurofins, 16-03-22

https://www.eurofins.com/consumer-product-testing/media-centre/news/chemicals-monthly-bulletin-march-2022/#A4

Council adopts 8th environmental action programme

2022-03-29

The Council today adopted the 8th Environmental Action Programme (EAP). The 8th EAP will serve as a guide for environmental policymaking and implementation until 2030. The adoption follows a provisional agreement reached with the European Parliament in December 2021 and is the final step of the adoption procedure.

The 8th EAP aims to accelerate the green transition in a just and inclusive way, with the 2050 long-term objective of 'Living well, within the planetary boundaries.'

The six thematic priority objectives of the 8th EAP concern: greenhouse gas emissions reductions, adaptation to climate change, a regenerative growth model, a zero-pollution ambition, protecting and restoring biodiversity, and reducing key environmental and climate impacts related to production and consumption.

The Council and the Parliament agreed on several enabling conditions for achieving the priority objectives, in particular:

- decreasing the EU's material and consumption footprints
- strengthening environmentally positive incentives
- phasing out environmentally harmful subsidies, in particular fossil fuel subsidies.

The co-legislators also agreed to include in the 8th EAP a mid-term review in 2024 of the progress achieved in reaching its thematic priority objectives. Following this review, the Commission should, if appropriate, submit a legislative proposal to add an annex to the 8th EAP, which contains a list and timeline of actions for the period after 2025.

Background

Environment action programmes have steered the development of EU environment policy since the early 1970s.

The European Commission presented its proposal for a Decision of the European Parliament and the Council on a General Union Environment Action Programme to 2030 on 14 October 2020. The Council presidency and the European Parliament's negotiators reached a provisional political agreement on the proposal on 1 December 2021.

That decision has been formally adopted. It will now be published in the Official Journal of the European Union and enter into force.

The 8th EAP aims to accelerate the green transition in a just and inclusive way, with the 2050 long-term objective of 'Living well, within the planetary boundaries.'

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Council of the EU, 29-03-22

https://www.consilium.europa.eu/en/press/press-releases/2022/03/29/council-adopts-8th-environmental-action-programme/

Italy - Change of implementation date for environmental labelling in packaging

2022-03-16

On 28th February 2022, the law of 25 February 2022 n. 15 of the conversion of the decree law 30 December 2021 n. 228 (so-called Milleproroghe) was published in the Official Gazette.

Art. 11 of the provision will postpone the application of environmental labelling in packaging until 31st December 2022, as well as the possibility of marketing stocks of products already placed on the market until 1st January 2023.

After this date, the Italian Legislative Decree 116/2020 (amendment of the Italian Environmental Regulations) will be effective and mandatory for the environmental labelling on packaging in Italy for business to consumers (B2C) and business to business (B2B) packaging.

Read More

Eurofins, 16-03-22

https://www.eurofins.com/consumer-product-testing/media-centre/news/regulatory-updates-03-2022/

The law of 25 February 2022 n. 15 of the conversion of the decree law 30 December 2021 n. 228 (so-called Milleproroghe) was published in the Official Gazette.

Consultation: Safety of Triclocarban and Triclosan as substances with potential endocrine disrupting properties in cosmetic products - Deadline for comments: 27 May 2022

2022-03-25

Conclusion of the opinion:

In light of the information submitted via the call for data, the currently available scientific literature, relevant in silico tools and SCCS' expert judgement and taking under consideration in particular the concerns related to potential endocrine disrupting properties, the SCCS is requested:

1. to identify and justify specific concerns regarding the safe use of Triclocarban and Triclosan in cosmetic products

Based on the safety assessment carried out in consideration of all available information, including the potential endocrine effects, the SCCS is of the opinion that:

- The use of Triclocarban as a preservative in cosmetic products is safe up to a maximum concentration of 0.2%.
- In addition to the preservative function, the use of Triclocarban is also safe up to a maximum concentration of 1.5% in rinse-off products when used individually or in combination.
- The use of Triclosan is safe as a preservative up to a maximum concentration of 0.03% in shower gel and hand soap, 0.2% in mouthwash, and 0.3% in toothpaste, deodorant stick, face powder and blemish concealer, when used individually or in combination.
- The use of Triclosan is not considered safe as a preservative up to a maximum concentration of 0.3% in body lotion when used individually or in combination. The use of Triclosan in body lotion is considered safe when its concentration does not exceed 0.03% when used individually or combined with the above-mentioned products.

The SCCS is not aware of the use of Triclocarban and Triclosan together in a single product, and therefore this has not been assessed.

2. to highlight if there is a potential risk for human health from the use of Triclocarban and Triclosan in cosmetic products

Read More

European Commission, 25-03-22

https://ec.europa.eu/health/publications/safety-triclocarban-and-triclosan-substances-potential-endocrine-disrupting-properties-cosmetic_en

INTERNATIONAL

Food and packaging waste prevention and reduction initiative

2022-03-22

A special greeting and appreciation to the Consumer Goods Council of South Africa and the EU-SA Dialogue Facility for organising this special event of closing off the work that began in 2019 and to reflect on the

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progress and achievements made so far towards the United Nations' Sustainable Development Goal 12.3 of reducing food loss and waste by 50% by year 2030.

The Covid-19 pandemic that started in 2020, aggravated the already existing challenges on food production and consumption, but also provided us all with opportunities to rethink our practices as we grappled with changes in consumer buying habits and global supply chain disruptions.

The 2018 State of Waste report estimated that of the 55.6 million tonnes of general waste that was generated in South Africa, 19 247 851 tonnes was organic waste (incl. food waste) and 65.2 % was landfilled.

The Food and Packaging Waste Prevention and Reduction Initiative seeks to address food security from the perspective of avoiding food waste. Food loss and waste is a recognised global issue which is also affecting South Africa. According to the Department of Science of Innovation and CSIR, an estimated 10.3 million tonnes of food and beverages, which is about 34.3% of local food production, is wasted per year in South Africa amounting to R61.5 billion per annum.

While our country has these shocking food waste statistics, we also have a problem of acute food insecurity. The Integrated Food Security Phase Classification (IPC) is a common global scale for classifying the severity and magnitude of food insecurity and malnutrition. Globally, indications are that around 800 million people are undernourished It is concerning that in 2020, 9.34 million people in South Africa suffered from acute food insecurity and urgent action is required to reduce food gaps and protect livelihoods according to Integrated Food Security Phase Classification.

This requires urgent intervention directed at that those identified areas and populations with food deprivation that threatens livelihoods, regardless of the causes, context or duration. South Africa's deteriorating food security is mainly driven by the COVID-19 pandemic, high food prices, drought and economic decline. StatsSA indicates that almost 20% of South African households have inadequate access to food.

Read More

South African Government, 23-03-22

https://www.gov.za/speeches/s-barbara-creecy-23-mar-2022-0000

The Covid-19 pandemic that started in 2020, aggravated the already existing challenges on food production and consumption, but also provided us all with opportunities to rethink our practices.

MCTI and British Government launch this Thursday (24) platform for climate science

2022-03-22

The website will provide cutting-edge scientific research on sectors such as agriculture, energy, sanitation and infrastructure, directly affected by the impacts of climate change.

The Ministry of Science, Technology and Innovation (MCTI) and the British Embassy in Brazil launch this Thursday (24), at 10 am, the VIEWPoint Brazil platform . The site makes available in accessible and free language cutting-edge scientific research on the impacts of climate change in sectors such as agriculture, energy, sanitation and infrastructure. The objective is to reach especially managers responsible for decisions on crucial climate actions at the municipal, state and national levels.

The launch will be at an online event. To participate, simply register at this link.

The scientific research included in the platform was developed through the Partnership for Climate Science - Brazil (CSSP) and translated and adapted by the Climate Analysis Institute at the University of Reading, in the United Kingdom. Projections of future climate impacts in Brazil, improved fire risk alerts and seasonal forecasting services are some of the results of this partnership.

Brazilian and British researchers will make demonstration presentations on the platform's features on topics such as fire, climate extremes, agriculture, flood forecasting and carbon budgeting.

About CSSP Brasil - The partnership launched in 2016 between Brazil and the United Kingdom allowed institutions from both countries to work closely together. These include the institutions linked to the MCTI - National Institute for Space Research (INPE), the National Institute for Research in the Amazon (INPA), the National Center for Monitoring and Alerts for Natural Disasters (CEMADEN) - and the Met Office, British weather service, and academic partners in both countries. The partnership has produced cutting-edge climate research and critical scientific collaboration for climate-resilient economic and social development.

This is an innovative approach to encouraging the wider use of climate resources and the development of services for climate adaptation and mitigation in Brazil, the UK and internationally to reduce the impacts of climate change and achieve carbon neutrality (Net Zero).

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Read More

Gov.br, 23-03-22

https://www.gov.br/mcti/pt-br/acompanhe-o-mcti/noticias/2022/03/mcti-e-governo-britanico-lancam-nesta-quinta-24-plataforma-para-ciencia-climatica

The website will provide cutting-edge scientific research on sectors such as agriculture, energy, sanitation and infrastructure, directly affected by the impacts of climate change.

REACH Dossier Improvement Action Plan

2022-03-31

In June 2019 the European chemical industry launched an unprecedented action to help its members proactively and systematically review and update data in previously submitted REACH registration dossiers. This initiative comes in response to the recent conclusion by the European Chemicals Agency (ECHA) that many REACH registration dossiers require additional information.

To this end Cefic has developed a multi-annual Action Plan, which provides a framework for REACH registrants to evaluate the safety data in a stepwise manner. The Action Plan outlines the timeline, roles and responsibilities, substance prioritisation criteria, critical issues, and explains how progress will be reported.

The goal of the Action Plan is to achieve a better alignment between the data that have been submitted in good faith by registrants and ECHA's current expectations on the content of dossiers. Since there is no 'perfect REACH dossier' template and every case is different, the Action Plan will be implemented in cooperation with ECHA.

The Action Plan Package consists of the following elements:

- Declaration of Intent: signed by individual companies,whereby companies express their intent to re-evaluate dossiers and to provide further information, where appropriate, in line with the Action Plan. Companies also commit to report to Cefic on KPIs so that Cefic can report on progress on an annual basis. To that effect, a reporting template has been developed.
- Cooperation Agreement between Cefic and ECHA: outlines a series of specific activities to support the implementation of this Action Plan and guide registrants to a better understanding of how to meet ECHA's expectations under Article 41 of REACH ('Compliance Check').

The Action Plan will run between 2019-2026, allowing for one year of planning and setting-up and seven years of actual updates.

Read more

Cefic, 31-03-22

https://cefic.org/policy-matters/reach-dossier-improvement-action-plan/

Cefic launches Action Plan to help REACH registrants review chemical safety data

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ECHA Updated Registry of restriction intentions until outcome

2022-03-30

The Registry of restriction intentions until outcome has been updated. The update refers to the following substance(s):

Substance name	EC/list no.	CAS no.	Status	Expected date of submission	Submitter	Details on the scope of restriction	Latest update
Per- and poly-fluroalkyl substances	-	-	Opinion development	14/01/2022	ECHA	Restricting the use of per- and polyfluoroalkyl substances (PFASs) in fire-fighting foams.	25/03/2022
2,4-dinitro-toluene (2,4-DNT)	204-450-0	121-14-2	Opinion development	16/07/2021	ECHA	Restriction on the placing on the market or use of 2,4 dinitrotoluene in articles for supply to the general public or to professional workers in concentrations greater than 0.1 % weight by weight.	25/03/2022

Note: 2,4-DNT is mostly used as chemical intermediate in the production of toluene diisocyanate (4-methyl-m-phenylenediisocyanate). It is hydrogenated to yield toluenediamine (TDA) and this diamine is reacted with phosgene to yield toluenediisocyanate (TDI), which is used to make flexible polyurethane foams. Other, minor uses as an intermediate include the use in the production of dyes and dyestuffs and rubber chemicals.

Link to the Registry of restriction intentions until outcome

Read more

Chemycal, 30-03-22

https://chemycal.com/news/44484103-68f8-44b0-bb7c-955fc14d5ffe/ECHA__Updated_Registry_of_restriction_intentions_until_outcome__25_March_2022

Janet's Corner

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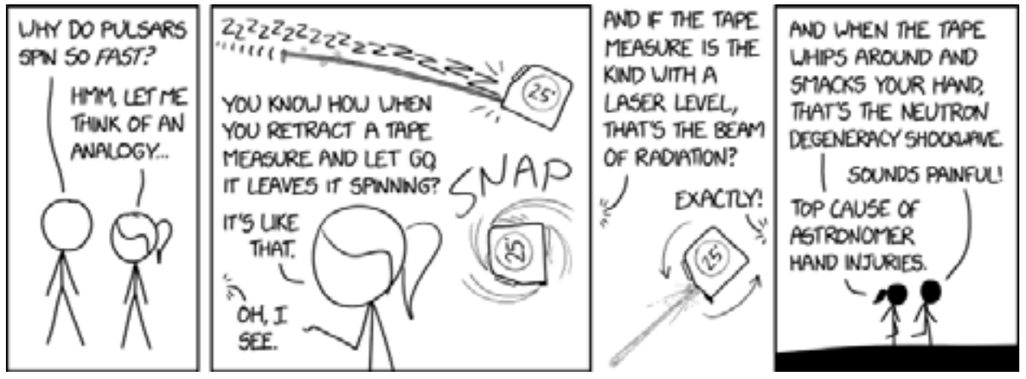
Pulsar Analogy

2022-04-08



https://xkcd.com/2413/

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Hazard Alert

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4,4'-Methylenebis (2-chloroaniline) (MOCA)

2022-04-08

4,4'-methylenebis(2- chloroaniline) or MOCA, is an aromatic amine used as a curing agent in the manufacture of castable polyurethane products, with the chemical formula $C_{13}H_{12}C_{l2}N_{2.}$ It creates chemical reactions that bond other molecules in relatively stable complex structures and produces a tough abrasion-resistant polymer. Pure MOCA is a colourless crysalline solid, but it is usually made and used as yellow, tan, or brown pellets. If MOCA is heated above 205°C it may decompose by itself. It has no odour or taste. [1,2]

USES [3]

MOCA is used to make polyurethane products that are a significant component of many common appliances. These are widely used in such items as gear systems in modern office and home appliances, sporting goods, mouldings for motor vehicle body parts and military equipment. The compound is commonly used as a coating to set other glues, plastics and adhesives. Its main purpose is to act as a curing agent for other polyurethane and elastomer compounds. It is essential for creating chemical reactions that bond other molecules in relatively stable complex structures, which comprise these compounds.

IN THE ENVIRONMENT [4]

- MOCA enters the environment from the disposal of solid waste from manufacturing plants that use it.
- It doesn't dissolve in water easily.
- MOCA sticks strongly to soil particles.
- It is not likely to enter groundwater.
- MOCA is not likely to evaporate from soil or water.
- It is broken down by sunlight in air and by microscopic organisms in soil or water.
- Levels of MOCA can build up in the roots of vegetables grown in contaminated soil.

4,4'-methylenebis(2-chloroaniline) or MOCA, is an aromatic amine used as a curing agent in the manufacture of castable polyurethane products, with the chemical formula C13H12Cl2N2.

SOURCES OF EMISSION & ROUTES OF EXPOSURE [3]

Sources of Emission

- Industry sources: Released from industries producing and manufacturing polyurethane products, for example components for household appliances, cameras, computers, motor vehicle component manufacturers specialised motor car body shops.
- Diffuse sources: Small quantities may be present in air or upon surfaces in the vicinity of plants that manufacture polyurethane products.
- Natural sources: Not known to occur in nature.
- Transport sources: No mobile sources.
- Consumer products: Present as a component in relatively stable compounds which comprise polyurethane products such as sporting goods, footwear, computers, cameras, gear and bearing systems in household appliances, motor vehicle body parts and mouldings.

Routes of Exposure

The main routes of exposure to MOCA are by direct contact with the skin or eyes or the inhalation of dust and other particles to which it is attached.

HEALTH EFFECTS [5]

Acute Effects

In one case, an accidental acute exposure of a worker to MOCA, symptoms of gastrointestinal distress, transitory kidney damage, and burning face and eyes were reported. Tests involving acute exposure of rats, mice, and guinea pigs have shown MOCA to have moderate to high acute toxicity from oral exposure.

Chronic Effects

No information is available on the chronic effects of MOCA in humans. Animal studies have reported effects on the lung, liver, and kidney from chronic oral exposure to MOCA. EPA has not established a Reference Concentration (RfC) for MOCA, however, it has calculated a provisional Reference Dose (RfD) of 0.0007 milligrams per kilogram body weight per day (mg/kg/d) for MOCA based on liver and kidney effects in dogs.

Reproductive/Developmental Effects

No information is available on the reproductive or developmental effects of MOCA in humans or animals.

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Cancer Risk

In one epidemiologic study of 200 workers exposed to MOCA, 3 men were diagnosed with bladder cancer. However, there were no controls in this study and no information on the exposure concentrations. Animal studies have reported that MOCA produces tumours of the liver, lung, urinary bladder, and mammary gland from oral exposure. MOCA has a chemical structure similar to benzidine, a known human bladder carcinogen, and to a potent animal carcinogen, 3,3'-dichlorobenzidine. EPA has classified MOCA as a Group B2, probable human carcinogen.

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. Get medical attention.
- Skin Contact: In case of contact, immediately flush skin with plenty of water. Cover the irritated skin with an emollient. Remove contaminated clothing and shoes. Wash clothing before reuse. Thoroughly clean shoes before reuse. Get medical attention.
- 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.
- Ingestion: Do NOT induce vomiting unless directed to do so by medical personnel. Never give anything by mouth to an unconscious person. If large quantities of this material are swallowed, call a physician immediately. Loosen tight clothing such as a collar, tie, belt or waistband.

Fire & Explosion Hazards

- MOCA may be combustible at high temperature.
- Slightly flammable to flammable in presence of heat.
- Non-flammable in presence of shocks.
- Slightly explosive in presence of open flames and sparks.
- Non-explosive in presence of shocks.
- For small fires, dry chemical powder should be used.

- For large fires, water spray, fog or foam should be used. Do not use water jet.
- Fine dust dispersed in air in sufficient concentrations, and in the presences of an ignition source is a potential dust explosion hazard.

Exposure Controls and Personal Protection

Engineering Controls

Use process enclosures, local exhaust ventilation, or other engineering controls to keep airborne levels below recommended exposure limits. If user operations generate dust, fume or mist, use ventilation to keep exposure to airborne contaminants below the exposure limit.

Personal Protective Equipment

The following personal protective equipment is recommended when handling MOCA:

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

Personal Protection in Case of a Large Spill:

- Splash goggles;
- Full suit;
- Dust 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 [4]

- EPA: Environmental Protection Agency has classified MOCA as a hazardous waste that must meet specific disposal requirements.

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The EPA requires that spills or accidental releases of MOCA into the environment of 10 pounds or more must be reported to EPA.

- ACGIH: The American Conference of Governmental Industrial Hygienists (ACGIH) set a maximum level of 0.11 milligrams of MBOCA per cubic metre (0.11 mg/m^3) of workplace air for an 8-hour workday, 40-hour workweek.
- NIOSH: The National Institute for Occupational Safety and Health (NIOSH) recommends an exposure limit of 3 micrograms of MOCA per cubic metre of air (3 mg/m^3) over a 10-hour day.
- These agencies advise avoiding eye and skin contact because this may be a route of significant exposure.

Australia [7]

- Safe Work Australia: Safe Work Australia has established a time weighted average concentration for MOCA of 0.02ppm and 0.22 mg/m^3 for an 8-hour workday, 40-hour workweek.

REFERENCES

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Birds are laying their eggs earlier, and climate change is to blame

2022-03-25

Spring is in the air. Birds are singing and beginning to build their nests. It happens every year, like clockwork. But a new study in the Journal of Animal Ecology shows that many species of birds are nesting and laying eggs nearly a month earlier than they did a hundred years ago. By comparing recent observations with century-old eggs preserved in museum collections, scientists were able to determine that about a third of the bird species nesting in Chicago have moved their egg-laying up by an average of 25 days. And as far as the researchers can tell, the culprit in this shift is climate change.

"Egg collections are such a fascinating tool for us to learn about bird ecology over time," says John Bates, curator of birds at the Field Museum and the study's lead author. "I love the fact that this paper combines these older and modern datasets to look at these trends over about 120 years and help answer really critical questions about how climate change is affecting birds."

Bates got interested in studying the museum's egg collections after editing a book about eggs. "Once I got to know our egg collection, I got to thinking about how valuable that collection's data are, and how those data aren't replicated in modern collections," he says.

The egg collection itself occupies a small room crammed full with floor-to-ceiling cabinets, each containing hundreds of eggs, most of which were collected a century ago. The eggs themselves (or rather, just their clean, dry shells, with the contents blown out a hundred years ago) are stored in small boxes and accompanied by labels, often hand-written, saying what kind of bird they belong to, where they're from, and precisely when they were collected, down to the day.

"These early egg people were incredible natural historians, in order to do what they did. You really have to know the birds in order to go out and find the nests and do the collecting," says Bates. "They were very attuned to when the birds were starting to lay, and that leads to, in my opinion, very accurate dates for when the eggs were laid."

The Field's egg collection, like most, drops off after the 1920s when egg-collecting went out of fashion, both for amateur hobbyists and scientists. But Bates's colleague Bill Strausberger, a research associate at the Field, had worked for years on cowbird parasitism at the Morton Arboretum in

The amount of carbon dioxide in the atmosphere over time neatly maps onto larger temperature trends, and the researchers found that it also correlated with the changes in egg-laying dates.

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the Chicago suburbs, climbing ladders and examining nests to see where Brown-headed Cowbirds had laid their eggs for other birds to raise. "He had to get out there every spring and find as many nests as he could and see whether or not they were parasitized, and so it occurred to me that he had modern nesting data," says Bates. Chris Whelan, an evolutionary ecologist at the University of Illinois at Chicago, also contributed to the modern dataset with songbird nesting data collected in Chicagoland starting in 1989 when he began work at the Morton Arboretum. Whelan and Strausberger's contributions to the study were critical, Bates says, because "finding nests is a lot harder than almost anybody realizes."

"Finding nests and following their fate to success or failure is extremely time-consuming and challenging," says Whelan. "We learned to recognize what I called 'nesty' behavior. This includes gathering nest material, like twigs, grass, roots, or bark, depending upon bird species, or capturing food like caterpillars but not consuming the food item—this likely indicates a parent is foraging to gather food for nestlings." Whelan and his team used mirrors mounted on long poles to peer into high-up nests and kept close track of the dates when eggs were laid and hatched.

The researchers then had two big sets of nesting data: one from roughly 1880-1920, and another from about 1990 to 2015. "There's a gap in the middle, and that's where Mason Fidino came in," says Bates. Fidino, a quantitative ecologist at Chicago's Lincoln Park Zoo and a co-author of the study, built models for analyzing the data that allowed them to address the gap in the middle of the 20th century, as well as the differences in sampling between early egg collectors and Whelan and Strausberger's research.

"Because of this uneven sampling, we had to share a little bit of information among species within our statistical model, which can help improve estimates a little bit for the rare species," says Fidino. "We all realized rather quickly that there may be some outliers present in the data, and if not accounted for, could have a rather large influence on the results. Because of this, we had to build our model to reduce the overall influence of any outliers, if they were present in the data."

The analyses showed a surprising trend: among the 72 species for which historical and modern data were available in the Chicagoland region, about a third have been nesting earlier and earlier. Among the birds whose nesting habits changed, they were laying their first eggs 25.1 days earlier than they were a hundred years ago.

In addition to illustrating that birds are laying eggs earlier, the researchers looked for a reason why. Given that the climate crisis has dramatically affected so many aspects of biology, the researchers looked to rising temperatures as a potential explanation for the earlier nesting. But the scientists hit another snag: there aren't consistent temperature data for the region going back that far. So, they turned to a proxy for temperature: the amount of carbon dioxide in the atmosphere.

"We couldn't find a single source of long-term temperature data for the Midwest, which was surprising, but you can approximate temperature with carbon dioxide levels, which are very well documented," says Bates. The carbon dioxide data comes from a variety of sources, including the chemical composition of ice cores from glaciers.

The amount of carbon dioxide in the atmosphere over time neatly maps onto larger temperature trends, and the researchers found that it also correlated with the changes in egg-laying dates. "Global climate change has not been linear over this nearly 150-year period, and therefore species may not have advanced their lay date in non-linearly as well. Therefore, we included both linear and non-linear trends within our model," says Fidino. "We found that the simulated data was very similar to the observed data, which indicated that our model did a decent job."

The changes in temperature are seemingly small, just a few degrees, but these little changes translate to different plants blooming and insects emerging— things that could affect the food available for birds.

"The majority of the birds we looked at eat insects, and insects' seasonal behavior is also affected by climate. The birds have to move their egg-laying dates to adapt," says Bates.

And while birds laying their eggs a few weeks early might seem like a small matter in the grand scheme of things, Bates notes that it's part of a larger story. "The birds in our study area, upwards of 150 species, all have different evolutionary histories and different breeding biology so it's all about the details. These changes in nesting dates might result in them competing for food and resources in a way that they didn't used to," he says. "There are all kinds of really important nuances that we need to know about in terms of how animals are responding to climate change."

In addition to serving as a warning about climate change, Bates says the study highlights the importance of museum collections, particularly egg collections, which are often under-utilized. "There are 5 million eggs out there in collections worldwide, and yet, they're very few publications using museum collections of eggs," says Bates. "They're a treasure trove of data about the past, and they can help us answer important questions about our world today."

Phys Org, 25 March 2022

https://phys.org

Advances in street lighting are reducing the efficacy of coastal species' camouflage

2022-03-25

Species that rely on darkness to forage and feed are losing the gift of camouflage thanks to advances in the lighting used to illuminate the world's cities and coastlines, a study has shown.

The worldwide proliferation of energy efficient broad spectrum lighting has the potential to disrupt an array of visually guided ecological processes.

New research has demonstrated that these new lighting technologies can significantly improve a predator's ability to discriminate prey species against a natural background.

The magnitude of this effect varies depending on an organism's colour, meaning certain colour variations may be at greater risk.

The study, published in the Journal of Applied Ecology, was conducted by researchers at the University of Plymouth and Plymouth Marine Laboratory (PML).

It is one of the first to examine the potential for artificial light at night (ALAN) to affect the camouflage mechanisms of coastal species.

Oak McMahon, who led the research while studying for an MSc in Applied Marine Science and is now a PhD candidate at the University of Plymouth, said: "This study clearly indicates that new lighting technologies will increase the conspicuousness of prey species by reducing the efficacy of their camouflage. Our findings revealed that species of Littorinid snails found commonly on our coastlines will remain camouflaged when illuminated by older style lighting. However, when illuminated by modern broad spectrum lighting, they are clearly visible to predators and at far greater long-term risk as a result."

When illuminated by modern broad spectrum lighting, they are clearly visible to predators and at far greater long-term risk as a result.

Funded by the Natural Environment Research Council, this is the latest research by the University and PML to highlight the growing levels of ALAN and its impacts on coastal environments.

For this study, scientists used a well-established model to determine the conspicuousness of three distinct colour morphs of Littorinid snail found commonly along the world's coastlines.

They compared how the species appeared to three common coastal predators when illuminated by different forms of lighting. This included 20th century narrow spectrum Low Pressure Sodium (LPS) lighting, three types of modern broad spectrum lighting -- High Pressure Sodium (HPS); Light Emitting Diodes (LEDs); and Metal Halide (MH) -- and the natural light provided by the sun and moon.

Under LPS lighting, all snails were effectively camouflaged. However, when illuminated by LEDs, MH, the sun or the moon, yellow snails were significantly more visible compared to brown and olive ones in the majority of cases.

Dr Thomas Davies, Lecturer in Marine Conservation at the University of Plymouth and the study's senior author, said: "As technologies develop, there has been a shift from narrow spectrum to lighting that enables us to live and travel in a safe, secure manner. However, estimates suggest that a quarter of the planet between the Arctic Circle and Antarctica is now being affected by night-time light pollution. Some predictions say that LED bulbs will account for 85% of the global street lighting market in around five years, and our study highlights that such advances will have repercussions for humans and animals alike now and in the future."

Dr Tim Smyth, PML Head of Science for Marine Biogeochemistry and Observations and co-author on the research, added: "The ability to light our environment around the clock has transformed the urban landscapes over the past century and has ushered in what some call the Urbanocene. The shift from the orange glow over cities, typical of my youth in the 1970s and 80s, has now shifted much more towards energy efficient wide spectrum LEDs which even enables us humans to correctly perceive colour. This work shows that this advancement has additional ramifications for the natural world, which is having to adapt at an increasing rate to the artificial changes we are making to the environment. We need to learn to adapt our technologies to avoid the worst consequences of their adoption."

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What can be done to reduce the impact of artificial lighting on our coastlines

With estimates indicating that 23% of the world's surface, between the planet's polar regions, are affected by ALAN -- and a rate of increase of 2.2% between 2012 and 2016 -- the need to address the situation is pressing to say the least.

In the study, the researchers highlight a variety of mitigation methods available to planners and environmental managers when considering its ecological impacts.

These include reducing the amount of light used, shielding lights to reduce their effects on the surrounding environment, employing part-night lighting during times of peak demand, and manipulating the spectra of lighting to minimise ecological impacts.

The researchers highlight that while it may seem intuitive to suggest using narrow spectrum lighting to avoid these impacts, the effects of ALAN extend beyond those seen on camouflage and that all parts of the visual spectrum will likely have some ecological impact.

Science Daily, 25 March 2022

https://sciencedaily.com

Medicines 3D-printed in seven seconds

2022-03-25

Medicines can be printed in seven seconds in a new 3D-printing technique that could enable rapid on-site production of medicines, reports a UCL-led research team.

The findings published in the journal, Additive Manufacturing, improve the prospects of how 3D printers could be integrated into fast-paced clinical settings for on-demand production of personalized medicines.

For the current study, the researchers loaded printlets (printed tables) with paracetamol, which is one of many medicines that can be produced with a 3D printer.

One of the leading techniques for 3D printing is vat photopolymerisation, which affords the highest resolution for complexity at microscales, and also suits many medications as it does not require high heat. For printing medicines, the technique uses a resin formulation, constituting

For the current study, the researchers loaded printlets (printed tables) with paracetamol, which is one of many medicines that can be produced with a 3D printer.

the required drug dissolved in a solution of a photoreactive chemical, activated by light to solidify the resin into a printed tablet.

But vat polymerisation has been hampered by slow printing speeds, due to its layer-by-layer approach.

Here, scientists have developed a new vat polymerisation technique that prints the entire object all at once, reducing the printing speed from multiple minutes to just seven to 17 seconds (depending on the resin composition selected). This works by shining multiple images of the object viewed at different angles, onto the resin. The amount of light shone gradually accumulates, until it reaches a point at which polymerisation occurs. By adjusting the intensity of light at different angles and overlaps, all points of the 3D object in the resin can reach this threshold at the same time, causing the entire 3D object to solidify simultaneously.

The currently study is led by Professor Abdul Basit (UCL School of Pharmacy), and also involved researchers at Universidade de Santiago de Compostela as well as FabRx, a UCL spin-out co-founded by three members of the UCL research team.

The Basit lab has previously developed 3D-printed polypills to help people who need to take multiple medications each day, as well as pills with braille patterns to help the visually impaired.

Co-lead author Dr. Alvaro Goyanes (UCL School of Pharmacy, FabRx and Universidade de Santiago de Compostela) says that "personalized 3D-printed medicines are evolving at a rapid pace and reaching the clinic. To match the fast-paced clinical environment, we have developed a 3D printer that produces tablets within seconds. This technology could be a game changer for the pharmaceutical industry."

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https://phys.org

Stem cell secrets allow researchers to revamp reprogramming

2022-03-25

Researchers from the Babraham Institute's Epigenetics research program have been able to learn more about naïve stem cell reprogramming following a genome wide functional screen. Their research, published today in Science Advances, describes the critical regulators of

Existing methods for reprogramming were inefficient and slow, preventing researchers' from quickly producing the numbers of high-quality stem cells they needed.

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reprogramming and offers opportunities for a more efficient, faster way to generate human naïve pluripotent stem cells.

Human pluripotent stem cells (PSCs) are a useful tool for researchers investigating how cells specialize to make every tissue of our body. They come in two different states, primed and naïve. Both types of PSC can self-renew and differentiate into new cell types but they have distinct functions and molecular characteristics.

Group leader Peter Rugg-Gunn explained the importance of these cells: "Human PSCs in the naïve state replicate the key molecular and cellular characteristics of cells in a pre-implantation stage embryo. Importantly, when naïve PSCs are encouraged to self-organize in particular conditions, they form structures that resemble an early blastocyst stage of development. By growing these cells in the lab, we can learn about the key events that happen during human development, and they have potential uses in personalized medicine. But we need to create high-quality, stable stem cell populations to be able to conduct our experiments."

Pluripotent stem cells are formed either from embryos or using Nobel Prize-winning methods to remove cell identity from specialized cells. The majority of reprogramming experiments generate primed PSCs, which are more developmentally advanced than naïve PSCs. Naïve PSCs can be collected directly from human pre-implantation embryos, or more commonly researchers expose primed PSCs to conditions that induces them to become naïve PSCs. Existing methods for reprogramming were inefficient and slow, preventing researchers' from quickly producing the numbers of high-quality stem cells they needed.

Adam Bendall, Ph.D. student and a lead researcher on the study, said: "Very little was known about what genetic and epigenetic factors are required for naïve cell reprogramming, and this knowledge gap limited the design of reprogramming conditions."

The low efficiency of naïve reprogramming suggests the presence of barriers that limit cells in reaching the naïve state. Adam and his colleagues honed in on these barriers by performing a large-scale genetic screen to identify genes that hinder and help reprogramming. They were able to identify a large number of genes that have a crucial role in naïve PSC programming that had not been previously linked to the process.

The team focused on one epigenetic complex in particular, the PRC1.3 complex, that regulates gene expression without altering the underlying DNA sequence, and which they found to be essential for the formation of

naïve PSCs. Without this complex, the cells undergoing reprogramming become a completely different type of cell rather than naïve PSCs. This suggests that the activity of PRC1.3 could encourage more cells to reprogram properly, in effect lowering the barrier.

After identifying factors that promote reprogramming, the researchers also looked at factors that impede reprogramming, exemplified in their study by an epigenetic protein called HDAC2. Dr. Amanda Collier, first author on the paper, explained: "Excitingly, when we inhibited one of these factors using selective chemicals, then naïve PSC reprogramming occurred more efficiently and rapidly. We're able to look at it from both sides; we can remove the barriers and introduce the factors that push cells towards state change."

Not only does this research improve scientists' ability to produce human naïve PSCs, it provides details on the molecular events that occur during the cell state transition itself, some of which are conserved in developmental regulation in human embryos.

The Rugg-Gunn lab are putting together the pieces of a bigger puzzle—the best understanding of the formation and control of naïve stem cells. Their previous research has identified molecular factors that help to maintain cells in a naïve stage. Group leader, Peter Rugg-Gunn said: "By building up our tools for manipulating pluripotent stem cells, we can spend more time asking important questions about the pre-implantation embryo. In the longer term, further improvements in working with naïve PSCs might open up the possibility for using these cells in personalized disease models or cell therapies, although this will require more research on how to differentiate naïve PSCs into specialized cell types."

Phys Org, 25 March 2022

https://phys.org

Scientists find microplastics in blood for first time

2022-03-25

Scientists have discovered microplastics in human blood for the first time, warning that the ubiquitous particles could also be making their way into organs.

The tiny pieces of mostly invisible plastic have already been found almost everywhere else on Earth, from the deepest oceans to the highest mountains as well as in the air, soil and food chain.

"Where is it going in your body? Can it be eliminated? Excreted? Or is it retained in certain organs, accumulating maybe, or is it even able to pass the blood-brain barrier?"

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A Dutch study published in the Environment International journal on Thursday examined blood samples from 22 anonymous, healthy volunteers and found microplastics in nearly 80 percent of them.

Half of the blood samples showed traces of PET plastic, widely used to make drink bottles, while more than a third had polystyrene, used for disposable food containers and many other products.

"This is the first time we have actually been able to detect and quantify" such microplastics in human blood, said Dick Vethaak, an ecotoxicologist at Vrije Universiteit Amsterdam.

"This is proof that we have plastics in our body—and we shouldn't," he told AFP, calling for further research to investigate how it could be impacting health.

"Where is it going in your body? Can it be eliminated? Excreted? Or is it retained in certain organs, accumulating maybe, or is it even able to pass the blood-brain barrier?"

The study said the microplastics could have entered the body by many routes: via air, water or food, but also in products such as particular toothpastes, lip glosses and tattoo ink.

"It is scientifically plausible that plastic particles may be transported to organs via the bloodstream," the study added.

Vethaak also said there could be other kinds of microplastics in blood his study did not pick up—for example, it could not detect particles larger than the diameter of the needle used to take the sample.

The study was funded by the Netherlands Organization for Health Research and Development as well as Common Seas, a UK-based group aimed at reducing plastic pollution.

Alice Horton, anthropogenic contaminants scientist at Britain's National Oceanography Center, said the study "unequivocally" proved there was microplastics in blood.

"This study contributes to the evidence that plastic particles have not just pervaded throughout the environment, but are pervading our bodies too," she told the Science Media Center.

Fay Couceiro, reader in biogeochemistry and environmental pollution at the University of Portsmouth, said that despite the small sample size and

lack of data on the exposure level of participants, she felt the study was "robust and will stand up to scrutiny".

She also called for further research.

"After all blood links all the organs of our body and if plastic is there, it could be anywhere in us."

Phys Org, 25 March 2022

https://phys.org

Injectable electrodes could prevent deadly heart arrhythmias

2022-03-25

Heart attacks and strokes triggered by electrical misfiring in the heart are among the biggest killers on the planet. Now, researchers have created a "liquid wire" that, when injected into pig hearts, can guide the organs to a normal rhythm.

The results, presented here this week at a meeting of the American Chemical Society, are "impressive and really cool," says Thomas Mansell, a biomolecular engineer at Iowa State University who was not involved with the work. "It's an exciting study," agrees Usha Tedrow, a cardiac electrophysiologist at Harvard Medical School, also not involved in the work. If the findings translate to people, she says, it could save thousands of lives each year.

"Pacemaker" cells keep the heart in rhythm. Located at the top of the organ, they produce a mild electrical pulse that travels down through the cardiac muscle, causing the heart's four chambers to pulse in the familiar two-part "lub-dub" beat. After a heart attack or other injury, scar tissue in cardiac muscle can prevent the needed electrical signals from propagating efficiently. The result is often arrhythmias that can either cause the heart to flutter quickly or beat too slowly, conditions that can lead to a stroke or heart attack.

Medications and a procedure known as ablation therapy—in which some of the pacemaker cells are frozen or fried—can help. Other patients must have a defibrillator implanted. If the device detects arrhythmia, it sends a powerful electrical pulse to the top of the heart to shock the muscle back into normal rhythm. It can be painful. "Patients never know when they'll be shocked," says Elizabeth Cosgriff-Hernandez, a biomaterials engineer

Researchers have created a "liquid wire" that, when injected into pig hearts, can guide the organs to a normal rhythm.

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at the University of Texas, Austin. Many wind up with chronic anxiety and depression.

Cardiologists would love to use an electrode that delivers a milder and potentially less painful pulse, not only to the top of the heart, but also to the lower chambers. One option is to thread a thin metal electrode through a coronary vein on the outside of the heart to reach the middle regions of the heart, where it can stimulate the heart's lower chambers. But the coronary veins of many patients are too narrow or have partial occlusions, making that impossible.

In hopes of getting around this problem, Cosgriff-Hernandez and her colleagues set out to create a liquidlike gel they could inject throughout the length of a coronary vein. The gel would then rapidly harden into a conductive, flexible plastic. (Blood returning through the heart would then flow through other veins.)

To pull this off, the team created a gel from two components: One, called poly(ether urethane diacrylamide) or PEUDAm, eventually forms the plastic; the other, N-acryloyl glycinamide, links the PEUDAm molecules together. When separate, both molecules are liquids.

The researchers then fed both through an ultrathin divided catheter that keeps the liquids separate and inserted the catheter into a coronary vein at the top of the hearts of live pigs. The team pushed the liquids down the vein and its tributaries and removed the catheter. Once the two liquids met inside the vein, the compounds reacted within minutes and hardened into a flexible wire.

"It worked the first time. It was really exciting," Cosgriff-Hernandez told attendees at the meeting. A bevy of tests showed the wires to be stable, conductive, and nontoxic.

In another round of tests, the scientists scarred some of the heart tissue of the pigs to resemble humans with heart muscle damage. They then injected the liquid wire and, after it hardened, connected it to a traditional battery-powered heart pacemaker. The pacemaker triggered a near-normal heart rhythm. The high-intensity shocks patients receive today can't match that performance, says team member Mehdi Razavi, a cardiologist at the Texas Heart Institute.

Getting these potentially lifesaving flexible wires into human hearts remains a way off, Cosgriff-Hernandez says. She notes that before that happens, the team needs to test the injectable wires in animal models

of heart disease. Tedrow adds that the material will also need to prove stable and safe in long-term studies in animals before human trials can be attempted. But if that proves equally successful, it could be a major win for biomaterials researchers, and patients, she says.

Science, 25 March 2022

https://science.org

The race to upcycle CO2 into fuels, concrete and more

2022-03-29

Tongyezhen is a town with coal in its bones. In this part of China's Henan province, people have been mining coal and smelting metals for millennia. Today, Tongyezhen hosts a sprawling industrial park where huge ovens bake coal and limestone into coke and lime, both key ingredients for producing steel. Unsurprisingly, it is one of the smoggiest places in China.

It might seem an unlikely venue for a clean-technology milestone. But later this year, a chemical plant here is set to become the world's largest facility for recycling carbon dioxide into fuel. It will combine CO2 from a lime kiln with excess hydrogen and CO2 from a coking furnace to produce methanol, an industrial chemical used for fuel and to make plastics. Carbon Recycling International (CRI), the Reykjavik-based firm behind the operation, says that the Tongyezhen plant will recycle about 160,000 tonnes of CO2 per year — equivalent to the emissions from tens of thousands of cars — that would otherwise go into the atmosphere.

It's an alluring idea: industrial CO2 emissions are warming the climate, and many countries are working on capturing the gas and storing it underground. But why not recycle it into products that are both virtuous and profitable? As long as the recycling process avoids creating more carbon emissions — by using renewable energy, or excess resources that would otherwise be wasted — it can reduce the CO2 that industry pumps into the atmosphere and lower the demand for fossil fuels used in manufacturing. That's a double climate win, proponents say.

This kind of recycling (sometimes called upcycling) is an increasingly crowded field, as companies big and small race to market a bewildering array of products made from CO2. Some are boutique items for the climate-conscious shopper — vodka or diamonds, for example — but most are staples of the global economy: fuels, polymers, other chemicals and building materials. More than 80 firms are working on new approaches to using CO2, noted a 2021 report by Lux Research, a

Companies are scrambling to turn the greenhouse gas into useful products — but will that slow climate change?

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market-research company in Boston, Massachusetts. The market for these products is tiny today, amounting to less than US$1 billion — but Lux predicts that it will grow to $70 billion by 2030, and could reach $550 billion by 2040.

This activity is being driven by a fall in the cost of renewable energy, along with rising carbon taxes and other climate incentives that are persuading firms to avoid CO2 emissions. At the same time, chemists have improved the efficiency of the underlying technologies.

But there are tough questions about whether CO2 recycling genuinely benefits the climate. Many of the products made this way only briefly delay carbon's journey into the atmosphere — fuels are burnt, products made from chemicals degrade and the CO2 consumed during their creation is released again. That will happen at Tongyezhen: much of the methanol produced is destined to be burnt as fuel in China's growing fleet of methanol-powered vehicles.

Meanwhile, some estimates suggest that the global market for recycled CO2 products is unlikely to lock up more than a few per cent of the CO2 that humans release into the atmosphere by burning fossil fuels, which totalled 36 billion tonnes last year. CRI's plant, for one, will convert the equivalent of a little over 2 minutes' worth of annual global CO2 emissions. "We can avoid a lot of that, for a lot less money, than we can by turning CO2 into stuff," says Niall Mac Dowell, an energy-systems engineer at Imperial College London.

"The assumption that we can fix this climate-change problem in an economically attractive and easy way — at best it's naive, and at worst it's actively disingenuous," he says. It's an argument that's heating up as CO2 recycling goes mainstream.

Premium product

Using CO2 as a chemical ingredient isn't a new idea. Roughly 200 million tonnes of CO2 are used in a handful of processes each year, most of it reacted with ammonia to make urea for fertilizers. (Producing ammonia emits extra CO2, and urea's carbon is quickly released after it is spread on a field, so there are no climate benefits.) The petroleum industry also injects CO2 underground to help recover oil, but using that oil can generate more gas than is stored.

What's changing now is the sheer number of firms that are moving new CO2-recycling methods towards the market and touting their climate

benefits. Approaches range from co-opting biological processes to using electrochemical cells or catalysts (see 'Reusing carbon dioxide').

Many of the bigger players use catalysts that help to combine CO2 with hydrogen to make fuels and commodity chemicals. Their main costs revolve around the energy needed to make hydrogen, capture streams of CO2 and break this molecule's strong carbon–oxygen bonds to forge new molecules. That is why so many early plants are located where there are plentiful streams of high-purity waste CO2, widely available spare hydrogen and heat (which powers the methanol production at Tongyezhen), or low-cost renewable electricity.

CRI, for instance, opened its first CO2-to-methanol plant in 2012, next door to a geothermal power station in Iceland. There, boreholes tap into hot water and steam that come with unwanted CO2. CRI's plant relies on Iceland's relatively low-carbon electricity grid to create 'green' hydrogen from water by electrolysis. Then the gases are combined, heated, pressurized and passed over a catalyst that eases the breaking of CO2 bonds. Each year, the Iceland plant recycles 5,500 tonnes of CO2.

"This is more expensive than producing conventional methanol, there is no doubt about it," says Emeric Sarron, chief technology officer at CRI, who declines to say how much more expensive. "But companies that need to source renewable fuels are willing to pay a premium for it." And the firm has customers: as well as the facility in Tongyezhen, CRI is working on other full-size plants in China's Jiangsu province and in northern Norway. Other consortia projects involving companies in Belgium, Sweden and Denmark will all recycle CO2 to methanol for use as a chemical feedstock and shipping fuel, and aim to start operations between 2023 and 2025.

Electrochemical fuels

Rather than building such large, centralized projects, some start-ups think it will be cheaper and more efficient to convert CO2 inside smaller, modular electrochemical cells. California-based start-up firm Twelve, for instance, aims by the end of this year to have an electrolyser system the size of a shipping container that uses electricity to process more than one tonne of CO2 each day into syngas. This mixture of carbon monoxide and hydrogen is widely used to make other chemicals, including fuels. Twelve plans to offer CO2 conversion as a service to firms wanting to reduce their emissions; it could charge per tonne converted, and sell its end products to cover costs. In July 2021, it raised $57 million in venture-capital funding. "We definitely see ourselves being a player in greenhouse-gas emission

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reduction," says Etosha Cave, the company's co-founder and chief scientific officer.

Syngas is conventionally made by an energy-intensive process that crushes methane and water together at high temperatures and pressures. Twelve, by contrast, uses a modified commercial electrolyser, which normally splits water into hydrogen and oxygen. Adding a metal catalyst to one of the device's electrodes (the cathode) enables it to simultaneously convert CO2 into CO, so that the system produces syngas at room temperature. Twelve aims to use renewable electricity sources to run these CO2-recycling units.

Academic chemists have pressed the case for electrochemical recycling by making significant improvements to cathode catalysts. A key metric known as Faradaic efficiency — the proportion of electrons that go into producing CO rather than unwanted by-products — is now more than 90% in some cases1. Chemists are also making headway on another front — improving the ability of catalysts to support a high electric-current density. This allows a given area of electrode to convert more CO2 molecules. Nevertheless, many catalysts struggle to work for more than a few hundred hours before they start to degrade, says Jan Vaes, programme manager for sustainable chemistry at the Flemish Institute for Technological Research (VITO) near Antwerp, Belgium.

Electrochemists aren't only targeting syngas. Avantium, a renewables chemical company in Amsterdam, is using improved catalysts2 to make formic acid, which can be converted into more-valuable chemicals. It is currently testing an electrochemical reactor at a fossil-fuel power plant in Germany.

And some chemists are hoping to make more complex carbon molecules that could command higher prices. Larger molecules can be more troublesome to make this way — with more chemical bonds, there are more opportunities for electrons to be diverted into side products, reducing efficiency — but progress is being made. This year, for instance, electrical engineer and materials scientist Edward Sargent at the University of Toronto in Canada and his team unveiled an electrochemical system that converts CO2 and water into ethylene oxide, which is widely used to make polymers. The team's catalyst achieved a record Faradaic efficiency of 35% for the conversion3.

Life-cycle arguments

Whether products recycled from industrial CO2 emissions actually protect the climate is unclear — because the CO2 they capture will still be released into the atmosphere if the molecules are burnt or broken down. Drawing CO2 directly from the atmosphere could have clearer climate benefits, but capturing the gas from air is extremely expensive, as are products made that way.

Proponents argue that recycling industrial CO2 into chemicals can reduce emissions in another way — by avoiding some fossil-fuel-based production. "Our process helps keep fossil fuels in the ground by tapping into existing streams of CO2," a spokesperson for Twelve told Nature.

The stringent way to examine this is through a life-cycle analysis (LCA) — a detailed accounting of the carbon involved in making and using a product, from the origins of its CO2 to its final fate. Many CO2-recycling firms say they have done these audits, but don't publish them because they contain proprietary information.

One firm that has released LCAs is LanzaTech, headquartered in Skokie, Illinois. The company uses bioreactors filled with Clostridium autoethanogenum bacteria to ferment industrial CO2, CO and hydrogen waste emissions into ethanol. Its chief executive, Jennifer Holmgren, notes that this kind of bioconversion can handle messy waste-gas streams, such as those from municipal waste gasifiers, better than chemical processes do. The firm's reactor at a Shougang Group steel plant near Tianjin in China has been producing ethanol since 2018. A second plant began operating at a Chinese alloy plant last year, and commercial plants in Belgium and India are expected to come online by the end of this year.

On 8 March, LanzaTech announced that it would become publicly listed, a move that values the company at $1.8 billion. This year, it reported that with genetic modifications, its bacteria could make larger molecules such as acetone and isopropanol, too4. Conventional production of acetone and isopropanol generates copious CO2 emissions. By contrast, LanzaTech's LCA suggests that its route is carbon-negative — consuming much more carbon than it emits4. But this analysis did not include what would happen to the CO2 when the products were used.

Holmgren thinks that CO2-based products will save on emissions anyway, by displacing their conventionally made equivalents. But she concedes that it is hard to be certain this is true — CO2-based products might simply add to the growing global consumption of fuels and other chemicals, rather than displace incumbent production. It's also tricky to pin down direct evidence for displacement in such a nascent market, adds Sarron.

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"The problem is that people use displacement with the idea that the market will do it, somewhere around the globe," says Andrea Ramírez Ramírez, who studies low-carbon systems and technologies at Delft University of Technology in the Netherlands. "But how do you monitor displacement? That's very, very difficult."

A greater availability of supposedly guilt-free CO2-derived products might also lead to increased consumption of those resources, she adds. Anyone who is trying to limit their international flights, for instance, might fly more often if their airline boasts of its climate-friendly fuel. This 'rebound effect' has been observed for some energy-efficiency measures, Ramírez Ramírez says, although it hasn't been studied for CO2-based goods.

In her view, negative emissions5, such as those claimed by LanzaTech, "should mean real CO2 removal from the atmosphere, that you can actually measure physically".

Locking carbon down

To maximize climate benefits, it makes more sense to lock recycled CO2 into products that last for decades. That's where polymers come in. "You're making products like insulation foam, mattresses, soft furnishings, that have quite a long lifetime," says Charlotte Williams, a chemist at the University of Oxford, UK.

Williams develops catalysts that can incorporate CO2 into polyols, which are used to make polyurethane foams. Polyols are usually made from expensive chemicals called epoxides, but her catalysts help CO2 to take the place of some of these in the polymer chain. This traps CO2 and reduces the consumption of epoxides — which themselves have a big carbon footprint.

Williams has founded a spin-off company, Econic Technologies. In September 2021, it signed a deal to build a pilot plant in India, and then retrofit an existing plant to incorporate waste CO2 into polyols. Other companies are seasoning polymers with CO2 in similar ways.

Despite this progress, projections suggest that using CO2 as a polymer ingredient would lock up only around 10 million to 50 million tonnes of CO2 per year by 20506. So, is it really worth it? "I think it's the wrong way of looking at the problem," Williams says. "We have to make massive cuts in CO2 emissions across the board, but we also have to invest in some technologies that can directly use it."

The biggest opportunity to incorporate CO2 into products lies in concrete and other building materials, says Runeel Daliah, a senior analyst at Lux Research, who is based in Amsterdam. The technology is proven and scalable, and could feed an enormous global demand for concrete, giving it the potential to dominate the CO2-conversion market. "Concrete is really the only one where you have permanent sequestration of CO2 in the product," Daliah says.

One of the leaders in this sector is Canadian company CarbonCure in Halifax. Founded in 2012, it pumps waste CO2 into fresh concrete to form nanoparticles of calcium carbonate. This improves the compressive strength of the concrete, so that less cement is needed7. Because cement-making accounts for most of concrete's carbon emissions, the company says this could reduce the carbon footprint of every tonne of concrete by around 5% (or 6 kilograms of CO2).

The company has installed more than 550 of its CO2 injection units at concrete plants around the world, most of them in North America, which has avoided and mineralized 150,000 tonnes of CO2 emissions so far. But with some 100,000 plants worldwide churning out roughly 33 billion tonnes of concrete per year, "we're really just scratching the surface", says Jennifer Wagner, CarbonCure's president.

Ramírez Ramírez says that converting CO2 into minerals offers a much clearer climate benefit than converting it into fuels. "In the life-cycle analysis, you can see the benefits are much larger, and I think much more robust."

Carbon-removal incentives

When it comes to making fuels and other chemicals, most CO2-derived products are currently more expensive than their conventional rivals, says Josh Schaidle, who led an analysis by the US National Renewable Energy Laboratory in Golden, Colorado, of 11 products made by CO2 conversion8. Yet they could still have a strong business case, if they can take advantage of low-cost renewable electricity, as well as the tax breaks, subsidies and quotas that aim to wean the world off fossil resources.

In the European Union, for instance, a broad package of policy incentives under the banner of the European Green Deal aims to make the bloc climate neutral by 2050. Pending legislation specifies quotas for the use of CO2-derived fuels in aviation. There will be reduced taxes on CO2-based fuels, and the promise of plenty of innovation funding to help technologies to market.

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In the United States, some companies say that a tax credit called 45Q is helping to encourage CO2 conversion. It pays industries $50 for every tonne of CO2 they store permanently underground, or $35 if they put the CO2 to use. In China, there has been relatively little commercial activity in developing CO2-conversion technologies9. But in 2021, key players in China's gigantic chemicals industry pledged to invest in CO2-based chemical production, a move that could win financial support through the country's carbon-trading market, which launched last year.

The success of the CO2-conversion businesses, however, could rest on LCAs and other measurements of carbon flows. The European Commission, for example, is developing a carbon-removal certification mechanism to provide a more rigorous framework for verifying whether a process is genuinely carbon negative.

So far, LCAs offer a rather downbeat assessment of most CO2-conversion strategies. In a report10 published in February, environmental scientist Kiane de Kleijne at Radboud University in Nijmegen, the Netherlands, and her colleagues scoured dozens of published LCAs to compare CO2 conversion routes with conventional ways of making the same products. Then the researchers compared CO2 savings from the recycling processes with the 2015 Paris agreement targets of halving global CO2 emissions by 2030, and of achieving net zero emissions by 2050. "We found that very few of those routes are able to meet the criteria for Paris compatibility," says de Kleijne. Routes that made the grade did so by storing CO2 permanently — mixing the gas with slag from steel mills to make construction blocks, for example.

Climate-focused academics conducting LCAs often note that geological storage of CO2 is better than conversion because it offers much greater reductions in emissions. That might be true, but it ignores a brutal economic reality, says Sarron. "Putting carbon back into the ground is expensive, and is not happening at a meaningful scale. The alternative to what we are doing today is not storage, it's emission to the atmosphere."

And if the global economy does eventually end its reliance on coal, oil and gas, industries of the future might need these CO2-conversion processes to produce the polymers and other chemicals we depend on.

De Kleijne says that all too often, the academics performing LCAs and companies developing CO2-conversion systems end up talking past each other on these issues.

But there is at least one point of broad agreement: that CO2 recycling technologies should eventually draw as much of their feedstock as possible from the atmosphere, rather than from waste industrial gases. A project called Norsk e-Fuel in Oslo is taking a step in that direction with a pilot plant in Herøya, Norway, which aims to start turning CO2-derived syngas into jet fuel. Some of the CO2 will come directly from the air, snared by carbon-capture technology developed by Climeworks, a company that was spun off from the Swiss Federal Institute of Technology in Zurich in 2009.

That technology is now in operation at Climeworks's first large-scale direct air-capture plant, which opened in September 2021 in Hellisheidi, Iceland. It will capture 4,000 tonnes of CO2 a year to be pumped underground. It costs $600–800 to sequester one tonne of CO2 in this way — hardly cheap — but the company says it can slash that to one-tenth of the cost as it scales up.

Even if there are limited climate benefits from converting today's fossil CO2 emissions into products, some companies argue that it's important to develop the technology so that it is ready to feed off CO2 from the air once direct air-capture technology matures. "I do think it's a valid argument," says Ramírez Ramírez. "But we need to be careful that it is part of a transition, that we eventually replace the fossil carbon with sustainable sources."

~Nature, 29 March 2022

https://nature.com

Ultra-processed foods are trashing our health – and the planet

2022-03-29

Our world is facing a huge challenge: we need to create enough high-quality, diverse and nutritious food to feed a growing population – and do so within the boundaries of our planet. This means significantly reducing the environmental impact of the global food system.

There are more than 7,000 edible plant species which could be consumed for food. But today, 90% of global energy intake comes from 15 crop species, with more than half of the world's population relying on just three cereal crops: rice, wheat and maize.

While research has highlighted how western diets containing excessive calories and livestock products tend to have large environmental impacts, there are also environmental concerns linked to ultra-processed foods.

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The rise of ultra-processed foods is likely playing a major role in this ongoing change, as our latest research notes. Thus, reducing our consumption and production of these foods offers a unique opportunity to improve both our health and the environmental sustainability of the food system.

Impacts of the food system

Agriculture is a major driver of environmental change. It is responsible for one-third of all greenhouse gas emissions and about 70% of freshwater use. It also uses 38% of global land and is the largest driver of biodiversity loss.

While research has highlighted how western diets containing excessive calories and livestock products tend to have large environmental impacts, there are also environmental concerns linked to ultra-processed foods.

The impacts of these foods on human health are well described, but the effects on the environment have been given less consideration. This is surprising, considering ultra-processed foods are a dominant component of the food supply in high-income countries (and sales are rapidly rising through low and middle-income countries too).

Our latest research, led by colleagues in Brazil, proposes that increasingly globalised diets high in ultra-processed foods come at the expense of the cultivation, manufacture and consumption of "traditional" foods.

How to spot ultra-processed foods

Ultra-processed foods are a group of foods defined as "formulations of ingredients, mostly of exclusive industrial use, that result from a series of industrial processes".

They typically contain cosmetic additives and little or no whole foods. You can think of them as foods you would struggle to create in your own kitchen. Examples include confectionery, soft drinks, chips, pre-prepared meals and restaurant fast-food products.

In contrast with this are "traditional" foods – such as fruits, vegetables, wholegrains, preserved legumes, dairy and meat products – which are minimally processed, or made using traditional processing methods.

While traditional processing, methods such as fermentation, canning and bottling are key to ensuring food safety and global food security. Ultra-processed foods, however, are processed beyond what is necessary for food safety.

Australians have particularly high rates of ultra-processed food consumption. These foods account for 39% of total energy intake among Australian adults. This is more than Belgium, Brazil, Columbia, Indonesia, Italy, Malaysia, Mexico and Spain – but less than the United States, where they account for 57.9% of adults' dietary energy.

According to an analysis of the 2011-12 Australian Health Survey (the most recent national data available on this), the ultra-processed foods that contributed the most dietary energy for Australians aged two and above included ready-made meals, fast food, pastries, buns and cakes, breakfast cereals, fruit drinks, iced tea and confectionery.

What are the environmental impacts?

Ultra-processed foods also rely on a small number of crop species, which places burden on the environments in which these ingredients are grown. Maize, wheat, soy and oil seed crops (such as palm oil) are good examples. These crops are chosen by food manufacturers because they are cheap to produce and high yielding, meaning they can be produced in large volumes.

Also, animal-derived ingredients in ultra-processed foods are sourced from animals which rely on these same crops as feed.

The rise of convenient and cheap ultra-processed foods has replaced a wide variety of minimally-processed wholefoods including fruits, vegetables, grains, legumes, meat and dairy. This has reduced both the quality of our diet and food supply diversity.

In Australia, the most frequently used ingredients in the 2019 packaged food and drink supply were sugar (40.7%), wheat flour (15.6%), vegetable oil (12.8%) and milk (11.0%).

Some ingredients used in ultra-processed foods such as cocoa, sugar and some vegetable oils are also strongly associated with biodiversity loss.

What can be done?

The environmental impact of ultra-processed foods is avoidable. Not only are these foods harmful, they are also unnecessary for human nutrition. Diets high in ultra-processed foods are linked with poor health outcomes, including heart disease, type-2 diabetes, irritable bowel syndrome, cancer and depression, among others.

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To counter this, food production resources across the world could be re-routed into producing healthier, less processed foods. For example, globally, significant quantities of cereals such as wheat, maize and rice are milled into refined flours to produce refined breads, cakes, donuts and other bakery products.

These could be rerouted into producing more nutritious foods such as wholemeal bread or pasta. This would contribute to improving global food security and also provide more buffer against natural disasters and conflicts in major breadbasket areas.

Other environmental resources could be saved by avoiding the use of certain ingredients altogether. For instance, demand for palm oil (a common ingredient in ultra-processed foods, and associated with deforestation in Southeast Asia) could be significantly reduced through consumers shifting their preferences towards healthier foods.

Reducing your consumption of ultra-processed foods is one way by which you can reduce your environmental footprint, while also improving your health.

The Conversation, 29 March 2022

https://theconversation.com

Longer-lasting lithium-ion

2022-03-29

An "atomically thin" layer has led to better-performing batteries.

Chemical engineers have figured out a way to more than double the lifespan of high-voltage lithium-ion batteries.

The international team of researchers, based at the University of Queensland, has developed a lithium-ion battery which has a higher energy density than conventional batteries, uses less precious metal, and can stay stable for over 1000 cycles.

They've published their technique in Nature Communications.

"Our process will increase the lifespan of batteries in many things, from smart phones and laptops to power tools and electric vehicles," says senior author and UQ researcher Professor Lianzhou Wang.

The team's discovery revolves around the cathode of the battery: the positive side, which attracts negatively charged electrons as they move through a circuit.

At the moment, for commercial lithium-ion batteries to work they need the costly and hazardous metal cobalt in their cathodes – otherwise the cathodes corrode too easily. Cathodes without cobalt can make higher-voltage and thus more energy dense batteries, but the corrosion problem means their lifespan and function is limited.

Researchers are keen to find a coating that can protect the metals in the cathode without disrupting the battery's performance.

Wang and colleagues discovered that an extremely thin epitaxial layer could protect a cathode made from lithium, nickel, and manganese. Epitaxy is a type of crystal growth in which the crystal's atoms are aligned with the atoms in the substrate (the thing they're growing on).

In this case, the researchers found that a specific material (made from lanthanum, nickel, manganese and oxygen) grown epitaxially on cathode particles could stop the cathode from dissolving.

The layer of crystal is only an atom thick – so it doesn't require much material to have a big effect.

"This new approach features a minimal protective coating at a scalable process, paving the way for the deployment of these abundant high-voltage materials for next generation, high-energy batteries," says Wang.

Wang says that other than being better performing and cobalt free, the battery operates very similarly to conventional lithium-ion batteries.

"The battery can be operated at higher voltage – about 4.5V, versus 3.7V for a normal lithium-ion battery – which means higher energy density can be delivered," he points out.

The researchers are now planning to commercialise the technology.

"We are now in discussion with our industry partners to assess the scale-up production process and to evaluate the battery performance under various conditions," says Wang.

He predicts that the battery could be ready for the market in two or three years.

Cosmos, March 29 2022

https://cosmosmagazine.com

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Chaos theory provides hints for controlling the weather

2022-03-28

Under a project led by the RIKEN Center for Computational Science, researchers have used computer simulations to show that weather phenomena such as sudden downpours could potentially be modified by making small adjustments to certain variables in the weather system. They did this by taking advantage of a system known as a "butterfly attractor" in chaos theory, where a system can have one of two states—like the wings of a butterfly—and that it switches back and forth between the two states depending on small changes in certain conditions.

While weather predictions have reached levels of high accuracy thanks to methods such as supercomputer-based simulations and data assimilation, where observational data is incorporated into simulations, scientists have long hoped to be able to control the weather. Research in this area has intensified due to climate change, which has led to more extreme weather events such as torrential rain and storms.

Research in this area has intensified due to climate change, which has led to more extreme weather events such as torrential rain and storms.

There are methods at present for weather modification, but they have had limited success. Seeding the atmosphere to induce rain has been demonstrated, but it is only possible when the atmosphere is already in a state where it might rain. Geoengineering projects have been envisioned, but have not been carried out due to concerns about what unpredicted long-term effects they might have.

As a promising approach, researchers from the RIKEN team have looked to chaos theory to create realistic possibilities for mitigating weather events such as torrential rain. Specifically, they have focused on a phenomenon known as a butterfly attractor, proposed by mathematician and meteorologist Edward Lorentz, one of the founders of modern chaos theory. Essentially, this refers to a system that can adopt one of two orbits that look like the wings of a butterfly, but can change the orbits randomly based on small fluctuations in the system.

To perform the work, the RIKEN team ran one weather simulation, to serve as the control of "nature" itself, and then ran other simulations, using small variations in a number of variables describing the convection—how heat moves through the system—and discovered that small changes in several of the variables together could lead to the system being in a certain state once a certain amount of time elapsed.

According to Takemasa Miyoshi of the RIKEN Center for Computational Science, who led the team, "This opens the path to research into the

controllability of weather and could lead to weather control technology. If realized, this research could help us prevent and mitigate extreme windstorms, such as torrential rains and typhoons, whose risks are increasing with climate change."

"We have built a new theory and methodology for studying the controllability of weather," he continues. "Based on the observing system simulation experiments used in previous predictability studies, we were able to design an experiment to investigate predictability based on the assumption that the true values (nature) cannot be changed, but rather that we can change the idea of what can be changed (the object to be controlled)."

Looking to the future, he says, "In this case we used an ideal low-dimensional model to develop a new theory, and in the future we plan to use actual weather models to study the possible controllability of weather."

The work, published in Nonlinear Processes in Geophysics, was done as part of the Moonshot R&D Millennia program, contributing to the new Moonshot goal #8.

Tech Xplore, 28 March 2022

https://techxplore.com

Men and women process pain signals differently

2022-03-22

A new study published in the journal BRAIN shows for the first time that neurons in the spinal cord process pain signals differently in women compared to men. The finding could lead to better and more personalized treatments for chronic pain, which are desperately needed, especially in light of the opioid epidemic.

Although it has long been known that women and men experience pain differently, most pain research uses male rodents. The new study is unique because it used female and male spinal cord tissue from both rats and humans (generously donated by deceased individuals and their families).

By examining the spinal cord tissue in the laboratory, the researchers were able to show that a neuronal growth factor called BDNF plays a major role in amplifying spinal cord pain signalling in male humans and male rats, but not in female humans or female rats. When female rats had their ovaries removed, the difference disappeared, pointing to a hormonal connection.

"Developing new pain drugs requires a detailed understanding of how pain is processed at the biological level," said Dr. Annemarie Dedek, lead author of the study and now a MITACS- and Eli Lilly-funded industrial research fellow at Carleton University and The Ottawa Hospital. "This new discovery lays the foundation for the development of new treatments to help those suffering from chronic pain."

The finding could lead to better and more personalized treatments for chronic pain

This discovery was possible because of a unique collaboration between the research laboratories of:

- Dr. Mike Hildebrand, associate professor at Carleton University and affiliate investigator at The Ottawa Hospital
- Dr. Eve Tsai, neurosurgeon and Suruchi Bhargava Chair in Spinal Cord and Brain Regeneration Research at The Ottawa Hospital and associate professor at the University of Ottawa Brain and Mind Research Institute
- Dr. Yves De Koninck, Director of the CERVO Brain Research Center at Laval University
- Dr. Jian Xu, associate research scientist, Yale University

This is the first time a sex-related difference in pain signalling has been identified in human spinal cord tissue. Future studies are required to understand how this biological difference may contribute to differences in pain sensation between men and women.

Learn more about how this team is bridging the gap between animal studies and new treatments for chronic pain.

This research was supported by the Canada Foundation for Innovation, the Natural Sciences and Engineering Research Council of Canada, the International Association for the Study of Pain Medicine, the Canadian Pain Society, Pfizer Canada, Fonds de recherche du Quebec, Sentinel North and the Canadian Institutes of Health Research. All research at The Ottawa Hospital is also enabled by generous donors to The Ottawa Hospital Foundation.

Science Daily, 22 March 2022

https://sciencedaily.com

How to investigate when a robot causes an accident, and why it's important that we do

2022-03-25

Robots are featuring more and more in our daily lives. They can be incredibly useful (bionic limbs, robotic lawnmowers, or robots which deliver meals to people in quarantine), or merely entertaining (robotic dogs, dancing toys, and acrobatic drones). Imagination is perhaps the only limit to what robots will be able to do in the future.

What happens, though, when robots don't do what we want them to—or do it in a way that causes harm? For example, what happens if a bionic arm is involved in a driving accident?

Robot accidents are becoming a concern for two reasons. First, the increase in the number of robots will naturally see a rise in the number of accidents they're involved in. Second, we're getting better at building more complex robots. When a robot is more complex, it's more difficult to understand why something went wrong.

Most robots run on various forms of artificial intelligence (AI). AIs are capable of making human-like decisions (though they may make objectively good or bad ones). These decisions can be any number of things, from identifying an object to interpreting speech.

AIs are trained to make these decisions for the robot based on information from vast datasets. The AIs are then tested for accuracy (how well they do what we want them to) before they're set the task.

What happens if a bionic arm is involved in a driving accident?

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AIs can be designed in different ways. As an example, consider the robot vacuum. It could be designed so that whenever it bumps off a surface it redirects in a random direction. Conversely, it could be designed to map out its surroundings to find obstacles, cover all surface areas, and return to its charging base. While the first vacuum is taking in input from its sensors, the second is tracking that input into an internal mapping system. In both cases, the AI is taking in information and making a decision around it.

The more complex things a robot is capable of, the more types of information it has to interpret. It also may be assessing multiple sources of one type of data, such as, in the case of aural data, a live voice, a radio, and the wind.

As robots become more complex and are able to act on a variety of information, it becomes even more important to determine which information the robot acted on, particularly when harm is caused.

Accidents happen

As with any product, things can and do go wrong with robots. Sometimes this is an internal issue, such as the robot not recognizing a voice command. Sometimes it's external—the robot's sensor was damaged. And sometimes it can be both, such as the robot not being designed to work on carpets and "tripping." Robot accident investigations must look at all potential causes.

While it may be inconvenient if the robot is damaged when something goes wrong, we are far more concerned when the robot causes harm to, or fails to mitigate harm to, a person. For example, if a bionic arm fails to grasp a hot beverage, knocking it onto the owner; or if a care robot fails to register a distress call when the frail user has fallen.

Why is robot accident investigation different to that of human accidents? Notably, robots don't have motives. We want to know why a robot made the decision it did based on the particular set of inputs that it had.

In the example of the bionic arm, was it a miscommunication between the user and the hand? Did the robot confuse multiple signals? Lock unexpectedly? In the example of the person falling over, could the robot not "hear" the call for help over a loud fan? Or did it have trouble interpreting the user's speech?

The black box

Robot accident investigation has a key benefit over human accident investigation: there's potential for a built-in witness. Commercial airplanes have a similar witness: the black box, built to withstand plane crashes and provide information as to why the crash happened. This information is incredibly valuable not only in understanding incidents, but in preventing them from happening again.

As part of RoboTIPS, a project which focuses on responsible innovation for social robots (robots that interact with people), we have created what we call the ethical black box: an internal record of the robot's inputs and corresponding actions. The ethical black box is designed for each type of robot it inhabits and is built to record all information that the robot acts on. This can be voice, visual, or even brainwave activity.

We are testing the ethical black box on a variety of robots in both laboratory and simulated accident conditions. The aim is that the ethical black box will become standard in robots of all makes and applications.

While data recorded by the ethical black box still needs to be interpreted in the case of an accident, having this data in the first instance is crucial in allowing us to investigate.

The investigation process offers the chance to ensure that the same errors don't happen twice. The ethical black box is a way not only to build better robots, but to innovate responsibly in an exciting and dynamic field.

Tech Xplore, 25 March 2022

https://techxplore.com

How do boa constrictors avoid suffocating when they squeeze their prey?

2022-03-25

Boa constrictors famously hunt by ambushing their prey and then squeezing the captured animals to death with their muscular coils.

But as a boa constricts its body around a victim and cuts off blood flow to that animal's brain, how does the snake avoid squeezing all the air from its own lungs and suffocating itself in the process?

It turns out, a boa constrictor can rapidly adjust which section of its ribcage it uses to breathe, according to a study published March 24, 2022, in the Journal of Experimental Biology (JEB). So if a boa entraps a squirrel or rat using the front half of its body, the constrictor will then use the ribs

It turns out, a boa constrictor can rapidly adjust which section of its ribcage it uses to breathe

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farther down its noodle-like body to continue breathing as it crushes the rodent. And likewise, the ribs closer to the animal's head will take over if the back ribs are currently pressed up against an immobilized animal.

"Constriction is an incredibly energetically taxing behavior and almost certainly requires high oxygen demands," said David Penning, an assistant professor of biology at Missouri Southern State University, who was not involved in the study. The new research "helps to unpack some of the confusion around how oxygen intake occurs during this taxing process."

In addition to revealing how boas breathe during constriction, "I think this work can be used to make larger inferences beyond just the boa constrictor," Penning told Live Science in an email. "Not only do we know very little about how snakes function, we know equally little about the real metabolic demands of most of their activities."

Snake lung evolution

This ability to control which section of their ribcage is involved in breathing likely allowed boas to evolve to their present forms, said study first author John Capano, a postdoctoral research associate in the Department of Ecology, Evolution, and Organismal Biology at Brown University. "It doesn't seem like you could evolve constriction to kill really big things if you're compromising lung ventilation," Capano said.

This precise breathing strategy likely also helps boas survive the process of swallowing and digesting large prey, since these hefty meals restrict the movement of the animals' ribs from the inside, Capano told Live Science. In their report, the study authors theorize that other snake species likely use this same breathing method, and that the method likely evolved in tandem with snakes' highly mobile skulls, which contort so the animals can wrap their jaws around enormous prey and swallow it in one gulp, he added.

Unlike humans, snakes lack diaphragms, the large, dome-shaped muscles that contract and flatten to allow a person's lungs to expand and fill with air and then relax and compress the lungs to push air out. Instead, snakes use muscles attached to their ribs to alter the volume of their ribcage and allow air in and out of the lungs.

When animals breathe with their ribcage, they typically use small muscles called intercostals that run between adjacent ribs, Capano said. These animals use the intercostal muscles to move entire "blocks" of ribs at one

time, rather than having fine-tuned, independent control of individual rib bones.

By comparison, boas and other snakes primarily use levator costae muscles to breathe; each levator costa runs from the vertebral column to one of the snake's more than 400 ribs. In their new study, the team revealed how each levator costa "can basically control motions a lot more discreetly," Capano said. "It can just lift that individual rib." When a levator costa contracts, it pulls the rib back, like a door on a hinge, while also causing the bone to slightly rotate; these delicate motions control when and where the snakes' lungs can inflate.

All snakes have fully-developed right lungs, but depending on the species, a snake may either have a puny left lung or no left lung at all, according to a 2015 report in the journal PLOS One. Boa constrictors fall into the first group, in that they have a teeny-tiny left lung and a lengthy right lung that's roughly one-third as long as the snake's body, the JEB report notes.

The front one-third of the long lung, closest to the snake's head, contains tissue that can perform gas exchange, meaning it can pass oxygen into the bloodstream and remove, or exhale, waste products, like carbon dioxide. The back two-thirds of the lung cannot perform gas exchange and are essentially "just a bag," Capano said.

Scientists have different theories as to the function of this bag-like region, but the new study supports the idea that it acts as a kind of bellows that helps draw air through the front, gas-exchanging part of the lung, Capano said. So when the front of the lung can't fully expand — when the boa is busy subduing a snack — the back of the lung can still pull air through the tissue and allow gas exchange to occur.

"Even if your front [lung] can't move, or even if something's squishing it, you can still draw air through it," Capano said. "And then by doing so, you're still pulling oxygenated air through your vascular tissue."

The team figured out that boa constrictors used this unique breathing method by placing blood pressure cuffs on adult boas in their lab, in order to restrict the movement of some of the snakes' ribs. The team used various techniques to measure air flow in and out of the snakes' lungs and the electrical activity of different muscles. They also used a technique called "X-ray reconstruction of moving morphology" (XROMM) to track how the snakes' ribs were moving, in real-time.

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Using XROMM involved placing small metal markers on a few of the snakes' ribs and then scanning the animals from the side and from above as they moved. By combining the footage taken from both viewpoints, the team captured how the ribs moved in three dimensions and created detailed models of the ribcage in motion, Capano said.

The new study nicely captures how the movement of boas' ribs changes in response to the blood pressure cuff, which presses in on the animal from all sides, Penning said. That said, when a snake actually constricts an animal, the side of the snake that makes contact with the prey is "likely doing the bulk of the work exerting force," while the other side of the snake may be less compressed, by comparison, he noted.

So there may be slight differences in how the snakes adjust their breathing to accommodate pressure from the cuff, as compared with when they're throttling prey; Penning said he'd be interested in seeing those differences investigated in the future. Looking forward, Capano said that he's interested in studying how boas and other snakes move their ribs during different dynamic behaviors, such as slithering.

Live Science, 25 March 2022

https://livescience.com

What countries and cities will disappear due to rising sea levels?

2022-03-27

NOAA predicts that sea levels will likely rise by at least 1 foot (0.3 m) above the levels seen in 2000 by the start of the next century, while the United Nations Intergovernmental Panel on Climate Change estimates that they will rise by 16 to 25 inches (40 and 63 centimeters) by 2100.

Should sea levels rise to this extent, it could wreak havoc around the globe. As many as 250 million people, spanning all continents, could be "directly affected" by 2100, according to a 2019 study in the journal Nature Communications.

So, will any of these countries, cities or states disappear entirely in our lifetime, and is there anything that can be done to avert disaster?

"Whether cities or countries disappear depends on whether we as humans are doing something to counteract the threat," Gerd Masselink, a professor in coastal geomorphology at the University of Plymouth in the United Kingdom, told Live Science in an email. "Most of the Netherlands is already

As many as 250 million people, spanning all continents, could be "directly affected" by 2100.

below sea level but is not disappearing, because the Dutch are building and maintaining their coastal defenses."

Which countries will be most affected?

First, let's look at the countries with the lowest elevations.

According to the Union of Concerned Scientists (UCS), the Maldives, made up of 1,200 small coral islands and home to around 540,000 people, is the flattest country on Earth, with an average elevation of just 3 feet (1 m). Should the Maldives experience sea level rise on the order of just 1.5 feet (45 cm), it will lose around 77% of its land area by 2100, according to the UCS.

Another country with an extremely low average elevation — around 6 feet (1.8 m) above sea level — is Kiribati. This small island in the heart of the Pacific, with a population of close to 120,000, could lose two-thirds of its land if sea levels rise by 3 feet.

In fact, nearly everyone who lives on a Pacific island is likely to be severely affected by rising sea levels. Around 3 million Pacific islanders live within 6.2 miles (10 km) of the coast and, therefore, might need to relocate before the end of the century, according to the Science and Development Network, a nonprofit focused on facilitating scientific learning.

Sea level rise has already led to the disappearance of at least five "vegetated reef islands" that were previously part of the Solomon Islands, with "a further six islands experiencing severe shoreline recession," according to a 2016 study in the journal Environmental Research Letters.

These Pacific islands, though very much in jeopardy, tend to have relatively small populations. So what larger nations might be hit hardest?

The country where the most people will potentially be affected by sea level change is China, with 43 million people in precarious coastal locations. Other countries subject to face major issues related to rising sea levels include Bangladesh, where 32 million people will be at risk by 2100, and India, with 27 million, according to the European Union-funded Life Adaptate project.

So, while various countries around the world are set to see the consequences of rising sea levels firsthand by the end of the century and many millions will be affected, it seems unlikely that any countries, even those with very low elevations, will disappear entirely by 2100 — though it could be just a matter of time before some are consumed by the ocean.

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Coastal cities

While no country is likely to be devoured by 2100, numerous major cities are at very serious risk of being inundated. One of the most clear-cut examples of rising sea levels causing significant, real-world difficulties is Jakarta, the capital of Indonesia.

Jakarta, home to around 10 million people, has been dubbed the "fastest-sinking city in the world" by the BBC; it is sinking by 2 to 4 inches (5 to 10 cm) each year due to "excessive groundwater drainage," according to Earth.org, a nonprofit environmental organization based in Hong Kong.

When coupled with rising sea levels, this is a recipe for disaster. According to the World Economic Forum, much of Jakarta could be underwater by 2050. In fact, Jakarta's situation is so dire that it is being replaced as Indonesia's capital by Nusantara, a soon-to-be built city on the east coast of Borneo, around 1,200 miles (2,000 km) from Jakarta.

But Jakarta is far from the only city with an uncertain future. According to the World Economic Forum, by 2100, Dhaka, Bangladesh (population 22.4 million); Lagos, Nigeria (population 15.3 million); and Bangkok, Thailand (population 9 million) could also be entirely drowned or have vast tracts of land underwater and unusable.

Rising sea levels are also likely to majorly impact the United States. Based on recent projections, many U.S. cities could face serious issues by 2050, with vast swathes of land potentially rendered unlivable.

According to NOAA, "in many locations along the U.S. coastline, high-tide flooding is now 300% to more than 900% more frequent than it was 50 years ago," which suggests that sea levels are a valid cause for concern.

New York City is most at risk, according to research from Climate Central. The report states that, by 2050, nearly half a million (426,000) New Yorkers will be living on "threatened land." New York's vulnerability to flooding was seen clearly in 2012, when the city was heavily impacted by Hurricane Sandy. At least 43 people in the city died as a result of the superstorm, around a quarter of a million vehicles were destroyed, and there was at least $32 billion worth of "damage and loss," then-Gov. Andrew Cuomo said at the time, according to Politico.

However, in terms of susceptibility to flooding, Florida seems certain to be the state that is hit hardest. According to Climate Central's research, 36 of the 50 U.S. cities that are most vulnerable to coastal flooding are in the Sunshine State.

Are we doomed?

So, what can be done? Are these cities and countries doomed, or can they be saved?

Countries that invest in infrastructure, such as the Netherlands, may be able to avoid some effects of flooding. But some investments, such as those being proposed in Florida, cannot be applied everywhere. For example, the restoration of mangroves, as suggested by The Nature Conservancy, and the expansion of coral reefs, are viable only in certain climatic regions. Moreover, such measures are expensive.

Officials in Miami-Dade County, Florida, recently announced a mitigation strategy that will involve "elevating homes and roads," as well as creating open space that will allow flooding to take place without damaging infrastructure, according to The New York Times.

However, these plans have not been greeted with universal praise. Some experts, such as Rob Moore, a senior policy analyst with the Natural Resources Defense Council, told the New York Times that he's "not sure if it's really owning up to the problems that are in Miami's future," while others have implied that the proposals have "downplayed the magnitude of the threat."

Elsewhere in Florida, there have been conversations around whether it is economically viable, or indeed worthwhile, attempting to protect all infrastructure, with suggestions that it could be better to accept defeat in some regions, according to an article published by Yale Climate Connections, a nonpartisan media outlet focused on climate change.

While countries such as the United States may be able to invest in coastal protection projects — and have the ability to learn via trial and error — most developing nations don't have the same luxury. When compared to countries like the Netherlands and United States in terms of having the financial clout to implement such projects, "Bangladesh is not in such a fortunate position," Masselink said.

So, a key factor in determining whether a city or country will disappear is not necessarily the rate of sea level rise, but more the capacity of a city or country to address the problem and develop long-term defenses.

A low-lying but politically stable and prosperous country might be fine for decades to come, but a low-lying, unstable and poor country will not be able to keep the sea at bay," Masselink said. "This, therefore, particularly exposes low-lying cities and countries in developing nations."

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With that in mind, what will our planet look like in 100 years?

"This is really difficult to foresee, as in addition to the uncertain rate of sea level rise — which depends strongly on our greenhouse gas emissions — the main factor is how nations and society intend to mitigate against rising sea level."

Live Science, 27 March 2022

https://livescience.com

Dangerous chemicals found in food wrappers at major fast-food restaurants and grocery chains, report says

2022-03-25

Alarming levels of dangerous chemicals known as PFAS were discovered in food packaging at a number of well-known fast-food and fast-casual restaurants and grocery store chains, a new report found.

The highest levels of indicators for PFAS were found in food packaging from Nathan's Famous, Cava, Arby's, Burger King, Chick-fil-A, Stop & Shop and Sweetgreen, according to an investigation released Thursday by Consumer Reports.

Often called "forever chemicals" because they do not break down in the environment, PFAS are used in food packaging to prevent grease and water from soaking through food wrappers and beverage cups. PFAS can also be found in the ink used to print logos and instructions on food containers.

The new report comes more than two years into the Covid-19 pandemic, when the public has relied heavily on takeout and grocery deliveries.

The US Centers for Disease Control and Prevention calls exposure to PFAS (per- and polyfluoroalkyl substances) a "public health concern," citing studies that found the human-made chemicals can harm the immune system and reduce a person's resistance to infectious diseases.

"There is evidence from human and animal studies that PFAS exposure may reduce antibody responses to vaccines," stated the CDC and the Agency for Toxic Substances and Disease Registry. "More research is needed to understand how PFAS exposure may affect illness from COVID-19."

More than 100 food products tested

Often called "forever chemicals" because they do not break down in the environment, PFAS are used in food packaging to prevent grease and water from soaking through food wrappers.

The Consumer Reports investigation collected 118 food packaging products sold by 24 companies in the tristate area of New York, New Jersey and Connecticut. It tested those products for organic fluorine -- a marker for PFAS. Researchers then sent samples of products with the highest levels to an independent laboratory that could perform more specific tests, said Michael Hansen, senior staff scientist for advocacy at Consumer Reports.

Regulatory limits for how much PFAS food packaging should contain can vary greatly. In the US, there are no federal limits, leaving action up to the states. Connecticut, Maine, Minnesota, New York, Vermont and Washington have passed bills banning intentional use of PFAS in food packaging, but haven't yet specified a limit, according to Consumer Reports. In January 2023, a new law in California will set the limit at less than 100 ppm (parts per million).

However, Denmark set a much lower regulatory limit of 20 ppm with great success, said Xenia Trier, a chemicals, environment and human health expert at the European Environment Agency.

"In Denmark we've seen both a decrease in noncompliance by industry from 60% to about 30% and a decrease in levels of PFAS in packaging products over the past 10 years," Trier told CNN. "It does work to set limits and enforce them. It is possible to find alternative solutions and if one manufacturer can make packaging without PFAS, then it should be possible for everybody to do it."

The Consumer Reports investigation found the highest indicators for PFAS -- 876 ppm and 618 ppm -- in two types of bags for sides at Nathan's Famous restaurants.

High indicators of PFAS (in the 500s) were also found in a Chick-fil-A sandwich wrapper and in fiber bowls at Cava, a Mediterranean restaurant chain.

Indicator levels in the 300s and 400s were found in a bag of cookies at Arby's, bamboo paper plates at Stop & Shop, and in a bag for both cookies and French toast sticks at Burger King.

Levels of PFAS indicators in the 200s were found in a Sweetgreen paper bag for focaccia, additional items at Cava, and in bags for french fries, cookies and Chicken McNuggets at McDonald's.

However, all of the companies listed had additional food packaging that tested at levels below 200 ppm. Four companies -- Arby's, Nathan's

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Famous, McDonald's and Stop & Shop -- also sold food in packaging that had no detectable levels of PFAS, the report said.

The Consumer Reports investigation did not test packaging from every food product sold at each company.

"I would not urge consumers to take these brand names and only go to this one or that one, as this investigation only looked at just over 100 products," said Graham Peaslee, a professor of physics, chemistry and biochemistry at the University of Notre Dame in Indiana.

"However, this will hold industry's toes to the fire, so in that sense, I think it's a valuable report," he added. "Measuring and saying PFAS is there and it's dangerous gets people's attention, and companies tend to avoid attention like that."

Health impact of PFAS

PFAS chemicals are in many products: nonstick cookware, infection-resistant surgical gowns and drapes, cell phones, semiconductors, commercial aircraft and low-emission vehicles. The chemicals also are used to make carpeting, clothing, and furniture resistant to stains, water and grease damage.

In use since the 1950s, PFAS are chemicals most Americans have "in their blood," especially perfluorooctane sulfonic acid (PFOS) and perfluorooctanoic acid (PFOA)," according to the Agency for Toxic Substances and Disease Registry, which is charged with protecting the public from hazardous substances.

In the Consumer Reports investigation, the most common chemical found in the food packaging that was tested was PFOA, with PFOS coming in fifth, according to the report.

In addition to impacts on the immune system, the Agency for Toxic Substances and Disease Registry said studies in humans and lab animals have found links between certain PFAS chemicals and an increase in cholesterol levels, alterations in liver enzymes, a higher risk of developing kidney or testicular cancer, small reductions in infant birth weights and an additional risk of high blood pressure in pregnant women.

"PFAS have also caused birth defects, delayed development, and newborn deaths in lab animals," the agency stated, while adding "not all effects observed in animals may occur in humans."

As environmental groups and the public began to take notice of the health impacts of the chemicals, manufacturers started to voluntarily phase out the use of PFOS and PFOA in the US. Between 1999 and 2014, blood levels of PFOS in Americans had declined by more than 80% and blood levels of PFOA had declined by more than 60%, the Agency for Toxic Substances and Disease Registry stated.

However, "as PFOS and PFOA are phased out and replaced, people may be exposed to other PFAS," the agency continued. Newer versions of PFAS in food packaging appear to be absorbed by food more readily than the older versions, according to a 2016 study.

Studies in Denmark have shown that PFAS do "migrate from the paper into the food," Trier said. "Even though it was not 100%, we still saw substantial transmission. In general, transmission from packaging to food is increased as the temperature of the food rises and the time spent in wrapping materials increases."

Industry response

The Consumer Reports investigation mirrored results of reports in 2018 and 2020 by Toxic-Free Future and Safer Chemicals Healthy Families. Those reports found "harmful" levels of PFAS in fast-food packaging and in nearly two-thirds of takeout containers made of paper, like those used at self-serve salad buffets and hot bars.

In response to the 2018 report, Whole Foods became the first grocery chain in North America to publicly commit to remove PFAS from takeout containers and deli and bakery paper. Other companies have followed suit, including Ahold Delhaize, Albertsons, Amazon.com, Cava, Chipotle, Freshii, McDonald's, Panera Bread, Sweetgreen, Trader Joe's and Wendy's, according to Toxic-Free Future.

In the new investigation, Consumer Reports tested 13 food packaging products from retailers that had previously committed to phasing out PFAS. Seven of the 13 had levels of PFAS above 20 ppm, the report said.

Burger King, which had high levels of PFAS in three of six products tested, had not made a public commitment to phase out PFAS, according to Consumer Reports. Early Thursday, parent company Restaurant Brands International announced it will globally phase out any "added" PFAS from "guest-facing packaging materials" at the Burger King, Tim Hortons and Popeyes brands "by the end of 2025 or sooner."

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Nathan's Famous, which Consumer Reports said also has not made a public commitment to reducing PFAS, told CNN the company had begun phasing out the bags. "One of our goals in this complete package redesign is to reduce PFAS," said Phil McCann, vice president of marketing at Nathan's Famous. "Full transition will be complete by December 2022."

Chick-fil-A told CNN it had been on a four-year journey to phase out PFAS: "Chick-fil-A has eliminated intentionally added PFAS from all newly produced packaging going forward in our supply chain. While some legacy packaging may still be in restaurants, it is expected to be phased out by the end of this summer," the company tweeted Wednesday.

Cava, which had previously pledged to reduce PFAS but had five out of six products with indicators between 200 ppm and 548 ppm, told CNN that "due to a multitude of factors related to the pandemic, and especially global supply chain shortages, the transition to eliminating added PFAS, which began in August of 2021, is taking longer than planned. Our teams are working with our suppliers to complete the transition within the year."

A McDonald's spokesperson said less than 7.5% of the company's global food packaging contained added PFAS at the end of 2020 and said the company was continuing its search for alternative materials that offered proper grease-resistant barriers, with a goal of reducing deliberately added PFAS by the end of 2025.

Sweetgreen told CNN the company was "proud to share that we are currently in the process of rolling out new PFAS-free focaccia bags that will be available in all Sweetgreen locations by the end of Q2."

Jennifer Brogan, director of external communications and community relations for Stop & Shop, told CNN the company could "confirm that these Nature's Promise brand plates have been removed from all store locations."

A spokesperson from Arby's told CNN in an email that the company has "minimal packaging materials containing PFAs and is on track to have PFAs removed from all packaging products by the end of 2022."

Actions the public can take

Experts say people who want to avoid PFAS in their takeout and food delivery packaging should favor companies that have pledged to remove the chemicals.

Take food out of the container as soon as you receive it, and never reheat food in its original container. Instead, remove your food and heat it in ceramic or glass containers, Trier said.

The Consumer Reports investigation found some of the highest levels of PFAS were in paper bags (192.2 ppm) and molded fiber bowls and trays (156.8 ppm). Paper plates tested at 149 ppm, and food wrappers and liners came in at 59.2 ppm.

Don't be fooled by "environmentally friendly" claims -- they don't guarantee a product is PFAS-free. When Consumer Reports tested those products, some had levels of PFAS above 100 ppm, and most had some detectable levels, the report said.

Experts also suggest reducing the frequency of takeout meals to once a week or less, and recommend that people instead make food at home.

You can also reach out to your congressional representative and senators and support the bipartisan bill Keep Food Containers Safe from PFAS Act, experts said. Designed to ban the use of any PFAS as a food contact substance, the bill was introduced into both chambers in November.

CNN Health, 25 March 2022

https://edition.cnn.com

Life-long recreational sport and exercise slows down aspects of ageing

2022-03-28

Research into the benefits of exercise on ageing tend to focus on competitive 'master athletes'.

This is anybody over the age of 35 who regularly trains and competes well into old age.

Why 35? Because that's when cardiovascular issues begin to affect your wellbeing. In other words, it's the line in the sand between youthful and … not so youthful,

Now comes the first study "to find that life-long exercise at a recreational level could delay some detrimental effects of ageing".

To get these results, you don't need to specifically lift weights.

Your long-time weekly hit and giggle on the tennis court has done more for your health than you realised.

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Your long-time weekly hit and giggle on the tennis court has done more for your health than you realised.

The study focused on people aged 68 and above.

It found those who were physically active throughout their life have healthier ageing muscle, with superior function and more resistance to fatigue "compared to inactive individuals, both young and old".

Both young and old? Really?

That's right. The researchers – in what they say is the first study to investigate muscle, stem cell and nerve activity in people – found "elderly life-long exercisers outperformed both the elderly and young sedentary adults".

The researchers from University of Copenhagen found that elderly individuals who keep physically active throughout their adult life, "whether by taking part in resistance exercise, ball games, racquet sports, swimming, cycling, running and/or rowing had a greater number of muscle stem cells, otherwise known as satellite cells in their muscle".

These cells are important "for muscle regeneration and long-term growth and protect against nerve decay".

How was the discovery made?

The researchers recruited 46 male participants who were divided into three groups:

- Young sedentary (15)
- Elderly life-long exercisers (16), and
- Elderly sedentary (15).

All participants performed a heavy resistance exercise: Sitting in a mechanical chair performing a knee extension movement to evaluate muscle function.

The amount of force produced was measured.

Blood samples were taken, and muscle biopsies were analysed from both legs.

Lead author and PhD candidate Casper Soendenbroe, from Copenhagen's Institute of Sports Medicine, said: "Using muscle tissue biopsies, we've found positive effects of exercise on the general ageing population. This

has been missing from the literature as previous studies have mostly focused on master athletes, which is a minority group."

He said the study was more representative of the general population aged 60 and above, as the average person is more likely to take part in a mixture of activities at a moderate level.

"That's why we wanted to explore the relation between satellite cell content and muscle health in recreationally active individuals," he said.

"We can now use this as a biomarker to further investigate the link between exercise, ageing and muscle health."

The study was only carried out in males and the average age was 73.

As the effects of ageing on muscle health become more pronounced at 80-plus years, "follow-up studies are needed to see if the benefits of life-long exercise are maintained later in life".

Further, investigation on recreational activity and muscle health need to be carried out in females.

Any good news for life-long slackers?

A 2018 study found that even very light workouts can increase the connectivity between parts of the brain responsible for memory formation and storage.

The Californian and Japanese researchers concluded that "people who include a little yoga or tai chi in their day may be more likely to remember where they put their keys".

You might also remember to get off the couch, lock the door on your way out of the house and keep moving.

You don't have to blow a gasket with effort to get some benefit, young or old.

The New Daily, 28 March 2022

https://thenewdaily.com.au

Here's how food waste can generate clean energy

2022-03-28

Food waste is a growing problem in Canada and many other parts of the world—and it is only expected to get worse in the coming years. The world population is expected to grow to 9.7 billion by 2050, alongside global food demand.

Biomass gasification uses heat, oxygen, steam, or a mixture of those, to convert biomass—food and agricultural waste or other biological materials—into a mixture of gases that can be used as fuel.

Not only will this create large amounts of food and municipal organic waste, but there will also be increasing amounts of agricultural waste as the global demand of vegetables, fruits and grains increases. An estimated 60 percent of food produced in Canada—over 35 million tons per year—ends up in landfills. However, Canadian cities have also run out of land to dispose this accumulating waste.

Food waste comes with its own set of issues, including greenhouse gas emissions, unpleasant odors, pests and toxic fluids that can infiltrate water sources. In addition, every year, municipal dumps take over more land, reaching the edges of communities, which can lead to health issues for those who are living nearby.

In an effort to reduce the growing problem of food waste disposal, researchers like myself are focusing on developing new technologies that use food waste to generate clean energy. My team and I are studying a process known as biomass gasification.

Biomass gasification

Biomass gasification works by feeding semi-dry food waste into a unit that looks a bit like a cooking pot, where it passes through a hot, bubbling substance that converts it to fuel gas. This process, known as fluidization is very efficient at converting food waste into high-valuable sources of energy-rich synthesis gas, a mixture of hydrogen, methane, carbon monoxide and carbon dioxide, also called syngas. Syngas can be used to generate heat and power. This process is sustainable because is considered to be carbon-neutral.

Farms, cities and municipalities could implement this sustainable technology to cut utility expenses for heating or electricity. They could also significantly reduce dependency on landfills and lower the operating budget for solid waste management services which can reach near $380 million per year for a city the size of Toronto.

Replacing fossil fuels

The consumption of fossil fuels and their derivatives has created an environmental crisis, mainly due to greenhouse gas emissions in the atmosphere, which has led to climate change. As governments around the world implement climate policies that restrict greenhouse gas

emissions or tax them, it is important to replace fossil fuels with alternative renewable sources of energy such as agricultural and food waste.

Although syngas can be used like a conventional natural gas, which is a methane-based fossil fuel, it is different from it because of its higher composition of carbon monoxide and hydrogen.

The gasification process turns trash into gas in an economical and eco-friendly way.

These gases can be further converted into high-value bio-based chemicals such as methanol and ammonia. Biomass gasification also generates biochar, which can be used to improve soil fertility.

While the production of syngas depends on the type of biomass and technology used. The Canadian Atikokan Generating Station, for instance, produced 205 megawatts of clean electricity. This is enough energy to power about 70, 000 residential and commercial buildings.

Global projects

Countries such as Finland, Brazil, Italy, Denmark and the United States are leading the way in developing sustainable and cost-efficient biomass gasification projects and using food waste to support their domestic production of heat, power and bio-based chemicals. Canada has a few companies supplying energy and bio-based chemicals from municipal waste. In this case, Canada produces 1.4 percent of its electricity with Biomass.

Costa Rica is another example. As one of the top 20 coffee producers in the world, Costa Rica generates a significant amount of agricultural waste from coffee production and its disposal presents serious environmental problems. Its present solution is biomass gasification technologies to convert coffee pulp into heat and power.

Small and marginal communities could also take full advantage of biomass gasification technologies by reducing the amount of food waste that accumulates in landfills, producing their own energy and power and significantly lowering their utilities expenses.

A sustainable and circular economy

Biomass gasification is a sustainable and technological strategy that turns food waste to a value-added product. It is a step along the path to a circular economy culture of zero waste.

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Policy leaders and governments need to support sustainable programs by providing financial aid, subsidies and tax incentives. These programs may also encourage individuals and companies to invest in biomass gasification technologies and develop them on a commercial scale.

Biomass gasification brings cities and municipalities one step closer to putting an end to concerns about food waste. It also helps meet energy demands and displace fossil fuel use and will help us transition towards a sustainable and circular economy.

Tech Xplore, 28 March 2022

https://techxplore.com

There is, in fact, a 'wrong' way to use Google: Five tips to set you on the right path

2022-03-28

I was recently reading comments on a post related to COVID-19, and saw a reply I would classify as misinformation, bordering on conspiracy. I couldn't help but ask the commenter for evidence.

Google's algorithms can penalize the truth for not being popular.

Their response came with some web links and "do your own research." I then asked about their research methodology, which turned out to be searching for specific terms on Google.

As an academic, I was intrigued. Academic research aims to establish the truth of a phenomenon based on evidence, analysis and peer review.

On the other hand, a search on Google provides links with content written by known or unknown authors, who may or may not have knowledge in that area, based on a ranking system that either follows the preferences of the user, or the collective popularity of certain sites.

In other words, Google's algorithms can penalize the truth for not being popular.

Google Search's ranking system has a fraction of a second to sort through hundreds of billions of web pages, and index them to find the most relevant and (ideally) useful information.

Somewhere along the way, mistakes get made. And it'll be a while before these algorithms become foolproof—if ever. Until then, what can you do to make sure you're not getting the short end of the stick?

One question, millions of answers

There are around 201 known factors on which a website is analyzed and ranked by Google's algorithms. Some of the main ones are:

- the specific key words used in the search
- the meaning of the key words
- the relevance of the web page, as assessed by the ranking algorithm
- the "quality" of the contents
- the usability of the web page
- and user-specific factors such as their location and profiling data taken from connected Google products, including Gmail, YouTube and Google Maps.

Research has shown users pay more attention to higher-ranked results on the first page. And there are known ways to ensure a website makes it to the first page.

One of these is "search engine optimization," which can help a web page float into the top results even if its content isn't necessarily quality.

The other issue is Google Search results are different for different people, sometimes even if they have the exact same search query.

Results are tailored to the user conducting the search. In his book The Filter Bubble, Eli Pariser points out the dangers of this—especially when the topic is of a controversial nature.

Personalized search results create alternate versions of the flow of information. Users receive more of what they've already engaged with (which is likely also what they already believe).

This leads to a dangerous cycle which can further polarize people's views, and in which more searching doesn't necessarily mean getting closer to the truth.

A work in progress

While Google Search is a brilliant search engine, it's also a work in progress. Google is continuously addressing various issues related to its performance.

One major challenge relates to societal biases concerning race and gender. For example, searching Google Images for "truck driver" or "president" returns images of mostly men, whereas "model" and "teacher" returns images of mostly women.

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While the results may represent what has historically been true (such as in the case of male presidents), this isn't always the same as what is currently true—let alone representative of the world we wish to live in.

Some years ago, Google reportedly had to block its image recognition algorithms from identifying "gorillas," after they began classifying images of black people with the term.

Another issue highlighted by health practitioners relates to people self diagnosing based on symptoms. It's estimated about 40% of Australians search online for self diagnoses, and there are about 70,000 health-related searches conducted on Google each minute.

There can be serious repercussions for those who incorrectly interpret information found through "Dr. Google"—not to mention what this means in the midst of a pandemic.

Google has delivered a plethora of COVID misinformation related to unregistered medicines, fake cures, mask effectiveness, contact tracing, lockdowns and, of course, vaccines.

According to one study, an estimated 6,000 hospitalisations and 800 deaths during the first few months of the pandemic were attributable to misinformation (specifically the false claim that drinking methanol can cure COVID).

To combat this, Google eventually prioritized authoritative sources in its search results. But there's only so much Google can do.

We each have a responsibility to make sure we're thinking critically about the information we come across. What can you do to make sure you're asking Google the best question for the answer you need?

How to Google smarter

In summary, a Google Search user must be aware of the following facts:

1. Google Search will bring you the top-ranked web pages which are also the most relevant to your search terms. Your results will be as good as your terms, so always consider context and how the inclusion of certain terms might affect the result.
2. You're better off starting with a simple search, and adding more descriptive terms later. For instance, which of the following do you think is a more effective question: "will hydroxychloroquine help cure my COVID?" or "what is hydroxychloroquine used for?"

3. Quality content comes from verified (or verifiable) sources. While scouring through results, look at the individual URLs and think about whether that source holds much authority (for instance, is it a government website?). Continue this process once you're in the page, too, always checking for author credentials and information sources.
4. Google may personalize your results based on your previous search history, current location and interests (gleaned through other products such as Gmail, YouTube or Maps). You can use incognito mode to prevent these factors from impacting your search results.
5. Google Search isn't the only option. And you don't just have to leave your reading to the discretion of its algorithms. There are several other search engines available, including Bing, Yahoo, Baidu, DuckDuckGo and Ecosia. Sometimes it's good to triangulate your results from outside the filter bubble.

Tech Xplore, 28 March 2022

https://techxplore

Genetically modified lettuce is the future of food and drugs in space, scientists say. Let us explain

2022-03-27

Want to go to Mars? Then you could end up eating a lot of lettuce. But not any ordinary lettuce.

Researchers from the University of California, Davis, have genetically engineered lettuce to produce a drug based on a human hormone that keeps bones strong.

It is the latest development in the emerging field of designing food and drugs suitable for long-distance space travel.

Astronauts lose on average about 1 per cent of their bone mass a month in space.

"Right now, astronauts on the International Space Station (ISS) have certain exercise regimens to try to maintain bone mass," said Kevin Yates, who presented the team's work at the American Chemical Society meeting earlier this week.

"But they're not typically on the International Space Station for more than six months."

A DIY veggie patch would not only provide fresh flavour and nutrients for space travellers in the short term, but it would be particularly important for long-term habitation.

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To prevent bone loss for that period of time, you'd not only need to commit to a serious workout, but you'd have to inject yourself with parathyroid hormone (PTH) every day.

So let us take a closer look at how this lettuce fits in with the future of space travel.

Why lettuce?

At the moment, astronauts onboard the ISS mainly eat ration packs, with the occasional fresh food delivery when a new spacecraft arrives.

This means "menu fatigue" quickly sets in, said Matthew Gilliham, director of the Waite Research Institute at the University of Adelaide.

"Astronauts lose 10 per cent of their body weight within the first few weeks of being on the space station, partly because of the monotonous diet," said Professor Gilliham, who researches future foods but was not involved in this research.

So NASA has been experimenting with growing plants such as lettuce on the ISS.

"Lettuce is great because it grows pretty fast," said Jenny Mortimer, who also studies future foods at the Waite Research Institute.

Growing plants in microgravity can be tricky. Some plants don't grow in the right direction, and water can stick to the roots and leaves of plants and kill them.

NASA uses a system of fans and LED lights to keep their mini-garden alive.

Along with lettuce, they've also successfully grown barley, radishes, and, most recently, chilli.

"That added excitement to their food because they were putting chilli on absolutely everything," Professor Gilliham said.

Spicing up the menu is not the only reason scientists are experimenting with growing their own veggies.

The cost of sending food to the ISS is estimated to be between $US 20,000-$40,000 per kilogram, with each crew member eating about 1.8 kilograms a day.

A crew going to Mars for three years would chew through about 10,000-11,000 kg of food.

Along with the cost of carrying and storing these tonnes of chow, most perishable vitamins such as vitamin B and C only last for 12 months.

Dr Mortimer said a DIY veggie patch would not only provide fresh flavour and nutrients for space travellers in the short term, but it would be particularly important for long-term habitation.

Beyond providing food, plants could be modified to become 'home-grown' sources of drugs and materials such as plastics.

"You can't take everything with you," she said.

"Plants are great because you can take seeds."

How do you turn lettuce into a drug?

There's been a big move over the past few years to start to produce molecules, drugs, and even plastics in biological organisms, Professor Gilliham said.

Plants are easier to grow and modify than single-celled organisms such as bacteria and yeast.

"You can put [the molecule] in different parts of the plant tissue, you could store it in different bits of the leaf that are less problematic to the plant for storing it," he said.

Some medicines, such as dopamine used in Parkinson's disease, and insulin used by people with diabetes, are produced by modifying plants such as tomatoes and then extracting and purifying the drug.

"But this team's approach is different. They are producing the molecules in the plant and there is potential to feed that leaf to humans," Professor Gilliham said.

The researchers attached a molecule to the genetic code of parathyroid hormone to keep it stable, then transferred this to the lettuce via a bacterium.

The idea is that astronauts could then eat the medication, rather than inject it.

"There will be some applications where lettuce would be the best option, but there will be others where you would need to purify," Professor Gilliham said.

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Because this plant has had genes added to it that have transformed it from a humble lettuce to an edible drug, it is classed as being genetically modified.

That means it can only be grown in controlled environments under current regulations.

"It would be a different story if you were using gene editing to modify a [known] medicinal plant … to make it suitable for space or other applications," Professor Gilliham said.

"That would be non-GM — for instance, gene editing a hemp plant to produce certain compounds."

When will we see this lettuce on the space menu?

A bunch of cos won't be on the menu in the near future.

Preliminary results indicate that, on average, the plants produce about 10-12 milligrams of the modified hormone per kilogram of fresh lettuce.

That means an astronaut would currently need to eat eight cups of lettuce a day to get enough of the hormone to keep their bones strong.

"I don't know if I'd want to share an astronaut capsule with someone who is eating that amount of lettuce," Dr Mortimer joked.

The team will next try to tweak the lettuce to make it more efficient at producing the drug, so astronauts won't have to eat as much.

They'd also like to see how it grows on the ISS.

And no-one knows what it tastes like yet because it hasn't been tested for safety on either animals or humans.

"If you are taking medication, you want to be sure how much you're taking," Dr Mortimer said.

"When you think about dosage, you might want to do some purification, or have some control over what's being produced.

"So that's one question: Can we be very confident about the amount we are producing per leaf of lettuce?"

But with travel to Mars at least another decade off, the team has plenty of time to perfect their lettuce.

And if Professor Gilliham and Dr Mortimer have their way, lettuce might not be the only homegrown produce on the menu by then.

Is this the food of the future?

If you've ever played near a waterway in Australia, then you might be familiar with duckweed.

"It's a really fascinating plant, it divides every two to three days so it grows on the surface," Dr Mortimer said.

That means duckweed production can be scaled up really quickly.

Although it's an aquatic plant, its closest relatives are wheat and barley. And it's packed with nutrition.

"It's got a good balance of protein, starch, and fats … and it's pretty digestible," she said.

"The World Health Organization has been interested in it as a food for a long time, but it doesn't look particularly appetising."

Not only does it take a much shorter time to grow than grain crops, you can eat every part of the plant, Professor Gilliham said.

"It is a zero-waste plant."

Professor Gilliham said that not only could research into plants like lettuce and duckweed benefit space travellers in the future, it could provide more sustainable sources of food, drugs and other materials on Earth.

"It's that example of using the lens of space to improve sustainability here on Earth," he said.

ABC News, 27 March 2022

https://abc.net.au

Daylight saving time could end up being permanent in the US. Experts say it's a bad idea

2022-03-26

Millions of Australians will turn the clocks back an hour next Sunday — but what if they didn't?

It's a scenario which may well come to be in the US, where year-round daylight saving time from 2023 is on the legislative table.

We know changing the clocks back and forth each year disrupts sleep, so why not keep daylight saving time all year round?

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Last week, the US Senate passed the so-called Sunshine Protection Act, which would permanently shift local time across all states to daylight saving time — that is, if it also gets the green light from the House of Representatives and President Joe Biden.

(The exceptions to the Act are Hawaii and some parts of Arizona, which don't do daylight saving time at all.)

The bill's most ardent advocate was Florida senator Marco Rubio, who said doing away with the current practice of changing the clocks twice a year could reduce heart attacks, car accidents, crime, childhood obesity and seasonal depression.

"The good news is that we can get this [bill] passed. We don't have to keep doing this stupidity anymore."

But science paints a much less sunny picture of year-round daylight saving time.

Oliver Rawashdeh from the University of Queensland was "gobsmacked" when he saw the bill had passed the Senate.

"Wherever you look, it's a bad idea," says Dr Rawashdeh, who studies what happens when biological clocks are out of whack.

Another biological clock researcher, Monash University's Sean Cain, was similarly scornful.

The Senate vote, which took place two days after the nation ticked over into daylight saving time for 2022, "is the kind of thing people do when they're sleep deprived and making poor decisions", Dr Cain says.

"That decision itself is an example of why you don't do [year-round daylight saving time]."

They're just two of a chorus of scientists around the world who have expressed disbelief and derision for this latest push for perennial daylight saving time.

So why is a permanent shift of just one hour such a shocker of a move?

And surely it's better than switching clocks back and forth each year … right?

We know changing clocks isn't great for us

First up, there's plenty of research on the health effects of daylight saving time.

When it starts, the clocks go forward and you lose an hour of sleep (assuming you need to get up at the same time each day).

This seemingly small temporal hop might mean you're just a bit tired first thing for a couple of weeks, but it has measurable effects when you look at the population as a whole, Dr Cain says.

And it doesn't help that a fair proportion of the population is already sleep deprived too.

A 2017 Sleep Health Foundation report discovered 40 per cent of Australian adults experience some kind of "inadequate sleep".

Multiple recent studies found the pandemic didn't help matters either.

"So if you instantly steal an hour of sleep away from people who are already living with a lot of sleep deprivation, there are short-term negative health impacts, such as more heart attacks and more accidents on a population level," Dr Cain says.

So eliminating clock changes, and simply sticking with daylight saving for the entire year, should be better for us, yeah?

Well … no.

And to discover why that's the case, we need to get a better understanding of the timekeepers inside our body and out.

The 'clocks' that coordinate your body

Your body contains a bunch of "clocks" of sorts, scattered through our organs, which switch genes on and off (and get each organ doing different things) at certain times of the day.

Coordinating most of these organ-based clocks is a bundle of nerve cells, tucked away in your brain, called the suprachiasmatic nucleus.

Dr Rawashdeh likens our body's internal cycles — the circadian rhythm — to an orchestra, with the suprachiasmatic nucleus acting as a conductor, and the organ's clocks as musicians.

"The conductor, by directing who plays when, collectively creates a symphony. And a symphony that sounds good is like being in good health."

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The thing is, the whole orchestra must be reset every 24 hours. And that's where daylight comes in.

The conductor in your brain receives direct input from the light-sensing cells in the back of your eyes, and it's this initial light exposure that triggers the start of a new symphony.

In summer, getting up an hour earlier due to daylight saving time isn't so bad, because the Sun comes up earlier too, so the circadian conductor still gets that early dose of light.

But getting up an hour earlier during the shorter days of winter — especially nearer the poles, where seasonal changes in day length are more pronounced — means getting up and heading off to work or school when it's still quite dark.

With even less bright morning light, the conductor loses its rhythm. And instead of a harmonious symphony of your bodily processes, it produces something more like a cacophony.

But, I hear you ask: we can switch on lights at home and in the office or classroom. Surely they're bright enough to reset our circadian conductor?

Not usually, Dr Rawashdeh says.

"You sit inside and you get a couple of thousand lux [a measurement of light intensity] — that's about as much as you can get.

"But go outside, and we're talking tens of thousands of lux."

But it's just an hour. How bad can it be?

To find out why permanent daylight saving time is problematic, we need to compare it to standard time.

"Standard time" is fairly well aligned with the movement of the Sun across the sky. So at 12pm local time, the Sun is at or very close to its highest point in the sky (with a few exceptions — more on that later).

This means standard time best matches your biological clock, Dr Cain says.

"Your body doesn't care what time you say it is. It's lining itself up with the Sun. That's how our bodies evolved."

But year-round daylight saving time forces your body into a routine that's ever-so-slightly out of sync with the Sun, and you can end up with what boils down to chronic jet lag.

Not only are you waking up in the dark, but your alarm's going off right when your internal clocks are actively trying to keep you in slumber, which happens in the second half of the night.

"So now in the winter time, we're waking up at a time when our bodies are saying 'sleep, sleep sleep,'" Dr Cain says.

This interruption also interferes with processes like your body's routine maintenance.

"For instance, your heart works really hard in the day, but it repairs itself at night.

"You mess up its clocks, then any vulnerabilities you have to disease are more likely to come out."

Once you've dragged yourself out of bed, it's time for breakfast.

But when you start eating in the dark, you're forcing food into a digestive system that's not ready to process it, Dr Cain adds.

"We now know that will impact your glucose metabolism and your insulin levels."

On top of that, eating earlier can also produce duelling circadian conductors.

Light is the main cue your body uses to reset its clocks, but food is another, Dr Rawashdeh says.

When you start eating earlier, it may trigger a second conductor — called the food-entrainable oscillator — to step up to the podium.

"Many of the peripheral clocks in your liver, pancreas and so on, they favour listening to food [and the food-entrainable oscillator] for their time cue.

"So now you have two conductors in the orchestra, and each is telling the body something different.

"They can create havoc."

And you've not even left the house.

This simple act of getting up in the dark can start a feedback spiral that affects your circadian cycles in days to come, Dr Rawashdeh adds.

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"When exposure to sunlight in the morning is reduced, our biological clocks will drift later and later, making it harder to wake up."

How do we know all this happens?

These are just a few ways permanent daylight saving time might disturb your body's natural rhythms.

Of course, not everyone is affected the same way. We all have our own natural "chronotype", with some thriving in the early morning and others functioning better later in the day.

Still, researchers have been able to see the effects of something akin to long-term daylight saving time on a population scale, Dr Cain says.

People residing on the western edge of a time zone see the Sun come up later than their eastern counterparts.

"Essentially within the same time zone, you have people [in the west] living out of phase with their body by an hour, and others [in the east] living in phase.

"There's more illness on the western side of time zones, because at a population level, living a little bit out of phase with their body is having these negative effects."

So now what for the US?

Dr Cain is pretty sure the bill won't progress any further, partly because of the recent uproar from the scientific community, but mostly because it's been tried before — and failed.

In the 1970s, the US gave year-long daylight saving a go. The plan was to see how it went for two years, then suss out if it was worth keeping full time.

They pulled the pin well before the trial period was up, because people hated getting up in the dark.

Take the example of Williston, North Dakota, a town less than 100 kilometres from the Canadian border.

It's on the western edge of the North American Central Time Zone. For around seven weeks during winter, the sun rises after 8.30am. With daylight saving time, the sunrise is after 9.30am.

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So if the worst-case scenario transpires — and the Sunshine Protection Act is passed and implemented — Dr Cain suspects it will be swiftly changed back following public backlash.

"Once winter rolls around, people will realise it's simply not fun to be getting up an hour earlier than normal."

And really, from a public health perspective, Dr Cain and Dr Rawashdeh (and many of their circadian and sleep biology colleagues) say countries should consider making standard time permanent.

Russia did it in 2014 after enduring three full years of daylight saving time.

But that's a harder sell to the voting public.

"One of the problems is daylight saving sounds good, right? Who doesn't want more daylight?" Dr Cain says.

"Standard time is not so sexy."

So next weekend, when most of the Australian population reverts to the not-so-sexy standard time, it might be better for the nation's health and wellbeing as a whole.

ABC News, 26 March 2022

https://abc.net.au

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