CHEMWATCH

Bulletin Board

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ASIA PACIFIC

China issues national standard for bio-materials

2021-04-14

On April 13, 2021, testing provider *SGS* reported on the publication of China's new standard GB/T 39514-2020 titled "Terminology, definition, identification of biobased materials," which was originally released in November 2020. The standard defines the term "biobased material" as referring to any material of biological origins such as lignin, cellulose, chitin, and natural rubber or materials made by biological manufacturing processes including biodegradable plastic, and wood plastic material. In total, the standard sets legal definitions for 58 terms including "plastic," "biodegradable plastic," "composite," and "renewable resource."

Beginning June 1, 2021, a standardized identification code must be indelibly marked on products. Each identification code begins with "BBM GB/T 39514—2020" representing the "biobased material as specified in regulation GB/T 39514—2020" followed by the product name of the material and the raw material component(s).

Read More

Food Packaging Forum, 14 April 2021

https://www.foodpackagingforum.org/news/china-issues-national-standard-for-bio-materials

India plans ban on single-use plastic items

2021-04-06

Government authority publishes draft ban set to come into force in three phases; would ban import, manufacture, and sale of plastic candy and ice cream sticks after January 1, 2022; expands ban to include plates, cups, cutlery, trays, certain wrapping films after July 1, 2022; proposal open for public comment until May 2021

In an article published on April 5, 2021, law firm *Keller and Heckman* reported on a draft notification released by the Indian *Ministry of Environment, Forest and Climate Change* on March 12, 2021 announcing a proposed ban on certain single-use plastic products and restrictions on plastic take-away bags. The proposal sets out new rules that would come into force in three phases: 1) From September 30, 2021, non-woven plastic take-away bags must be at a minimum 240 microns thick. An exception

Beginning June 1, 2021, a standardized identification code must be indelibly marked on products

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would be made for compostable plastic bags. 2) From January 1, 2022, a range of single-use plastic items would be banned from manufacture, import, distribution, and sale including candy and ice-cream sticks. 3) From July 1, 2022, this ban would be extended to comprise additional food contact articles such as plates, cups, cutlery, straws, trays, stirrers, and certain wrapping films.

The draft notification is currently open for public comment until 60 days after publication (May 9, 2021). The proposal follows an earlier announcement from the government in 2019 in which it announced its intention to ban many of the same items (FPF reported).

Read More

Food Packaging Forum, 6 April 2021

https://www.foodpackagingforum.org/news/india-plans-ban-on-single-use-plastic-items

ASEAN guidelines for FCM manufacture and use available online

2021-04-15

Association of Southeast Asian Nations (ASEAN) general guidelines for good manufacturing practice of food contact materials (FCMs), the safety and safe use of FCMs within the food industry, and sale of FCMs within ASEAN Member States recently made available online.

On April 12th, 2021 The Prepared Foodstuffs Product Working Group (PFPWG) of the *Association of Southeast Asian Nations* (ASEAN) made available online two guidelines for the control systems for food contact materials (FCMs) within *ASEAN* Member States. The two documents, "ASEAN General Guideline on Food Contact Materials" and "ASEAN Guidelines for Good Manufacturing Practice for Food Contact Materials" are meant to be used together by industry stakeholders as part of ongoing efforts to meet global standards and promote responsible, sustainable investment.

The "ASEAN General Guideline on Food Contact Materials" is primarily targeted for users of food packaging to outline the use of safe food packaging, the traceability system to ensure FCMs comply with trade guidelines, and how to place FCMs on the market within ASEAN Member Nations.

The PFPWG additionally "intends to prioritize and establish the schedule for the development of specific measures for 17 groups of Food Contact Materials"[.]

The "ASEAN Guidelines for Good Manufacturing Practice for Food Contact Materials" defines terms relative to the manufacturing of FCMs including "good manufacturing practice", outlines a quality assurance system, and includes an example of good manufacturing practice for the production of plastic FCMs.

The PFPWG additionally "intends to prioritize and establish the schedule for the development of specific measures for 17 groups of Food Contact Materials": active and intelligent materials and articles, adhesives, ceramics, cork, rubbers, glass, ion-exchange resins, metals and alloys, paper and board, plastics, printing inks, regenerated cellulose, silicones, textiles, varnishes and coatings, waxes, and wood.

Read More

Food Packaging Forum, 15 April 2021

https://www.foodpackagingforum.org/news/asean-guidelines-for-fcm-manufacture-and-use-available-online

AMERICA

Opinion: Alaska needs to do more to ensure safe drinking water

2021-04-08

As we look at the possibility of visitors returning to pristine Glacier Bay and Gustavus this year, we are still grappling with the not-so-little secret that Gustavus is not pristine. We have a major water contamination issue that many still haven't heard of — PFAS.

Last year Sen. Jesse Kiehl and Rep. Sara Hannan introduced legislation that helped to fill critical gaps in how our Great State currently regulates PFAS chemicals. PFAS are a group of human-made chemicals that do not easily break down and have been widely used in industry and consumer products for decades. PFAS have been linked to cancer, thyroid disease, infertility, high blood pressure, liver and kidney damage, and a host of other ailments. PFAS are key ingredients in firefighting foam that has long been used for fire suppression at airports across Alaska, where regular training with the foam has led to significant groundwater contamination.

The legislation introduced last year would have lowered the "action level" for key PFAS chemicals in drinking water in Alaska.In the past year, similar legislation was passed in many other states. These states are stepping

We have a major water contamination issue that many still haven't heard of — PFAS.

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up and taking action to protect residents and visitors in the absence of regulatory action at the federal level. Unfortunately, COVID-19 shut the Alaska legislature down early last session, and the considerable momentum that had quickly built for the bills died with the last legislative session. Now Kiehl and Hannan are preparing a similar set of PFAS bills to be introduced this session.It is time for Alaska to join the many other states across the nation who have passed stringent legislation to regulate these insidious chemicals.

Read More

Juneau Empire, 8 April 2021

https://www.juneauempire.com/opinion/opinion-alaska-needs-to-do-more-to-ensure-safe-drinking-water/

Silent spring institute continues PFAS testing on Cape Code

2021-04-09

Silent Spring Institute presented to the Barnstable County Board of Regional Commissioners Wednesday, April 7, about the level of certain potentially toxic chemicals in the water on Cape Cod and its current testing for them.

Founded in 1994, Silent Spring Institute is a Massachusetts-based scientific research organization dedicated to uncovering the links between chemicals found in the everyday environment and women's health, with a focus on breast cancer prevention.

Per- and polyfluoroalkyl substances (PFAS) are manufactured chemicals that are resistant to degradation and can be found in everyday items such as dental floss, microwavable popcorn bags, non-stick cookware, carpets and others. Perfluorooctanesulfonic acid (PFOS) and perfluorooctanoic acid (PFOA) are part of the PFAS group.

Dr. Laurel Schaider, a research scientist at the institute, presented to the commissioners about three ongoing studies that Silent Spring is conducting on PFAS.

One study of those is part of the Sources, Transportation, Exposure & Effects of PFAS Superfund Research Program, or STEEP. This study is seeking to see how PFAS moves in the environment along with exposures and health-related effects. Alyson McCann from the University of Rhode Island, and Dr. Schaider are leading this study.

Of the sampled wells, only 3 percent exceeded the Massachusetts standard of 20 parts per trillion for six different chemicals.

In 2018, 101 wells across 12 Cape Cod towns were sampled to measure the levels of PFAS in the water. Of the sampled wells, only 3 percent exceeded the Massachusetts standard of 20 parts per trillion for six different chemicals.

Currently, there are no federal regulations for PFAS in drinking water. Back in 2016, the Environmental Protection Agency set a lifetime health advisory of 70 parts per trillion for PFOS and PFOA. Since then, several states have begun regulations on their own. The Massachusetts standard, which is lower than the EPA guideline, also includes testing for four additional PFAS whereas EPA's guideline only includes PFOS and PFOA.

PFAS were detected in 46 percent of wells in this study, and 28 percent of wells had two or more PFAS chemicals present. Dr. Shraider said the plan was to test more wells last spring, but the ability to do so was altered because of COVID-19.

Read More

Cape News, 9 April 2021

https://www.capenews.net/regional_news/silent-spring-institute-continues-pfas-testing-on-cape-cod/article_d58e44a9-f603-5fd2-8a0c-097bc830b2a7.html

EPA releases updated PFBS toxicity agreement

2021-04-09

The U.S. Environmental Protection Agency (EPA) announced on April 8, 2021, that it is releasing an updated toxicity assessment for perfluorobutane sulfonic acid (PFBS), which is a member of the group of per- and polyfluoroalkyl substances (PFAS). EPA states that this PFBS assessment is part of its commitment to restore scientific integrity to all of the Agency's actions and increase the amount of research and information available to the public on PFAS. According to EPA's announcement, "EPA, federal agencies, states, tribes, and local communities can use the PFBS toxicity assessment, along with specific exposure and other relevant information, to determine if and when it is necessary to take action to address potential health risks associated with human exposures to PFBS under appropriate regulations and statutes." EPA notes that the updated assessment "has gone through all appropriate reviews, includes input EPA received from external peer review, upholds the tenants of scientific integrity, was authored by expert career scientists in EPA's Office of Research and Development, and has not been compromised by political

EPA states that this PFBS assessment is part of its commitment to restore scientific integrity to all of the Agency's actions and increase the amount of research and information available to the public on PFAS.

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staff -- these were all issues with a version of the assessment that was posted during the previous administration. The release of today's PFBS assessment upholds the integrity of EPA's science, which EPA, states, tribes, and more rely on to make decisions that protect the health of their communities."

According to EPA's fact sheet on the toxicity assessment, PFBS is a replacement chemical for perfluorooctanesulfonic acid (PFOS), a PFAS that was voluntarily phased out by the primary U.S. manufacturer by 2002. PFBS has been identified in the environment and consumer products, including surface water, wastewater, drinking water, dust, carpeting and carpet cleaners, and floor wax. The fact sheet states that the PFBS toxicity assessment is comparable to assessments developed under EPA's Integrated Risk Information System (IRIS) and Provisional Peer-Reviewed Toxicity Value (PPRTV) Programs in that it provides hazard identification, dose-response information, and toxicity values. EPA will continue to work with state, tribal, and local partners to provide technical assistance as they consider the final PFBS toxicity values in relevant exposure scenarios. The fact sheet notes that at this time, EPA does not plan to issue a regulation for PFBS.

Read More

TSCA Blog, 9 April 2021

http://www.tscablog.com/entry/epa-releases-updated-pfbs-toxicity-assessment

~yOSHA proposes extension to comment period for amendments to the hazard communication standard

2021-04-14

On April, 12, 2021, the Occupational Safety and Health Administration (OSHA) published a Federal Register notice to extend the comment period of the notice of proposed rulemaking (NPRM) to amend the Hazard Communication Standard (HCS) by one month. The HCS is the federal-level legislation that sets forth the classification, labeling, Safety Data Sheet (SDS), and training requirements for hazardous chemicals intended to be used, handled, or stored in workplaces. The current HCS is based on the third revised edition (Rev 3) of the United Nations (UN) Globally Harmonized System of Classification and Labeling of Chemicals (GHS). The proposed changes include updating the HCS to align with the seventh revised edition (Rev 7) of GHS. The transition period proposed is one year for chemical manufacturers, importers, and distributors of substances

The proposed changes include updating the HCS to align with the seventh revised edition (Rev 7) of GHS.

and two years for chemical manufacturers, importers, and distributors of mixtures after the effective final rule is published. The notice was open for comments until **April 19, 2021**. OSHA states in the *Federal Register* that it will extend the comment period to **May 19, 2021,** and that it intends to schedule an informal public hearing.

Background

In 2012, the first update to the HCS since 1994 was published in the *Federal Register*. 77 Fed. Reg. 17574. The notice revised and amended the previous HCS substantially as it introduced the GHS concepts into the regulatory framework. At the time of publication, HCS 2012 was based on Rev 3 of GHS. The UN updates and revises the GHS model on a biannual basis, and at this time, the most current version is Rev 8. OSHA is proposing an update to align with Rev 7 and includes several other points of clarification and revision in the notice.

Overview of Proposed Amendments

Highlights of several major changes include the following:

Revisions to align with Rev 7, with consideration of specific elements of Rev 8;

Changes to labeling, including new label elements and accommodations to address small containers and bulk shipments;

Revisions, clarifications, and additions to definitions;

Updates to testing methods for various endpoints;

Considerations for concentrations ranges for Trade Secrets;

Proposed revisions to SDS content; and

Proposal for scheduled updates to the HCS.

For a more detailed discussion on a few of the more significant changes, *see* our February 16, 2021, memorandum, "OSHA Proposes Amendments to the Hazard Communication Standard."

Issues for Comment

OSHA included an "Issues and Options Considered" section that is intended to solicit stakeholder input on various regulatory issues and to allow for potential regulatory flexibility with respect to the content of the final rule. While OSHA invites stakeholders to comment on all aspects

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of the NPRM, this section identifies the specific areas of interest. The section includes certain issues and questions that are intended to assist stakeholders as they review the proposal and consider the comments they plan to submit. Details on these issues were previously provided in our February 16, 2021, memorandum.

Commentary

Apparently, several parties requested an extension to the comment period. OSHA in the *Federal Register* states that it "agrees to an extension and believes a 30-day extension of the public comment period is sufficient and appropriate." Stakeholders should note that the content provided in responses to the NPRM are public and should provide OSHA with sufficient detail to allow thoughtful consideration to any proposed changes to the current language in the NPRM.

OSHA includes in the proposed update several items related to labeling. These items are currently addressed in various Letters of Interpretation. OSHA is amending the HCS to include these items and seeks comments from stakeholders on this approach. Chemical manufacturers, importers, and distributors should review the changes and prepare comments to OSHA on the applicability and utility of these changes in their operations. The changes to allow concentration ranges as an approach for addressing trade secrets and to include prescribed proposed ranges create better alignment with Canada and allow additional options to those wishing to disclose certain details, while allowing exact concentrations to remain protected. The use of concentration ranges and proposed ranges is a benefit interested parties should consider supporting in comments to OSHA.

Read More

National Law Review, 14 April 2021

https://www.natlawreview.com/article/osha-proposes-extension-to-comment-period-amendments-to-hazard-communication

First, and most importantly, "safe" must mean "not containing hazardous chemicals".

EUROPE

Safe and sustainable by design can make the wear-and-tear economy a thing of the past

2021-04-15

Changes in the everyday life of European citizens could be remarkable if products on the market were safe and sustainable by design. The recycling industry would boom, as a lot more products would be recycled. The general health would improve, as products would contain no hazardous chemicals. The very fundaments of the market would tremble, as the wear-and-tear economy would turn obsolete.

This is a possible outcome of the work currently being done by the Commission. It has been stated, in both the Circular Economy Action Plan (CEAP) and the Chemical Strategy for Sustainability (CSS), that a central goal for the Commission is to make the European society and economy more sustainable. One way of doing this is to define criteria for what makes a product safe and sustainable by design.

In March, ChemSec attended a workshop together with other stakeholders, arranged by DG RTD (the Commission's Directorate-General for Research and Innovation), with this exact purpose. The goal is to have an accepted definition by 2022.

ChemSec's view on the issue is quite straight forward. First, and most importantly, "safe" must mean "not containing hazardous chemicals". As we are transitioning into a circular economy, this will be increasingly important. It is sometimes said that we should talk about the risk of exposure rather than the hazardous properties of chemicals, but this is a dangerous approach.

Read More

Chemsec, 15 April 2021

https://chemsec.org/safe-and-sustainable-by-design-can-make-the-wear-and-tear-economy-a-thing-of-the-past/

Germany notifies WTO of MOAH restrictions

2021-04-07

German authorities notify World Trade Organization (WTO) about intention to restrict mineral oil aromatic hydrocarbons (MOAH) in food

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contact materials and articles made from recycled paper and board; sets migration limits into food (<0.5 mg/kg) and food simulant (<0.15 mg/kg); will come into effect three years after publication

On March 22, 2021, testing provider *SGS* reported that German authorities have notified the *World Trade Organization (WTO)* of their intent to restrict mineral oil aromatic hydrocarbons (MOAH) in food contact materials and articles made from recycled paper and board under the nation's Consumer Goods Ordinance (Bedarfsgegenständeverordnung, BedGgstV).

The draft regulation attached to the *WTO* notification provides information such as a definition for waste paper pulp, functional barriers, and MOAH. Further, the document sets limits for MOAH migration into food (<0.5 mg/kg) and food simulant (<0.15 mg/kg) from food contact paper, paperboard, as well as cardboard made of recycled paper. The ordinance will come into effect three years after publication.

In February 2020, a review article written by scientists from the *German Federal Institute for Risk Assessment (BfR)* had revealed a lack of safety data available on MOAH and that these impurities should be minimized in food and its contaminating sources (FPF reported). In August 2020, the *European Commission* announced a draft version of this notification and opened it for public comment (FPF reported).

Read More

Food Packaging Forum, 7 April 2021

https://www.foodpackagingforum.org/news/germany-notifies-wto-of-moah-restrictions

INTERNATIONAL

H&M Group's position on safe-by-design chemicals definition to drive circular economy

2021-04-15

H&M Group has the ambition to become 100% fair and equal, 100% circular and climate positive. Circular products mean products that are made to last, from safe, recycled and sustainably sourced input that can recirculate multiple times. Chemical management is an essential part of our circular ambition: our vision is to lead the change towards safe products and toxic-free fashion. H&M Group's Chemical Roadmap is our major tool to reach our overarching goal: toxic-free fashion by 2030.

To put sustainability at the core of our industry is a big opportunity to accelerate the pace of change and drive for a Green Recovery.

We support the European Commission's holistic and coordinated approach to accelerate circular economy in the industry. The harmonisation and definition of one common legal and implementation scheme will allow the fashion industry to contribute to the Green Deal vision and transition to a circular and carbon neutrality by 2050. To put sustainability at the core of our industry is a big opportunity to accelerate the pace of change and drive for a Green Recovery.

In this context, H&M Group values the opportunity to contribute to the current debate on the definition of chemicals that are safe and sustainable-by-design under the EU Chemicals Strategy for sustainability – and to be taken into account under the Sustainable Product Initiative as well as under the EU Textile Strategy.

As a downstream user of chemicals, we experience a gap in how hazards are communicated in a clear, harmonised, and transparent way. This gap continuously poses a problem while working towards our vision of a toxic-free fashion future, for example in substitution of hazardous chemicals and our aim of promoting best available chemicals. At H&M Group, we therefore see a need to establish an acknowledged and harmonised hazard assessment methodology to future-proof circular products.

While reading the EU Chemical Strategy, the European Commission's first attempt at defining safe and sustainable- by-design chemicals caught our attention (EU Chemical Strategy, EC COM(2020) 667 final, p. 4, note 19).

We would like to seize the opportunity to further delve into the concept of safe. We agree with what we interpret as a definition in line with the "prevent, prioritize, remove hierarchy", where minimising volumes and the environmental footprint of chemicals before they are placed on the market is important.

H&M Group's chemical approach

At H&M Group, it is, and has long been, evident that we must avoid and restrict substances of concern (health and environment, including, but not limited to, Substances of Very High Concern (SVHC) as defined in Articles 57-59 of the REACH Regulation (EC) No 1907/20069) in our products as well as in their manufacturing processes. Not only for the safety of our customers and the environment, but because it is our responsibility as a leading global fashion company to use our size and scale to create positive change. H&M Group Chemical Restrictions were among the first in our industry.

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We are constantly monitoring progress of substances' hazard evaluations, making sure that our Chemical Restrictions are up to date with recent research. Where required, the precautionary principle is applied to phase out substances before consensus has been reached e.g., on specific hazard category.

Read More

Chemsec, 15 April 2021

https://chemsec.org/hm-groups-position-on-safe-by-design-chemicals-definition-to-drive-circular-economy/

Hazardous chemicals are holding back the safe and sustainable by design approach

2021-04-15

Avoiding substances of concern is the very first step when implementing a safe and sustainable by design process, and chemical safety is a key criterion for sustainable products, according to the European Environment Agency (EEA). This is most welcome validation of facts that we at ChemSec have known and talked about for a long time.

The EEA recently published a briefing describing the need for a new approach to chemicals, in order to design safe and sustainable products. The briefing has been produced to further emphasize the need for a wider and safer approach to the use of chemicals, which is also highlighted in the Chemicals Strategy for Sustainability.

Four key criteria contributing to the sustainability of products are identified in the briefing: **chemical safety**, **resource use and circularity**, **greenhouse gas emissions**, and **impact on ecosystems**. There is a clear focus on **chemical safety** to achieve sustainability, and several important findings are described.

Safety from known harm is not safe enough

The concept of "safety" might require some elaboration, since it is sometimes used in an alternative context, with different implications. Dr. Xenia Trier at EEA explains the meaning of the concept in the briefing:

*"If you ask a citizen, most would understand '**safe**' as being safe from diseases caused by chemicals, regardless of whether the chemicals are known or suspected to cause harm. It is this intuitive definition of safe that we mean."*

The concept of "safety" might require some elaboration, since it is sometimes used in an alternative context, with differ-ent implications.

Non-toxic from the start – and through recycling loops

The briefing states that the very first action, when implementing a safe and sustainable by design process, is to avoid chemicals of concern. In other words: Ditch the hazardous stuff! As we at ChemSec have described in our report, The Missing Piece, using non-hazardous chemicals is the only way to achieve safe and sustainable products in the long run. This is increasingly true in a circular economy.

The importance of considering **resource use and circularity** is emphasized in the briefing. The end-of-life and continue-to-live options for products suitable for the circular economy must be considered. Recyclability is a central feature of any circular product design.

Read More

Chemsec, 15 April 2021

https://chemsec.org/hazardous-chemicals-are-holding-back-the-safe-and-sustainable-by-design-approach/

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EU chems regulator cools down industry's confidence on substances dossiers

2021-04-08

LONDON (ICIS)--The European chemicals trade group Cefic published this week an optimistic analysis on how chemicals companies across the EU are managing to fulfil their obligations under the 27-country bloc's regulatory regime Reach.

Under Reach, companies or a group of companies must register the chemicals they are producing or trading; the framework is the strictest chemicals regulation globally, and entrepreneurs often complain its associated costs dent their global competitiveness.

DATA GAPS: NOT MUCH PROGRESS

A key concern repeatedly expressed by the EU's chemicals regulator in charge of policing Reach, the Helsinki-based European Chemicals Agency (ECHA), has always referred to the quality of the dossiers filed, as many are incomplete.

Whether this was done out of naivety or to deliberately delay the implementation of Reach, proposals to fix the data gaps were in quite a small number.

While Cefic praised its relation with ECHA during 2020, arguing that more clarity had been achieved after a joint pilot project was set up for the chemical industry to understand better what ECHA's expectations of the quality of chemicals safety data were.

"The objective of the project was to explore different read-across approaches and testing strategies in order for companies to provide new data, where needed, and improve compliance of registrations under Reach. New testing has been or will be performed as a result," said Cefic.

But in a written response to ICIS, a spokesperson for ECHA said that the "commitment and efforts" by the chemicals industry so far were laudable, much more progress would be required to achieve the regulatory regime Reach draws up.

"We welcome the number of dossier updates, but in terms of testing strategies and testing proposals to address data gaps, it is too early to say anything as we have only received few," the spokesperson added.

Whether this was done out of naivety or to deliberately delay the implementation of Reach, proposals to fix the data gaps were in quite a small number.

"We encourage the companies to continue their efforts and to also check the advice on our website to review their dossiers."

CEFIC TAKE

As progress has overall been slow in filing and updating dossiers, small increase in compliance could be presented as large jumps ahead.

According to Cefic's second progress report on the implementation of the industry's voluntary Action Plan for Reach dossiers' update and improvement, the number of dossiers evaluated in 2020 had shot up by 55% year on year.

Other findings, according to Cefic, included:

- The voluntary commitment was signed by 190 Cefic member companies, representing 1,355 legal entities holding Reach registration dossiers.

- 2,731 Reach registration dossiers were re-evaluated in 2020, which is 55% more compared to reported re-evaluated dossiers in 2019, bringing the total of all evaluated dossiers to 4,489 since June 2019.

- Based on the forecasts submitted by member companies, it is estimated that 7,170 Reach lead registrants' dossiers will have been reviewed by 2026, representing one-third of all substances or more than half of all non-intermediate substances registered under Reach.

Sylvie Lemoine, the executive director for product stewardship at Cefic, said that Cefic remains committed to working with ECHA to improve the quality of the dossiers.

"More work will be done by participating companies over the next years to better understand potential data gaps and submit testing proposals, where needed," she said.

Read More

ICIS, 8 April 2021

https://www.icis.com/explore/resources/news/2021/04/08/10626336/eu-chems-regulator-cools-down-industry-s-confidence-on-substances-dossiers

D4, D5, and D6 are considered harmful to the environment and human health.

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ECHA proposes seven substances for authorisation to protect people and the environment

2021-04-14

ECHA recommends for the European Commission to add seven substances, including the cyclosiloxanes D4, D5 and D6, to the Authorisation List. Once on the list, companies will need to apply for authorisation to continue using them.

Helsinki, 14 April 2021 – D4, D5, and D6 are considered harmful to the environment and human health. ECHA prioritised these chemicals from the Candidate List because they are hazardous, produced in high volumes and widely used.

Some uses of the cyclosiloxanes are already restricted or in the process of being restricted in consumer products and in most professional uses under REACH. The cyclosiloxanes have been prioritised for inclusion in the Authorisation List as some of their uses, for example, industrial production of electronics and some professional uses such as dry cleaning in closed systems, are not covered by the restriction activities.

Terphenyl, hydrogenated is considered to be harmful for the environment. The substance is used as a heat transfer fluid mainly in industrial installations as well as in adhesives, sealants, coatings, inks and paints and can also be found in some plastic articles.

The three other substances – DCHP, disodium octaborate and TMA – are considered harmful to human health. They may be used to replace substances with similar chemical structures and uses that have already been recommended or included in the Authorisation List.

The final decision to include these substances of very high concern (SVHCs) in the Authorisation List will be taken by the European Commission together with the EU Member States and the European Parliament. These decisions will also indicate the dates by when companies will need to apply to ECHA for authorisation to continue using the substances.

Read More

ECHA, 14 April 2021

https://echa.europa.eu/-/echa-proposes-seven-substances-for-authorisation-to-protect-people-and-the-environment

Brain Freeze

2021-04-23

http://havefunwithyourenglish.blogspot.com/2016/11/meaning-of-idiom-brain-freeze.html?spref=pi

2,4-Dinitrophenol (DNP)

2021-04-23

2,4-Dinitrophenol (2,4-DNP, or DNP), molecular formula $C_6H_4N_2O_5$, is an inhibitor of efficient energy (ATP) production in cells with mitochondria. It uncouples oxidative phosphorylation by carrying protons across the mitochondrial membrane, leading to a rapid consumption of energy without generation of ATP. [1]

2,4-Dinitrophenol is a yellow solid with no known smell. It dissolves slightly in water. When present in water and soil as a pollutant, DNP does not easily evaporate to air. [2]

USES [2,3]

2,4-Dinitrophenol is used in the manufacture of dyes and wood preservatives, as a pesticide, and as an indicator for the detection of potassium and ammonium ions. It is also used to make photographic developer and explosives. During the 1930s, 2,4-dinitrophenol was used as a diet pill, but this use was stopped in 1938.

2,4-Dinitrophenol (2,4-DNP, or DNP), molecular formula C6H4N2O5, is an inhibitor of efficient energy (ATP) production in cells with mitochondria.

SOURCES AND ROUTES OF EXPOSURE [2]

Sources of Exposure

People can be exposed to DNP by breathing contaminated air, drinking contaminated water, eating contaminated food, or by contact with contaminated soil. Other than the air in certain workplaces, the levels of DNP in air we breathe are not known. DNP is present in wastewater from certain industries. Groundwater from a waste site that was once occupied by a factory that used DNP contained 30.6 mg DNP/L of water. The levels of DNP in drinking water and food are not known. Certain people may be exposed to low levels of DNP where they live or work. Breathing contaminated air may expose people who live near waste sites with DNP. Touching and eating soil that contains DNP may expose children playing at or near these sites. Exposure may occur in the workplace in those industries manufacturing or using DNP. Furthermore, workers involved in incinerating certain wastes or cleaning up waste sites containing DNP may be exposed.

Routes of Exposure

The major routes of exposure are:

- Inhalation
- Ingestion
- Dermal/eye contact

HEALTH EFFECTS [3]

Acute Effects

- Acute oral exposure to high levels of 2,4-dinitrophenol in humans has resulted in increased basal metabolic rate, nausea, vomiting, sweating, dizziness, headache, loss of weight, and other symptoms.
- 2,4-Dinitrophenol is considered to have high acute toxicity, based on short-term animal tests in rats and mice.

Chronic Effects

- Chronic oral exposure to 2,4-dinitrophenol in humans and animals has resulted in the formation of cataracts and skin lesions and has caused effects on the bone marrow, CNS, and cardiovascular system.
- The Reference Dose (RfD) for 2,4-dinitrophenol is 0.002 milligrams per kilogram body weight per day (mg/kg/d) based on cataract formation in humans. The RfD is an estimate (with uncertainty spanning perhaps an order of magnitude) of a daily oral exposure to the human population (including sensitive subgroups) that is likely to be without appreciable risk of deleterious noncancer effects during a lifetime.
- EPA has not established a Reference Concentration (RfC) for 2,4-dinitrophenol.
- Case reports of women taking 2,4-dinitrophenol orally for weight loss suggest that it may affect the female reproductive system, but the limited information is inconclusive.
- One study reported an increased incidence of stillborn animals and increased pup mortality in the offspring of animals exposed to 2,4-dintrophenol by gavage.
- No information is available on the carcinogenic effects of 2,4-dinitrophenol in humans.
- One study reported that 2,4-dinitrophenol did not promote tumour development in mice.
- EPA has not classified 2,4-dinitrophenol for potential carcinogenicity.

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SAFETY

First Aid Measures

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

Fire Information

- DNP is highly flammable in presence of open flames and sparks, of heat, reducing materials and combustible materials.
- Explosion is caused by heat, friction or shock.
- Dinitrophenol forms explosive salts with alkali or ammonia and should not be heated with them in closed vessels.
- Dry chemical powder should be used to fight small fires and water spray or fog should be used on large fires.
- Cool containing vessels with water jet should be used to prevent pressure build-up, auto-ignition or explosion.

Exposure Controls and Personal Protection

Engineering Controls

The following engineering controls should be used when handling DNP:

- Explosion-proof electrical (ventilating, lighting and material handling) equipment;
- 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 Protection

The following personal protective equipment is recommended when handling DNP:

- Splash goggles;
- Lab coat;
- Dust respirator (be sure to use an approved/certified respirator or equivalent);
- Gloves;
- Suggested protective clothing might not be sufficient; consult a specialist BEFORE handling this product.

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 [2,5]

United States

No workplace exposure limited have been set for DNP

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EPA: The United States Environmental Protection Agency lists DNP as a hazardous air pollutant under the Clean Air Act. EPA recommends that the amount present in bodies of water, such as lakes and rivers, should not be more than 0.07 mg/L in water used for swimming or where water might possibly be swallowed. No more than 0.765 mg/L should be present in water where people catch fish to eat, but there is no swimming. EPA requires industry to report releases or spills of 10 pounds or more of DNP. EPA has designated DNP as a hazardous substance, and intends to cancel, restrict, or require reregistration of pesticide products containing dinitrophenols. DNP is also listed as a waste constituent and specific regulations regarding its disposal are in effect.

Australia

A Temporary Emergency Exposure Limit (TEEL) for DNP has been set at the following:

- TEEL-1: 0.61mg/m3
- TEEL-2: 6.8mg/m3
- TEEL-3: 16mg/m3

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Old diabetes drug given new life as potential cancer treatment

2021-04-14

A new review article published in the journal Trends in Cancer is presenting a promising case for phenformin, an old diabetes drug related to metformin, being repurposed as an adjunct to new immunotherapy cancer treatments. A phase 1 clinical trial is already underway to test the safety of the combination treatment for skin cancer.

Metformin, a common drug prescribed to manage diabetes, is currently the subject of a number of compelling investigations into potential alternate uses, from slowing age-related cognitive decline to possibly even extending a person's lifespan.

Retrospective epidemiological studies have also suggested metformin could possess anti-tumor properties. Preclinical and animal studies have been promising but so far early clinical work has delivered mixed results when repurposing the drug, either alone for cancer treatment, or in combination with other therapies.

Metformin is part of a class of oral antihyperglycemic drugs called biguanides. Phenformin is another biguanide, more potent than metformin and discontinued as a diabetes treatment back in the mid-1970s due to reports of lactic acidosis.

Now researchers are looking back to phenformin, this time as a potential adjunct to newly developed cancer immunotherapies. The hypothesis is that phenformin's increased potency compared to metformin could help bridge the gap from successful preclinical research to human clinical trials.

"While the outcomes of various clinical studies of metformin in cancer patients have been underwhelming, research from our laboratory and others suggests that phenformin may have greater potential, particularly in combination with immunotherapies," explains Bin Zheng, senior author on the new study.

The new study presents a body of preclinical evidence demonstrating the potential of phenformin to significantly increase the anti-tumor activities of immunotherapy treatments. Zheng suggests there are several plausible mechanisms to justify how phenformin could amplify the effectiveness of cancer immunotherapy.

"We have found, for example, that phenformin, but not metformin, enhances the efficacy of BRAF inhibitors in suppressing the proliferation

Now researchers are looking back to phenformin, this time as a potential adjunct to newly developed cancer immunotherapies.

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of BRAF-mutant melanoma cells and BRAF-driven tumor growth in animal models," Zheng notes.

The toxic side effects that led to phenformin being pulled from the market nearly 50 years ago are relatively low when compared to the adverse effects seen in current cancer treatments such as chemotherapy. This toxicity profile made the drug unsuitable as a long-term diabetes treatment, but Zheng suggests it is well within the limits of what is acceptable for a short-term cancer treatment.

A phase 1 clinical trial is currently underway testing phenformin alongside dabrafenib/trametinib, a combination immunotherapy treatment for metastatic melanoma.

"If the safety of phenformin is confirmed in this trial, combinations of phenformin with targeted immunotherapies such as anti-PD-1 (programmed cell death 1 antibodies, which stimulate anti-tumor immunity) could be explored for patients with various types of solid tumors," says Zheng.

Alongside the burgeoning interest in phenformin, other experimental biguanides have been developed to more specifically target cancer. IM156, for example, is a novel molecule derived from phenformin and recently demonstrated promising results from a phase 1 human trial.

The new research was published in the journal Trends in Cancer.

newatlas.com, 14 April 2021

https://www.newatlast.com

Indoor dust contains PFAS and other toxic chemicals

2021-04-15

INDOOR DUST CONTAINS dangerous, endocrine-disrupting chemicals, according to a study published today in Environmental Health Perspectives. The study of 46 dust samples from 21 buildings at a U.S. university found that all 46 samples contained hormonally active compounds that can lead to health effects, including infertility, diabetes, obesity, abnormal fetal growth, and cancers.

The study helps explain how industrial chemicals known as PFAS and flame retardants, which are found in the blood or urine of over 90 percent of Americans and are already known to cause widespread health and reproductive effects, enter the body. PFAS, which first came to light as

According to Young, people ingest an average of 20 milligrams of dust each day.

ingredients in Teflon, are also used to coat carpets, furniture, and clothing. Despite a lack of evidence that they prevent fires, flame retardants are added to furniture, carpet, electronics, and building insulation. While we don't eat these products, this study makes it clear that we breathe in tiny bits of them that have entered the air as dust.

"We don't realize we're taking this dust into our bodies all day every day," said Anna Young, a postdoctoral research fellow in the Department of Environmental Health at the Harvard T.H. Chan School of Public Health and lead author of the study. According to Young, people ingest an average of 20 milligrams of dust each day.

While the health effects of PFAS and flame retardants have been known for years, the Environmental Protection Agency has been ineffective at curbing exposure to the chemicals. One class of flame retardants found in the dust — polybrominated diphenyl ethers, or PBDEs — was phased out in 2013 after they were found to cause infertility, thyroid dysfunction, and other health problems. But those compounds remain in many products and have been recycled into many others. Meanwhile, a class of chemicals now used to replace PBDEs, organophosphate esters, has also been found to cause reproductive problems, impair behavioral and cognitive development, and lead to pregnancy loss.

The health effects of PFAS are also well known and include impaired fetal development, obesity, decreased vaccine response, preeclampsia, testicular cancer, immune dysfunction, kidney cancer, and elevated cholesterol levels. But while two compounds in the class, PFOA and PFOS, were voluntarily phased out as of 2015, those two compounds remain in many products, and thousands of other PFAS, including some that present clear health dangers, are still in use.

"They've shown there's a lot of bioactivity in dust," Linda Birnbaum, former director and scientist emeritus of the National Institute of Environmental Health Sciences and the National Toxicology Program, said of the study's authors. "People don't understand that we are being exposed all the time to a multitude of chemicals that impact our endocrine systems. Things that are in our products don't stay put. They get into our dust, whether house or office dust. And if they get into our house or office dust, they get into us." Birnbaum pointed out that the study didn't look for many other chemicals that have already been found in dust, including PCBs, heavy metals, pesticides, and phthalates.

While regulators have so far failed to prevent exposure to the PFAS and flame retardants that were identified in the study, some companies have

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begun to get rid of these chemicals on their own. In 2016, Ikea phased out textiles that contain PFAS. Three years later, the Home Depot stopped purchasing and distributing carpets that contain the chemicals. In 2020, Lowe's made a similar commitment. Furniture makers have also begun to make couches and chairs without flame retardants.

A study by Young published last year showed that dust in rooms where furniture and rugs that were free of these chemicals contained lower levels of the contaminants. Consumers concerned about the toxicity of their homes can check out the quickly evolving list of PFAS-free products. And people worried about whether their couches contain flame retardants can even send samples to scientists at Duke University, where scientists will test them to see if the chemicals are present.

But making indoor air safe to breathe will ultimately require regulatory action. "It can't be on consumers to figure out what products are safe when there are thousands of these chemicals and manufacturers don't have to disclose them," said Young. "We need to send the market a signal that we want healthy products to be the default and not the exception."

theintercept.com, 15 April 2021

https://www.theintercept.com

To become queen, these ants shrink their brains and balloon their ovaries (then, they reverse it)

2021-04-17

Even among ants, royal status is mostly an inherited affair. But for Indian jumping ants, a shot at wearing the crown is worth losing a bit of your brain for — especially as you'll always be able to grow it back later.

Unlike other ant species, Indian jumping ants (Harpegnathos saltator) do not die with their queens. Rather, select females participate in monthlong antenna-boxing matches to decide who gets to be the new matriarch. The victorious female then expands her ovaries and shrinks her brain to three-quarters of its original size.

So far, so bizarre, but scientists have discovered another surreal twist to the storied lives of the forest-dwelling, black-eyed, forcep-jawed critters — If a female is deposed from her queenly throne, she will revert back to being a worker, shrinking her ovaries, regrowing her brain and resuming her previous duties.PLAY SOUND

Rather, select females participate in month-long antenna-boxing matches to decide who gets to be the new matriarch.

"We found that their brain returns completely to its previous size within a month after reverting back to a subordinate worker," lead study author Clint Penick, an associate professor at Kennesaw State University, told Live Science. "This was pretty amazing, and it's the first time reversible changes in brain size of this scale have been reported in an insect."

As with most other ant species, colonies of Indian jumping ants are strictly hierarchical. A queen is responsible for laying eggs — queens of some species, like the army ant, can produce up to 300,000 eggs a day — and the workers protect the colony, raise the larvae and hunt for food.

Where they differ is what happens once the queen is dead. Most ant colonies slowly dwindle away after their leader dies, the workers die one by one and the royal offspring leave to become queens of their own colonies.

But in an Indian jumping ant colony, the death of the queen is cause for more than half of the colony's females to enter into a monthlong tournament of fierce dueling with their antennas. The workers capable of activating their ovaries while delivering and receiving constant antenna jabs to the face are then chosen to be the next queens, the researchers said. Once the ritual is over, the triumphant new queens release a pheromone to alert their fellow ants of their royal status.

In a colony of 100 ants, around five to 10 females will become new queens, according to the researchers.

Only after they have acquired queenly status do these newly minted ant-queens undergo some more radical changes. Changes in gene expression and a cascade of hormones, driven by a burst of dopamine, cause their ovaries to balloon to five times their original size and their brains to shrink down by 25%. The life spans of these new queens stretch out from six months to five years.

"The biggest changes to the brain occur in the optic lobes and central brain," Penick said. "Ants that win the tournament essentially become egg-laying machines, and they will generally never leave their nest or see daylight again. They also no longer need to hunt, take care of larvae or defend the nest. All of their needs are taken care of, so they don't need the same level of cognition required to perform complex tasks."

To test whether this metamorphosis was reversible, the researchers used a sample of 30 colonies, marking two new queens from each colony. One of the queens from each colony was kept as a control and allowed to do

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their normal royal duties, while the randomly chosen others were sent into solitary confinement for a month — where they were fed and kept in complete isolation from their fellow ants. Soon enough, the isolated new queens stopped laying eggs and had gone back to behaving like workers.

Upon return to their colonies, the reverted workers were seized and detained by their fellows for a few hours, likely because of their partially-developed ovaries. Once they were released, they returned to their duties as queens. Later dissection, performed six to eight weeks later, showed the ovaries of the reverted ants had shrunk and their brains had returned to their full size.

The researchers suspect that this bizarre plasticity may have evolved because the species experiences a higher than normal queen-mortality rate in their natural nests in the Indian jungle, but they aren't certain.

Their study isn't the only research that shows animals morphing their brain structure in extreme ways, according to Penick. Species of songbirds do it too, regrowing the part of the brain involved in song-learning before the breeding season.

"The typical wisdom I heard growing up was that once you lose brain cells they never grow back," he said. "Now that we know this occurs in the Indian jumping ant, it's possible it may be common in other species. At the very least, this research shows that even the brain of an ant has the tools to regrow itself, and many of the genes and regulatory networks involved in this are likely to be similar in other animals, even vertebrates."

The researchers published their findings April 14 in the journal Proceedings of the Royal Society B.

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https://www.livescience.com

Only 3 percent of Earth's land hasn't been marred by humans

2021-04-15

The Serengeti looks largely like it did hundreds of years ago.

Lions, hyenas and other top predators still stalk herds of wildebeests over a million strong, preventing them from eating too much vegetation. This

The vast majority of land on Earth — a staggering 97 percent — no longer qualifies as ecologically intact, according to a sweeping survey of Earth's ecosystems.

diversity of trees and grasses support scores of other species, from vivid green-orange Fischer's lovebirds to dung beetles. In turn, such species carry seeds or pollen across the plains, enabling plant reproduction. Humans are there too, but in relatively low densities. Overall, it's a prime example of what biologists call an ecologically intact ecosystem: a bustling tangle of complex relationships that together sustain a rich diversity of life, undiminished by us.

Such places are vanishingly rare.

The vast majority of land on Earth — a staggering 97 percent — no longer qualifies as ecologically intact, according to a sweeping survey of Earth's ecosystems. Over the last 500 years, too many species have been lost, or their numbers reduced, researchers report April 15 in Frontiers in Forests and Global Change.

Of the few fully intact ecosystems, only about 11 percent fall within existing protected areas, the researchers found. Much of this pristine habitat exists in northern latitudes, in Canada's boreal forests or Greenland's tundra, which aren't bursting with biodiversity. But chunks of the species-rich rainforests of the Amazon, Congo and Indonesia also remain intact.

"These are the best of the best, the last places on Earth that haven't lost a single species that we know of," says Oscar Venter, a conservation scientist at the University of Northern British Columbia in Prince George who wasn't involved in the study. Identifying such places is crucial, he says, especially for regions under threat of development that require protection, like the Amazon rainforest.

Conservation scientists have long tried to map how much of the planet remains undegraded by human activity. Previous estimates using satellite imagery or raw demographic data found anywhere from 20 to 40 percent of the globe was free from obvious human incursions, such as roads, light pollution or the gaping scars of deforestation. But an intact forest canopy can hide an emptied-out ecosystem below.

"Hunting, the impacts of invasive species, climate change — these can harm ecosystems, but they can't be easily sensed via satellite," says conservation biologist Andrew Plumptre of the University of Cambridge. A Serengeti with fewer lions or hyenas — or none at all — may look intact from space, but it's missing key species that help the whole ecosystem run.

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What exactly constitutes a fully intact and functioning ecosystem is fuzzy and debated by ecologists, but Plumptre and his colleagues started by looking for habitats that retained their full retinue of species, at their natural abundance as of A.D. 1500. That's the baseline the International Union for the Conservation of Nature uses to assess species extinctions, even though humans have been altering ecosystems by wiping out big mammals for thousands of years (SN: 8/26/15).

Large swaths of land are necessary to support wide-ranging species. So the researchers initially considered only areas larger than 10,000 square kilometers, roughly the size of Puerto Rico. The team combined existing datasets on habitat intactness with three different assessments of where species have been lost, encompassing about 7,500 animal species. While 28.4 percent of land areas larger than 10,000 square kilometers is relatively free from human disturbance, only 2.9 percent holds all the species it did 500 years ago. Shrinking the minimum size of the area included to 1,000 square kilometers bumps the percentage up, but barely, to 3.4.

Degraded ecosystems

About 20 to 40 percent of land habitats on Earth remain free from obvious human incursions such as roads, cities or light pollution. But such ecosystems can still be degraded by human actions such as hunting. Since A.D. 1500, those areas have experienced varying amounts (denoted by color) of species loss, according to a survey of about 7,500 animal species. Purple areas represent the 3 percent of land where no known species have been lost in that time.

Simply retaining species isn't enough for ecological intactness, since diminished numbers of key players could throw the system out of whack. The researchers tallied up the population densities of just over a dozen large mammals whose collective ranges span much of the globe, including gorillas, bears and lions. This is a narrow look, Plumptre concedes, but large mammals play important ecological roles. They also have the best historical data and are also often the first to be affected by human incursion. Factoring in declines in large mammals only slightly decreased the percentage of ecologically intact land, down to 2.8 percent.

Overall the tally of ecologically intact land "was much lower than we were expecting," says Plumptre. "Going in, I'd guessed that it would be 8 to 10 percent. It just shows how huge an impact we've had."

Both Venter and Jedediah Brodie, a conservation ecologist at the University of Montana in Missoula, question whether the authors were too strict in their definition of ecological intactness.

"Many ecosystems around the world have lost one or two species but are still vibrant, diverse communities," Brodie says. A decline in a few species may not spell disaster for the whole ecosystem, since other species may swoop in to fill those roles.

Still, the study is a valuable first look that shows us "where the world looks like it did 500 years ago and gives us something to aim for," Plumptre says. It also identifies areas ripe for restoration. While only 3 percent of land is currently ecologically intact, the introduction of up to five lost species could restore 20 percent of land to its former glory, the researchers calculate.

Species reintroductions have worked well in places like Yellowstone National Park, where the restoration of wolves has put the ecosystem back into balance (SN: 7/21/20). Such schemes may not work everywhere. But as the global community discusses how to protect nature over the next decade (SN: 4/22/20), Plumptre hopes this study will prompt policy makers to "not just protect the land that's there, but also think about restoring it to what it could be."

sciencenews.org, 15 April 2021

https://www.sciencenews.org

Lab-grown embryos mix human and monkey cells for the first time

2021-04-15

By slipping human stem cells into the embryos of other animals, we might someday grow new organs for people with faltering hearts or kidneys. In a step toward that goal, researchers have created the first embryos with a mixture of human and monkey cells. These chimeras could help scientists hone techniques for growing human tissue in species better suited for transplants, such as pigs.

"The paper is a landmark in the stem cell and interspecies chimera fields," says stem cell biologist Alejandro De Los Angeles of Yale University. The findings hint at mechanisms by which cells of one species can adjust to survive in the embryo of another, adds Daniel Garry, a stem cell biologist at the University of Minnesota (UM), Twin Cities.

These chimeras could help scientists hone techniques for growing human tissue in species better suited for transplants, such as pigs.

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In 2017, researchers reported growing pancreases from mouse stem cells inserted into rat embryos. Transplanting the organs into mice with diabetes eliminated the disease. But cells from more distantly related species, such as pigs and humans, haven't gotten along as well. That same year, developmental biologist Juan Carlos Izpisúa Belmonte of the Salk Institute for Biological Studies and colleagues reported injecting human stem cells into pig embryos. After the embryos had developed in surrogate mother pigs for 3 to 4 weeks, only about one in 100,000 of their cells were human.

The pig study used human skin cells that had been reprogrammed into stem cells. But so-called extended pluripotent stem (EPS) cells, made by exposing stem cells to a certain molecular cocktail, can spawn a greater variety of tissues. In the new study, Izpisúa Belmonte, reproductive biologist Weizhi Ji of Kunming University of Science and Technology, and colleagues tested those more capable cells in a closer human relative—cynomolgus monkeys. They inserted 25 human EPS cells into each of 132 monkey embryos and reared the chimeras in culture dishes for up to 20 days.

The team reports today in Cell that the human cells showed staying power: After 13 days, they were still present in about one-third of the chimeras. The human cells seemed to integrate with the monkey cells and had begun to specialize into cell types that would develop into different organs.

By analyzing gene activity, the researchers identified molecular pathways that were switched on or turned up in the chimeras, possibly promoting integration between human and monkey cells. Izpisúa Belmonte says manipulating some of those pathways may help human cells survive in embryos of species "more appropriate for regenerative medicine."

Still, the human and monkey cells didn't quite mesh, notes UM stem cell biologist Andrew Crane. The human cells often stuck together, making him wonder whether there's "another barrier that we aren't seeing" that could prevent human cells from thriving if the embryos were to develop further.

In the United States, federal funding cannot be used to create certain types of chimeras, including early nonhuman primate embryos containing human stem cells. The new study was performed in China and funded by Chinese government sources, a Spanish university, and a U.S. foundation. Bioethicist Karen Maschke of the Hastings Center in New York says she is satisfied that the work, which passed layers of institutional review

and drew on advice from two independent bioethicists, was performed responsibly.

Human-monkey chimeras do raise a worry, addressed in a report released last week by the National Academies of Sciences, Engineering, and Medicine (p. 218): that human nerve cells might enter animals' brains and alter their mental capabilities. But that concern is moot for the chimeras in this study because they don't have a nervous system. They "can't experience pain and aren't conscious," says bioethicist Katrien Devolder of the University of Oxford. "If the human-monkey chimeras were allowed to develop further," she says, "that would be a very different story."

sciencemag.org, 15 April 2021

https://www.sciencemag.org

Rapidly dropping sperm count 'imperilling the future of humans', says expert

2021-04-16

In merely a few generations' time, the human race might find itself at a moment that could spell the end of our species.

As sperm counts decline to levels below those considered adequate for fertility, we may no longer be able to reproduce unless drastic lifestyle measures are taken to reverse this trend.

That's the chilling warning from a leading reproductive epidemiologist at New York's Mount Sinai, Dr Shanna Swan, a Professor in Environmental Medicine and Public Health, who says the sperm count of Western men has plunged by over 50 per cent in less than 40 years.

At this rate, she says in her new book Countdown, that sperm count is set to reach zero in 2045 – meaning that most couples may have to use assisted reproduction.

And, by 2060, men could have little or no reproductive capacity at all, Dr Swan warns.

The situation – which is reflected across the globe – is so concerning that Dr Swan says it is "imperilling the future of the human race".

In an interview with BYU Radio this week, she said there were many causes behind the worrying trend.

And, by 2060, men could have little or no reproductive capacity at all, Dr Swan warns.

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"There are lifestyle factors, things like smoking, binge drinking, not getting enough exercise, obesity and a poor diet," she said.

"Those things are relatively easy to control, but the other class of problems is the chemicals we use in our daily lives which we're surrounded with.

"Those chemicals have the ability to affect our bodies' hormones, and once you affect the hormones that affect reproduction, then you can affect reproductive health – and that's what I think is going on."

She said the chemicals she has studied most are phthalates – a group of chemicals used in hundreds of products from toys, vinyl flooring and wall covering to detergents and food packaging.

"Those soft plastics give up their phthalates in many ways, for example when food goes through them or they come into contact with food and then we eat that food, get it in to our bodies and that lowers testosterone," she told BYU.

"And, if this happens when a woman is pregnant or when a man is about to conceive a child, that affect the development of that child in a way could lower his sperm count when he grows up."

Bisphenol A (BPAs), used to harden plastic and found the lining of some canned-food containers, is another chemical of concern.

Dr Swan said BPAs are oestrogen mimicking, increased risks of fertility challenges for women.

She is not alone in her concerns. In a piece for The Conversation this week, Alex Ford, a Professor of Biology and Gary Hutchison, a Professor of Toxicology, said her claims are backed by a growing body of evidence that's finding reproductive abnormalities and declining fertility in humans worldwide.

"Equally alarming is an increase in the rate of miscarriages and developmental abnormalities in humans, such as small penis development, intersexuality (displaying both male and female characteristics) and non-descended testes – all found to be linked to declining sperm count," they wrote.

They wrote that "endocrine-disrupting chemicals" (EDCs) – like the phthalates Dr Swan has researched – are passed to the foetus by the mother.

"(Her) exposure to the chemicals during her pregnancy will determine the degree to which the foetus experiences hormonal interference," they wrote.

"That means that present-day sperm count data speaks not to the chemical environment today, but to the environment as it was when those men were still in the womb. That environment is undoubtedly becoming more polluted."

Dr Swan said that while the situation is concerning, she believes that humanity can turn things around.

She said that a promising recent study on rodents at the University of Washington showed that if there is no further exposure to EDCs over three generations, then their full fertility can be restored.

One major change, she suggests is that the chemical industry starts producing chemicals that can be used in everyday products that are non-hormonally active.

"Regrettable substitution – where one harmful chemical is replaced by another untested one, which then turns out to have the same risks – must also stop," she told The Guardian in a recent interview. "It has happened with different phthalates, BPA and flame retardants and it is unacceptable.

She said this means that when a product has a "BPA free" label on it, it probably doesn't have BPA, but it could have chemicals like bisphenol S or F, which have a very similar effect on our bodies.

"And we need to test the chemicals we are currently using – and not just at high doses and not just one at a time, because we are being exposed to a large number," she added.

"We have the ingenuity and the resources to do it. But we need a recognition of the problem and the will to change."

Some nations are beginning to take steps to address the issues – like the UK, where the Department for Environment, Food and Rural Affairs is currently building a chemicals strategy. The EU, meanwhile, is changing chemical regulations to prevent banned substances being replaced with other harmful ones.

Dr Swan said couples looking to conceive should research the effects of chemicals, and try to avoid using plastic in their kitchen as much as they can. She said to avoid microwaving or storing food in plastic.

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"When it's cold it's not so much of a risk, but when its warm the chemicals leave the plastic," she told BYU.

She also recommended avoiding processed food – which has often passed through a plastic tubes – and food that is stored in plastic.

news.com.au, 16 April 2021

https://www.news.com.au

'Monkeydactyl' may be the oldest known creature with opposable thumbs

2021-04-14

Future Jurassic Park films could feature one weird new beast in the menagerie: a pterosaur nicknamed Monkeydactyl for its opposable thumbs.

This flying reptile from the Jurassic Period may be the earliest known animal that could touch the insides of its thumbs to the insides of its other fingers, researchers report online April 12 in Current Biology. Such dexterity probably allowed Monkeydactyl to climb trees about 160 million years ago, perhaps to feed on insects and other prey that nonclimbing pterosaurs did not, the researchers say (SN: 12/21/18). The latter half of the creature's official name, Kunpengopterus antipollicatus, comes from the words "opposite" and "thumb" in ancient Greek.

Monkeydactyl's fossilized remains, unearthed in northeastern China in 2019, are embedded in rock. So the team used micro-CT scanning to create a 3-D rendering of the fossil. "With this detail, we're able to look at the fossil from any angle, and make sure that the bones are in their right [original] place," says study coauthor Rodrigo Pêgas, a paleontologist at the Federal University of ABC in São Bernardo, Brazil.

Those scans helped confirm that the skeleton had a well-preserved opposable thumb on each hand. "Almost all of the modern animals that have opposable thumbs use them to climb trees," Pêgas says, including primates and some tree frogs. That evidence, along with the apparent flexibility of Monkeydactyl's joints, suggests this species was well suited to clambering through tree branches.

The latter half of the creature's official name, Kunpengopterus antipollicatus, comes from the words "opposite" and "thumb" in ancient Greek.

sciencenews.org, 14 April 2021

https://www.sciencenews.org

Man's energy drink habit lands him in the hospital with heart failure

2021-04-17

A young man's heart problems may have been triggered by his excessive consumption of energy drinks — he ended up in the hospital with heart failure after consuming four energy drinks per day for two years, according to a new report of the case.

The findings add to a growing body of evidence linking energy drink consumption with heart problems, leading the authors to call for warnings about the dangers of drinking these beverages in large amounts.

The 21-year-old man went to the hospital after he experienced progressively worse shortness of breath for four months as well as weight loss, according to the report, published Thursday (April 15) in the journal BMJ Case Reports.

He reported drinking four 500-milliliter cans of energy drinks every day for about two years, with each can containing 160 milligrams of caffeine. (A typical cup of coffee contains about 90 mg of caffeine.)

The man recalled that he occasionally had episodes of indigestion, tremors and a racing heartbeat, which he didn't seek care for in the past. He felt so unwell and lethargic in recent months that he had to stop his university studies, according to the report, from doctors at St Thomas' Hospital in London.

After a barrage of tests, the man was diagnosed with two potentially life-threatening conditions: heart failure and kidney failure. Heart failure occurs when the heart muscle can't pump enough blood to meet the body's needs; and kidney failure happens when the kidneys can't properly filter waste products from the blood. In the man's case, the two conditions appeared to be unrelated, but they each had serious effects. The man's doctors discussed whether he needed a double (heart and kidney) organ transplant.

His kidney failure was due to a long-standing but previously undiagnosed condition called chronic obstructive uropathy, when urine can't properly drain through the urinary tract tubes and so it backs up into the kidneys.

His doctors considered a number of possible causes for his heart failure, including "broken heart syndrome," when the heart's main pumping chamber becomes enlarged and weakened, and myocarditis, or inflammation of the heart. However, neither condition fit with the man's

The man recalled that he occasionally had episodes of indigestion, tremors and a racing heartbeat, which he didn't seek care for in the past.

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history and test results. The most likely explanation for his heart failure was his high level of energy drink consumption, the authors concluded, although they can't prove this for certain.

Previous studies have linked energy drink consumption with concerning cardiovascular effects, including increased blood pressure and abnormal heart rhythms. There have been several reports of young people who have suffered heart attacks and heart rhythm problems after consuming energy drinks, Live Science previously reported.

After 58 days in the hospital, the man was cleared to go home and was prescribed several heart medications. He stopped drinking energy drinks completely and his heart function improved so much that his doctors say he doesn't need a heart transplant at this time. However, he will likely need a kidney transplant at some point in the future.

Some people may be predisposed to heart problems from energy drinks due to underlying biological factors, although more research is needed to determine what these factors are, the authors said.

"This case further highlights the potential cardiovascular dangers of energy drinks in susceptible individuals," the authors wrote. "Clear warnings should be provided about the potential cardiovascular dangers of energy drink consumption in large amounts," they concluded.

livescience.com, 17 April 2021

https://www.livescience.com

Burning pig poop fumes doesn't solve anything

2021-04-12

Last week, the North Carolina Department of Environmental Quality officially approved the installation of biogas digesters at four Smithfield-owned hog waste lagoons in the Sampson and Duplin counties. The digesters, which capture fecal fumes to be converted to natural gas, are the result of a partnership between Smithfield and Dominion Energy, one of the partners behind the failed Atlantic Coast Pipeline. The digesters are part of what's officially known as the Align RNG (renewable natural gas) Project; colloquially, the Grady Road Project. Environmentalists mostly hate them. To critics, the Grady Road Project shows that even as issues of emissions and environmental justice have taken center stage in recent years, companies like Smithfield, the nation's leading pork producer, have only fortified their position in the region, staving off meaningful reform

The mass production of pork results in an ungodly amount of feces and methane emissions…

with the help of state agencies—and, as fate would have it, a couple of Biden Cabinet members.

In the coming decade, Smithfield plans to cover 90 percent of its hog waste lagoons with these anaerobic digesters. The digesters capture the methane, which in the Grady Road Project's case will then be transported via a new Dominion pipeline to an off-site facility, where it will be converted to natural gas and then used in Dominion's existing pipeline infrastructure. Duke Energy has already enacted similar plans in the region. The digesters—and biofuels more broadly—are a key part of an attempt by the agriculture and gas industries to cash in on the current push for short-term energy solutions. The mass production of pork results in an ungodly amount of feces and methane emissions; the companies want to channel the methane into another income stream. But while the anaerobic technology does help extract more value from the enterprise, ultimately it still releases greenhouse gas into the air, and it doesn't solve any of the local pollution problems caused by the hog farms. As usual, marginalized communities in the area are facing a double team of state regulators and private interests.

Duke, Dominion, and Smithfield are all predictably bullish on the potential of biogas and have spent the past few years talking it up to anyone who will listen. They don't talk as much about what these hog farms do with the leftover feces. As Blakely Hildebrand, an attorney with the Southern Environmental Law Center, told North Carolina Health News in 2019, "Biogas technology that doesn't address water pollution and public health issues associated with industrial-scale hog production is not a complete solution."

See, after the digesters have done their work and extracted the available methane, what's left of the waste, or liquefied pig shit and urine, is then used in Smithfield's sprayfield system, wherein it is misted over crops and fields as a fertilizer. This leaves neighbors—who, in this part of the state, are often a combination of low-income, Black, Latinx, and Native families—with few options but to shut their windows; hold their nose; and pray that their yards, gardens, and groundwater wells go uncontaminated. If the majority of the hog farms in North Carolina were clustered in the western part of the state, there might be fewer—albeit still pressing—concerns. But they're not. The farms in Sampson and Duplin counties that Smithfield has claimed for itself sit on low-lying, coastal-adjacent lands. So in 2018, when Hurricane Florence ripped through the East Coast, over 100 lagoons were flooded, sending the mix of feces, urine, and anaerobic

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bacteria over the lagoon walls. The same happened with Hurricane Floyd in 1999.

Even without the risk from hurricanes, these facilities present risks to the health and life expectancy of nearby residents. In 2018, a Duke University study published in North Carolina Medical Journal found that, while it could not prove causality, communities living in zip codes near these operations posted "higher rates of all-cause mortality, infant mortality, mortality of patients with multimorbidity, mortality from anemia, kidney disease, tuberculosis, and septicemia." And while the new digester systems will marginally mitigate methane emissions, there's evidence that capping the ponds will result in "higher concentrations of ammonia in the sprayed waste," as a group of Democratic lawmakers in North Carolina wrote when petitioning the Department of Environmental Quality in January to reject the application for water quality permits. And let's be clear: The fuel produced by this scheme still releases gas that warms the planet. A proposal to burn poop just because it's there is not the same thing as installing a wind farm.

As the Duke University study pointed out, the population density in Sampson and Duplin counties is "substantially higher" than in areas of Iowa and Minnesota featuring a similar number of large-scale industrial hog farms. So there are significantly more people at risk. The study also found that the number of low-income, uninsured, Black and Native households living near hog farms vastly exceeded those in its control group. In short, hog farms, as currently constituted in North Carolina, remain one of the most blatant forms of environmental racism that exist in this nation.

This makes it all the more vexing that two current Cabinet members—U.S. Department of Agriculture Secretary Tom Vilsack and Environmental Protection Agency Secretary Michael Regan—have tacitly and explicitly co-signed the use of biofuels, both throughout their careers and in recent months. In the case of Regan, who moved to the EPA from his post as director of the North Carolina DEQ, he was in office when the DEQ was approving permits for Smithfield and Dominion's Grady Road Project. (The USDA did not respond to The New Republic's request for comment, while the EPA pointed TNR to the North Carolina DEQ and did not respond to questions about the EPA's stance on regulating lagoons and biofuels by publication.)

Before, during, and after his Senate confirmation hearings, Regan repeatedly said his own experience as a Black citizen from eastern North

Carolina had affected his understanding of a regulator's responsibilities with regard to environmental justice. As the head of the DEQ, he created the North Carolina Environmental Justice and Equity Board and spearheaded efforts to hold Duke Energy accountable in the fallout of its coal ash spills. He also resisted efforts by North Carolina Republicans to place a cap on the amount of relief that residents can receive from nuisance lawsuits against polluting farms, and slapped Smithfield contractors whose lagoons leaked due to mismanagement with five-figure fines. And just last Wednesday, Regan issued a memo to the entire EPA staff, instructing them to "examine, and appropriately use, the full array of policy and legal tools at our disposal to incorporate environmental and climate justice considerations."

In theory, therefore, Regan is one of the best-prepared EPA chiefs in history to make the agency more aware of environmental justice issues. But, as environmentalists in North Carolina pointed out following his EPA nomination, it's also true that Regan's appointment to the EPA was met with glowing praise by the National Pork Producers Council, who found that while leading the DEQ, Regan had an "open door" for the industry. Although he cracked down on leaking lagoons, as E&E News reported in December, he did little to block permits for farms with outdated manure management systems like those that still litter Sampson and Duplin counties. While hog farmers learned not to act as recklessly during his tenure, the lagoon and sprayfield systems at the center of the industry's environmental issues emerged largely unchanged. And now, Smithfield is able to move full-steam ahead with its plans to carve out more lagoons, so it can pump more biofuel in Duke and Dominion pipelines.

As for Vilsack, it's been clear for years that the former Obama-era USDA secretary isn't interested in seriously reforming American agriculture. In the Obama years, Vilsack's department made millions available in grants for farms looking to introduce anaerobic digesters. In his Senate confirmation hearings in February, Vilsack repeatedly issued his vote of confidence in biofuels as a form of clean energy that the federal government should encourage the agriculture industry to undertake. That's consistent with his prior ties to Iowa, where both hog and corn producers are looking to capitalize on biofuels. He's since doubled down on this stance, commenting at a recent conference that he expects biofuels to be an integral part of extending the lifespan of combustion-engine automobiles through the coming decades.

As with natural gas produced by fracking, the idea that biofuels can be produced without causing very real harm to marginalized communities

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is one that should have been laughed off the stage years ago. Instead, as the modern agriculture industry looks to the future, it has, much like its gas and oil counterparts, determined that the best route forward is the short-term plan that nets it the most cash and federal grants possible. Regan's past actions do leave the door open for his EPA to more stringently regulate how hog farms and others manage their waste. But if governmental agencies across the board continue enabling and encouraging the nation's reliance on natural gas, then the spot we'll be in five decades from now will feel eerily similar to both the past and our current moment: with a select few corporations reaping all the benefits, and Black, Native, and Latinx communities paying for the marginal gains with literal years off their lives.

newrepublic.com, 12 April 2021

https://www.newrepublic.com

A third of Antarctic ice shelves could collapse at current pace of warming

2021-04-14

A third of Antarctica's vast offshore ice shelves could collapse into the ocean if the world warms by 4 degrees Celsius (7.2 degrees Fahrenheit) above pre-industrial levels. These floating platforms of solid water wouldn't directly raise sea levels if they melted; they already sit in the ocean. But they're important barriers preventing the immense bulk of the frozen continent's glaciers from rolling out to sea. If those inland glaciers reached open water, sea level could rise catastrophically.

The at-risk ice makes up two-thirds of the peninsula's ice shelf extent.

Of the 34% of ice shelves at risk of collapse by the end of the 21st century, many are concentrated in the Antarctic Peninsula — a region of West Antarctica that juts northward toward South America. The at-risk ice makes up two-thirds of the peninsula's ice shelf extent. In total, 190,000 square miles (500,000 square kilometers) of Antarctic ice would be at risk. That's a region much bigger than California.

"Ice shelves are important buffers preventing glaciers on land from flowing freely into the ocean and contributing to sea-level rise. When they collapse, it's like a giant cork being removed from a bottle, allowing unimaginable amounts of water from glaciers to pour into the sea," lead author Ella Gilbert, a scientist at the University of Reading, England, said in a statement.

The good news is that this sort of ice-shelf breakdown is far from inevitable. Right now, the world has already warmed by about 1 C (1.8 F) above pre-industrial levels. If we managed to hold warming to 2 C (3.6 F) — which some scientists suspect may not be possible, as the Associated Press reported — then just half of the 34% of threatened ice shelves would be at risk. Stop the warming at 1.5 C (2.7 F) and the impacted region would be even smaller.PLAY SOUND

The new study modeled the processes that drive melting for shelves including Larsen C, Wilkins, Pine Island and Shackleton, at a new level of detail. Some of this melting may already be in motion: Larsen C already has a habit of spitting icebergs the size of New England states into open water, as Live Science has reported.

Under normal circumstances, the ice shelves melt a little in the summer. That melt trickles down through cracks in the ice to later freeze again in their underbellies. But when too much melting occurs, water pools on their surfaces.

"We know that when melted ice accumulates on the surface of ice shelves, it can make them fracture and collapse spectacularly," Gilbert said in the statement.

In the past, researchers have modeled the future behavior of ice shelves at the scale of the entire Antarctic, without fine attention to the details of individual ice shelves. This new study modeled ice melt in different scenarios with previously unheard-of resolution and complexity. The result: visions of Antarctica in a world where climate change goes further than even some pessimistic projections, and in a world where society makes substantial progress against greenhouse gas emissions.

"I think that we're presently on track for something between 3 to 3.5 C (5.4 to 6.3 F). That's not to say that 4 C (7.2 F) is out of the question — if we're unlucky and unwise, we could certainly get there," said Andrew Dessler, a Texas A&M University scientist who studies the prospects for future warming and was not involved in this study.

In other words, the world where climate change proceeds to the point where a third of Antarctic ice shelves are at risk would involve more major failures to curb greenhouse gas emissions or the discovery of some warming feedback mechanisms that haven't been discovered yet.

"My personal opinion is that staying below 1.5 C (2.7 F) is pretty much out of the question unless we deploy some type of solar radiation

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geoengineering," Dessler told Live Science, noting that not every scientist agrees on this point. "Two C (3.6 F) will be very very difficult, but I believe that we could still limit warming to that without significant economic cost if all of the world's governments work together on climate change. I'll leave it up to you to decide how likely that is."

The study was published April 8 in the journal Geophysical Research Letters.

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https://www.livescience.com

Man fined for farting on cop argues farts are protected forms of expression

2021-04-14

A 22-year-old Austrian man who made headlines in June of last year after he was fined €500 euros (~$600) for farting on a police officer argued in court that his fart actually falls under freedom of expression, Austrian daily newspaper Der Standard reported last week.

In a decision released by the administrative court in Vienna, the court lays out some much needed detail in regards to the alleged events that transpired on that fateful day, meaning that we as readers can look at the facts and come to our own conclusions about whether the fart was indeed protected speech.

The ordeal began on June 5, 2020, when the farting man—named "Mr. AB" in the document—was hanging out with a friends at an unnamed park when a group of police officers approached them during a routine identity check.

That's when things got windy.

That's when things got windy.

"When he released the intestinal gas, the complainant was sitting on a park bench," the document reads. "He then lifted his buttocks and tensed up a little before letting the intestinal gas escape."

"The complainant's friends laughed at the intestinal gas and witness F made a joke," the document continues. "Due to the resulting entertainment from the intestinal gas, the defendant grinned at the officers."

In court, the man argued that the fart was not intentional and that, even if it was intentional, it would still fall under his fundamental right for freedom of expression.

Unfortunately for the wind-breaker, the judge didn't buy his argument.

In a detailed legal assessment of whether farting is indeed a protected form of expression, the judge argues while farts and burps can cause "social inappropriateness" they do not contain "communicative content," and even if they did, it would still be considered "a form of expression that transcends the boundaries decency."

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The judge did show some sympathy for the man though, reducing his fine from €500 euros to €100, citing his financial situation and the fact that he had no criminal record.

However, speaking to local Viennese newspaper Kurier, Matej Zenz, the man's lawyer, made clear that this is a hill his client is willing to die on, and that they would be appealing the decision to the country's constitutional court.

"It's a matter of principle for us," the Zenz said, "because it's petty to get a punishment for a fart."

vice.com, 14 April 2021

https://www.vice.com

Glass molded like plastic could usher in new era of complex glass shapes

2021-04-08

The production of glass—one of humanity's oldest materials—is getting a 21st century makeover. A new approach to glassmaking treats the material like plastic, allowing scientists to injection mold vaccine vials, sinuous channels for carrying out lab chemistry, and other complex shapes.

"This is a great way to form glass into complicated and interesting geometries."

"It's a really exciting paper," says André Studart, a materials scientist at ETH Zürich. "This is a great way to form glass into complicated and interesting geometries."

Glass was first produced in Egypt and eastern Mesopotamia around 3500 B.C.E. Then, as now, the material was made by melting silicon dioxide, or silica, at about 2000°C, and then using a variety of techniques to shape it. Modern glassmaking techniques can readily mass produce certain shapes, such as flat windowpanes and rounded bottles, but they can't mass produce the intricate designs needed for modern biomedical instruments.

In 2017, researchers led by Frederik Kotz, a microsystems engineer at the Albert Ludwig University of Freiburg, set out to change that. They reworked a 3D printer to forge glass rather than printing plastics or metals.

The scientists created a printable powder by mixing silica nanoparticles with a polymer that could be cured with ultraviolet (UV) light. After printing the shapes they wanted, they cured the polymer with UV light so it would hold its shape. They then fired the mix in an oven to burn off the polymer and fuse the silica particles into a continuous glass structure.

The approach worked, making it possible to craft shapes such as tiny pretzels and replica castle gates. The work garnered interest from companies wanting to build minute lenses and other complex transparent optical components for telecommunications equipment. But the procedure was slow, turning out components one by one, rather than a fully industrial approach that could produce parts en masse, as is done with plastic.

To speed things up, Kotz and his colleagues have now extended their nanocomposite approach to work with injection molding, a process used to mass produce plastic parts like toys and car bumpers by the ton. The researchers again started with tiny silica particles. The team then mixed the silica with two polymers, polyethylene glycol (PEG) and polyvinyl butyral (PVB). The mixture created a dry powder with the consistency of toothpaste. The team fed the paste into an extruder that pressed it into a preformed mold with shapes such as a disc or tiny gear.

Outside of the mold, the parts hold their shape because myriad weak attractive bonds, called van der Waals interactions, form between neighboring silica particles. But the parts are still fragile.

To harden them, the researchers used water to wash away the PEG. They then fired the remaining material in two stages: First at 600°C to burn out the PVB, and second at 1300°C to fuse the silica particles into the final piece.

"What you get in the end is high purity silica glass" in any shape you want, Kotz says. The glass parts also end up with the optical and chemical characteristics needed for commercial telecommunications devices and chemical reactors, he and his colleagues report today in Science.

That's useful, Studart says because glass' transparency, chemical inertness, and stability at high temperatures makes it ideal for diagnostics, packaging for pharmaceuticals, and even bumpy surfaces that improve the efficiency of solar cells. "I think [the method] will trigger a lot of new ideas."

However, Studart says this new approach to mass producing glass parts still faces a bottleneck: Washing away the PEG must be done slowly, over days, to ensure the glass parts don't crack. Speed that up, he says, and injection molding of glass could become as popular as it is with plastic.

sciencemag.org, 8 April 2021

https://www.sciencemag.org

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Can vaccinated people still spread COVID-19? Huge study tackles question

2021-04-14

A federally funded study taking place at 21 college campuses will test how well Moderna's COVID-19 shot prevents vaccinated people from spreading the coronavirus, The Washington Post reported.

Clinical trials have shown that the Moderna vaccine is more than 94% efficacious at preventing illness from COVID-19, and that the shots are especially protective against severe disease, hospitalization and death from the virus. However, the clinical trials were not designed to answer an important question: Can vaccinated people still carry the coronavirus in their nose and mouth and unwittingly spread it to others?

Real-world studies in Israel and the U.K. hint that COVID-19 vaccines cut down the risk of both symptomatic and asymptomatic infections, meaning those without any outward signs of illness, the Post reported. These two studies each focused on the Pfizer and AstraZeneca vaccines, respectively. Another study in 4,000 health care and essential workers in the U.S. provided additional evidence that the Pfizer and Moderna vaccines protect against all infections, including those without symptoms, Stat News reported.

AY SOUND

While these studies provide clues that vaccinated people may be less likely to spread the virus, because they appear to avoid infection overall, they cannot confirm this conclusively. The new college campus study, called PreventCOVIDU, will attempt to directly answer the question through contact tracing — where COVID-19 infections are tracked among vaccinated people, unvaccinated people and a large group of their close contacts.

Tracking if and how infections ripple through this large group of people should help reveal how often vaccinated people pass the virus to those around them, regardless of whether the vaccinated person falls ill.

"This study is addressing the important issue about what does it mean to be vaccinated, as far as your risk for transmitting SARS-CoV-2 to people in your bubble of trust," Dr. Lilly Immergluck, a pediatric infectious-disease specialist at Morehouse School of Medicine in Atlanta, told the Post.

PreventCOVIDU will include 12,000 university students ages 18 to 26, according to the study's recruitment website. The students will be

These two studies each focused on the Pfizer and AstraZeneca vaccines, respectively.

randomly split into two groups; half will receive their first Moderna vaccine dose right away, while the other half will be vaccinated four months later. The entire trial will take place over a five-month period.

All participants will take daily nose swabs throughout the trial, so the study organizers can track when COVID-19 infections occur and in whom. The swabs will also help them calculate the quantity of viral particles in each infected person's nose and the genetic sequence of the virus they contracted. These data points will help determine whether viral load — the amount of virus in a person's system — is linked to the risk of transmission. They will also show whether the Moderna vaccine provides different levels of protection against different strains of the virus and whether vaccinated people are more likely to spread certain strains over others.

A phone app will remind participants to swab their noses daily. They will also complete daily questionnaires about their symptoms, provide blood samples at several points in the study and undergo routine COVID-19 screenings through their university testing systems.

The main study participants will also identify a group of their close contacts, meaning people who could be at risk of catching COVID-19 if the college students test positive for the virus. In total, the trial organizers hope to collect data from 25,500 close contacts. (Both the main participants and their close contacts will be compensated for their participation in the trial.)

Roommates and coworkers of the main participants will be considered "prospective close contacts (PCC)," and in the event a participant tests positive for the virus, they'll also identify "case-ascertained close contacts (CACC)," or additional people they may have exposed to the virus in recent days.

Following a confirmed infection in a participant, close contacts who participate in the study will answer weekly symptom questionnaires, take daily swab tests for two weeks after the positive test and may potentially provide two blood samples. PPC participants will undergo routine COVID-19 screening at their university throughout the trial, while CACC's will do so for just one month following their potential exposure.

Results from the study are expected "later this year," according to the study website.

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You can read more about the trial's first participants at The Washington Post.

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https://www.livescience.com

How scientists are teasing apart the biology of Long COVID

2021-04-13

Science's COVID-19 reporting is supported by the Heising-Simons Foundation.

After the first surge of COVID-19 cases in spring 2020, a new worry emerged: Some people didn't get better. For those with so-called Long COVID, lingering symptoms ranged from brain fog and intense fatigue to shortness of breath and loss of smell and taste. So far, there's little clarity about what causes or how to treat this constellation of symptoms. Some surveys suggest between 10% and 30% of people infected with the pandemic coronavirus may struggle to recover, but these data are preliminary.

So far, there's little clarity about what causes or how to treat this constellation of symptoms.

Emilia Liana Falcone, an infectious disease specialist at the Montreal Clinical Research Institute, and Michael Sneller, an infectious disease specialist at the National Institute of Allergy and Infectious Diseases (NIAID), are each leading a large Long COVID clinical trial. They are recruiting volunteers who've had COVID-19—some with ongoing symptoms and some without—along with a control group of people who never caught the virus. Volunteers come in regularly for medical tests, and scientists probe their blood for immune abnormalities. The goal: a biological explanation of chronic symptoms after COVID-19. The pair spoke with Science about their work, their thoughts on Long COVID, and their efforts to let the data guide them. This conversation has been edited for brevity and clarity.

Q: We've known for a long time that many infections—not just COVID-19—can cause enduring and disabling symptoms, like crushing fatigue and brain fog, in some people. Is Long COVID just another example of this?

Michael Sneller: Maybe it's new, maybe it's not. There are precedents for this kind of postinfectious, noncritical illness, such as posttreatment Lyme

disease. And there are people with chronic fatigue syndrome, some of whom pinpoint the onset of their symptoms to a viral infection. During polio outbreaks in the 1950s, there was another syndrome that developed in people: fatigue, concentration difficulties, aches and pains. I thought early on that given tens of millions of people who were likely going to get infected with COVID, that we would be seeing this.

Emilia Liana Falcone: In terms of fatigue, some of the neurological complications, brain fog, lack of concentration, is common for sure after other infections. That being said, I think there are certain features that are not quite as common that we're seeing now—the loss of smell and taste I've seen in the clinic at least 6 months out. There's also this new onset of some endocrinopathies, such as thyroid problems. Maybe this happens in the context of other viral infections and we're not looking for it. But it might be something more distinctive of COVID.

Q: How did you get interested in Long COVID?

E.L.F.: I spent almost 9 years at the National Institutes of Health, where I was looking at long-term inflammatory complications in patients with inborn errors of immunity. It seemed to me highly plausible that given the intense inflammatory processes in the acute phase of COVID-19, there would be long-term effects.

M.S.: About 6 years ago, I was asked to help lead a study of Ebola survivors in West Africa. In the 2014 outbreak, it infected hundreds of thousands of people. Of those who survived, there emerged persistent symptoms such as headaches and joint pain. We enrolled approximately 1000 Ebola survivors and about 2300 Ebola-negative people in Liberia—it was an NIAID-Liberia collaboration. I knew we needed to have a control group, in order to really determine whether any of the things we were seeing were related to Ebola per se, or just life in Africa, which can be hard. I learned a lot that I was able to apply to studying post-COVID syndrome.

Q: Why don't we yet have a clear definition of Long COVID?

M.S.: A year ago, this didn't exist. So that's why.

E.L.F.: A lot of the first studies were based on questionnaires and chart reviews, especially in hospitalized patients. There's been a lot of describing symptoms. There's a lack of mechanistic data.

Q: How is your study set up to dig into the biology?

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M.S.: We have a COVID group, at least 6 weeks out from the onset of symptoms, of 18 years and older. We've enrolled about 150 survivors, and about 55% have no post-COVID symptoms. As was the case with the Ebola study, we knew it was important to have a control group. We ask participants to identify people that they had contact with who didn't get COVID, and we ask them to join the study. We try to match them for age, and if you do that, you get pretty good matching for other comorbidities, including hypertension, diabetes, obesity, and so forth. We've got just about 100 controls now enrolled.

Both groups undergo basically the same evaluations, which include lung function, exercise testing, and heart MRIs. Cortisol and thyroid functions are measured to work out reasons for various things like fatigue. We have an extensive mental health evaluation with neurocognitive testing, psychiatric interviews. And then we have a whole laboratory component, looking at aspects of the immune response, evidence of persistent virus, persistent inflammation. It's a longitudinal study for 3 years. We see people every 6 months, sometimes sooner.

E.L.F.: This is very similar to our study. We also begin with a slew of questionnaires that include information on diet, well-being, etc. There's neuropsychiatric or neuropsychological testing by a separate team. We look at every organ system. And then there's collection and analysis of blood and tissue samples—we have laboratories right upstairs. We also have a team of specialists that we refer to for deeper workups of anyone with an actual organ dysfunction.

Q: You both include control groups of people who have not had COVID-19. Why is that important?

E.L.F.: You need to control for the background noise. We're in a pandemic, and that is creating anxiety, stress, insomnia, depression. We have to include people who are living that to be able to tease out what is really related to the infection.

M.S.: With the Ebola study, by having a control group, we showed that a lot of symptoms that were thought to be post–Ebola syndrome symptoms actually occurred at the same frequency in the control group.

I can give you two examples from our current study. There are published reports about tinnitus being a post-COVID problem. About 12% of our COVID group complains of tinnitus, and about 14% of the control group has tinnitus. It's the same thing with finding a mild abnormality in a lung test that measures how well lungs transfer oxygen to the bloodstream.

About 50% or 60% of the COVID group has that, with a median age of 50. Had I not had a control group, I'd say, "This is from COVID." Well, exactly the same percentage of the age-matched, comorbidity-matched control group have the defect. You need a control group to really attribute any abnormality to the viral infection. Without a control group, that's difficult, if not impossible.

E.L.F.: Exactly.

Q: Might your findings help explain who is susceptible to Long COVID?

M.S.: Potentially. It might give some clues to what might be causing these symptoms. If you had detailed biospecimens from the acute illness phase from the same patients, that would be ideal, but that's very hard to do. In my cohort, 90% rode COVID-19 out at home. So they've got no biospecimens.

E.L.F.: Developing predictive models is very attractive, and people have been interested in that. But the issue is with those patients who are not hospitalized, you just don't have any samples from before or during the illness to compare to the present.

Q: It's going to take time for your studies and others to tease this out. Are there ways to help people with Long COVID right now?

E.L.F.: There isn't a clear treatment pathway. You can treat the obvious reversible issues—someone who's anemic, someone who's vitamin D deficient. A lot revolves around rehabilitation, depending on the patient.

Q: What does rehabilitation involve?

E.L.F.: If it's pulmonary, there are exercises you can do to improve shortness of breath, some of which are related to the exercises opera singers do. We've been approached by the Opera House of Montreal to develop a rehab program for patients, because a lot of these exercises work on improving lung function.

M.S.: I find in talking to patients, they're afraid to exercise because they think they have heart damage or lung damage. I tell them that we're doing a lot of testing. If we don't find any evidence of serious damage in the lungs, I encourage them to start gradual exercise. There are a lot of mental health issues, and in the control group, too. There is a lot of room for better mental health evaluation in the community, and treatment.

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E.L.F.: The only thing I would add is if you think that the patient has chronic fatigue syndrome, then it's more of a conservational approach in terms of their energy, rather than forcing an exercise progression.

Q: Do you think that some of these cases are chronic fatigue syndrome?

E.L.F.: I think there's a subgroup of post-COVID patients where maybe they will fall into that category, but there might be others that have something else.

Q: There have been anecdotal reports about people with Long COVID getting better after vaccination. What do you think of this?

E.L.F.: It's very provocative; it's intriguing. With the control group, you have to take a careful look. It could just be patients' natural rate of healing.

M.S.: We asked people to let us know when they are getting vaccine. On a subset, we're trying to draw blood at certain time points to study B cell and antibody response in both groups after vaccination.

E.L.F.: We, too, are sampling patients after the first dose and the second dose, although here in Quebec, if they've had COVID, they only get one dose.

M.S.: As far as symptoms go, the majority of people in my protocol who got vaccinated haven't said one thing or the other. We'll just see what happens.

Q: Long COVID is in the news constantly. What do you think about how it's being described to the general public?

M.S.: There's a lot of misinformation out there that does not give context. There will be a headline saying psychosis is a new symptom of Long COVID, and it turns out the story is about just one person. My patients, some of them tell me they spend 6, 8 hours a day on social media pages related to Long COVID. I think that's not always a good thing.

Q: But they might be doing that because they're not getting the support they need from the health system, right?

M.S.: That's true.

E.L.F.: You're right, there are people who feel like it's not being recognized. The reports started with infectious disease doctors in the U.K. who were like, "Hey, at several months out, I'm not performing like a normal doctor." That for me struck a chord. It's important that we listen, that we

acknowledge that there's something going on. But, like Mike said, there's misinformation. That's where research projects play a role. We get to have some concrete, objective data to put it all in perspective.

sciencemag.org, 13 April 2021

https://www.sciencemag.org

The ocean is a giant dump for chemical weapons. Can we clean it up before it's too late?

2021-04-12

Almost seventy years ago, a group of Polish children arrived in the coastal village of Darłowo for summer camp. As some children splashed in the cold, turbid waters of the Baltic Sea, others played around an old, corroded barrel they found lodged on the beach, blissfully unaware of the looming threat leaking from within.

A few hours after being exposed to the barrel's brown-black liquid, over 100 children began feeling sick. The culprit? Mustard gas.

According to the Centers for Disease Control and Prevention, symptoms of mustard gas exposure include red, itchy skin that can turn into painful yellow blisters, difficulty breathing, runny or bloody nose, nausea, vomiting, eye irritation, and even temporary blindness. The blisters can lead to deep burns and take weeks to heal. According to case reports, four of the Polish children ultimately suffered irreversible eye damage.

It was a national scandal, and the public demanded answers. So the government convened a panel of experts to find out what was going on and how to fix it. They concluded that the barrel had been a sulfur mustard bomb—one piece among over a million tons of obsolete conventional and chemical warfare munitions dumped in the oceans after World War I and II—washed ashore by the natural flow of currents over time.

The panel's solution was to spread bleaching powder on the beach to neutralize the mustard gas. One of the experts in that commission, Krzysztof Korzeniewski, used to tell that story to his marine chemistry students at the University of Gdańsk in Gdańsk, Poland. The lecture sparked a lifelong passion for one of the students, Jacek Beldowski, who went on to devote his career to investigating defunct chemical weapons abandoned in the ocean.

These discarded warfare relics are disintegrating with every passing second, with the potential to pollute everything they touch. Yet the

It was a national scandal, and the public demanded answers.

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solutions to stop that scenario are still in the early stages—and the political will to use them lackluster.

The dangerous, global legacy of dumped chemical munitions

There are roughly 150 to 300 sites with dumped chemical weapons worldwide, according to Beldowski, who now works as a professor of marine chemistry and biochemistry at the Polish Academy of Sciences. That number includes around 50 sites along American coastlines, with a significant proportion in Hawaii. "They're in every ocean and almost in every sea," he says.

In 2017, a group of researchers from the Middlebury Institute of International Studies in Monterey, California, calculated that the total amount of chemical munitions quietly lying on the ocean floor reached 1.6 million tons. That number only includes the weapons in known locations—which they believe is only 40 to 50 percent of the total number of sites.

There is ample evidence that these chemical weapons are already leaking. Studies in the Baltic Sea have found toxic remnants in the tissues of sea stars, lobsters, and even commercial fish species. They've already taken a toll on fish populations off the German coast, says Claus Boettcher, the director of Germany's Program on Underwater Munitions.

"We have a serious suspicion of an effect on the reproduction rate of cod, the most commercial species in Europe," he says, "because most of the cod's main reproduction areas are exactly in the same areas where the highest munitions contamination concentrations are."

If these weapons keep leaking—or the volume of the leak increases—they could endanger the survival of organisms that are already struggling to adapt to a warmer, polluted, and acidifying ocean.

But the effects of these noxious conflict artifacts extend beyond sea creatures, and the Darłowo children were just one example. Between 1998 and 2009, almost 2,000 encounters with abandoned munitions occurred in the waters around Belgium, France, Germany, Ireland, the Netherlands, Spain, Sweden and the United Kingdom, according to the European OSPAR commission, which works to protect the northeastern Atlantic Ocean.

About 60 percent of the incidents involved fishermen pulling munitions up in their nets. In one particularly disturbing instance, three Dutch

fishermen were killed by a WWII-era bomb that exploded when they hauled it aboard their ship.

In Germany alone, authorities annually record between one and five cases of people at beaches getting burned with highly flammable white phosphorus (it can be mistaken for amber), a byproduct of chemical weapons, says Boettcher.

The underwater dumpsites are also becoming an increasing hurdle for the development of climate change adaptation efforts, from the construction of better flooding-prevention systems to the installation of wind farms.

"Seventy years ago, we didn't think that we'd be building offshore wind farms and that we would have offshore telecommunication cables going all over the place," says Margo Edwards, who works as the director of the applied research laboratory at the University of Hawaii. "As we have moved out into the ocean, we've come in conflict with the lack of foresight that we had in the 1940s, and now we have to deal with the problem."

To understand how the ocean became a collection of chemical weapons dumpsites, we need to go back almost a century, to the First World War, when armies first began deploying mustard gas, an extremely abrasive chemical that burns the skin and inflames the eyes and throat. Despite signing a protocol in 1925 that prohibited the wartime use of chemical and biological weapons, the nations involved in World War II again used mustard gas and other chemical weapons on the battleground anyway.

The end of the war left an arsenal of unusable chemical warfare, which, governments figured, wouldn't hurt anyone in the depths of the ocean. Ships left the shores of Poland, Germany, the UK, Japan, and even the US, loaded with thousands of tons of chemical weapons and other objects like sea mines, bombs, torpedo heads, grenades, and ammunition.

Some munitions were simply thrown overboard, according to the Middlebury group, while the majority were loaded as cargo onto ships that would then intentionally be sunk. One by one, toxic chemical weapons sank to the bottom of the sea.

Finding dirty needles in a watery haystack

Until the late nineties, both the public and politicians turned a blind eye to the dumpsites, says Beldowski. In 1997, the Chemical Weapons Convention (CWC) treaty entered into force, which demanded nations destroy their chemical weapon stockpiles. But the treaty didn't address what countries should do with the weapons created and dumped in the seas before 1972.

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Some activists and scientists were critical of the omission, so in 2004, the nine countries that share the Baltic Sea—where the majority of dumped munitions rest—created the first integrated European project to measure the environmental risk of the abandoned ordnance, dubbed MERCW.

The MERCW group used sonar scanners to map the biggest dumpsite in the Baltic, the Gdańsk Deep. If they detected something in the landscape that resembled a weapon, they sampled water from the nearby area looking for one particular byproduct of degraded mustard gas, ethylene glycol. They found evidence of widespread contamination with warfare agents like Adamsite, sulphur mustard, tabun, chlorobenzene, and arsine oil. But it was a small project, so the sampling was patchy and the results inconclusive.

Something didn't sit well when Beldowski saw those results. The MERCW team had chosen to study several compounds, but only one possible byproduct of mustard gas. By that point, other researchers had identified at least 50 additional compounds that appeared as mustard gas and other chemical weapons degraded in the ocean. Additionally, he disagreed with how the sampling sites had been chosen. Sometimes, he argued, they were too far away from the potential weapon.

By 2011, he had convinced the European Union to fund a new project that would search for pollution from warfare agents in sediments and determine if the contamination was spreading and reaching live organisms.

That project became Chemical Munitions Search and Assessment, or CHEMSEA. It brought together an international team of some 200 researchers from 11 European institutions. They sampled 200 objects over three years and looked for contamination from all 50 possible compounds.

Not only did they discover an undocumented dumpsite in the Baltic, but they found that on average, each remnant was polluting a larger area than initial models predicted, up to 250 meters, or nearly three American football fields. In the dumping sites, the fauna and flora were close to non-existent due to the low concentrations of oxygen.

After that project, the North Atlantic Treaty Organization (NATO) asked Beldowski to follow up on his previous results. His team decided to create better, more reliable monitoring methods. Up to that point, discovering dumped chemical weapons was extremely expensive and time-consuming. Sonar would signal if something was hiding on the seafloor, but scientists had to actually go to each site with submarines to confirm

it. A new international team representing 18 countries from all over the world got involved to develop tools that would make monitoring cheaper and more precise.

Beldowski thought that with cheaper ways to monitor what was going in the dumpsites, he could finally convince countries to pay attention to the problem. But he was wrong.

"Their usual response is that you can just leave those things there because nothing has happened," he says. "It's like they think the problem will go away if they close their eyes."

There are only three options to deal with these weapons, according to Beldowski: Leave the object alone if removing increases the risk of leakage; remove it if the corrosion is so severe that leakage is accelerating; or isolate the weapon, like the USSR did to Chernobyl's reactors after they exploded.

But there are about 50,000 tons of chemical munitions buried in the Baltic alone, and 190,000 tons more to the north in the Skagerrak Strait—millions of individual pieces, each needing a tailored solution.

The complicated solutions for dumped munitions remediation

To figure out what to do with each individual piece, in 2015, Beldowski started a series of projects called DAIMON I and II. The project created a set of "decision aid tools" to help countries decide what to do with which objects, including a detailed catalogue of all the known munitions dumped in the Baltic.

The system allows decision-makers to consider every possible variable of an individualized weapon—its size, dumping year, exact location, the strength of currents in the area, among others—to determine if it should stay in the ocean, be closely monitored, or be removed immediately.

In the Baltic, where shallow, cold waters hardly move, "probably lots of those munitions are either totally corroded or are in such a situation like covered with sediments that they really can stay there," explains Beldwoski.

"But maybe 10 percent of it is still dangerous and should be either monitored or taken out. And only then you can start calculating costs." The problem is that, according to the team's calculations, scientists only have enough data for 4 percent of the known munition dumpsites, mostly in the Baltic.

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These solutions are also not universally applicable: Fixes for weapons in Northern Europe might not be useful for those buried in the deeper, warmer, and restless Pacific waters, says Margo Edwards, from the University of Hawaii.

Edwards suspects that in the islands, where she says there are about 3,000 tons of dumped munitions, many chemical weapons imploded a long time ago, crushed under the higher pressure of deep waters. As a result, the contaminants' concentration is an order smaller than those found by Beldwoski's team in Europe.

"Where I live, life has grown over the munitions that were disposed of in the 1940s. Removing these from shallow waters involves more damage because they've become part of the habitat," she says.

As an alternative, people are working on a technology "where you drill a hole into the munition and drain all the internal stuff, leaving the munitions to be the habitat for the animals that have already grown up on it."

Other solutions require the weapon to be taken out of the ocean and incinerated at extremely high temperatures in a closed space, so the gases won't reach nearby people, explains Benedykt Hac, an oceanographer working for a Polish company developing these technologies.

Hac says that most removal technologies are being developed by small companies that can't scale their solutions to an industrial level, so removing these objects remains expensive: about 30,000 euros per piece. To do so, he says, they'll need governmental support, which so far remains elusive.

In some countries like Sweden and Denmark, there's less public pressure to clean up the waste, which often drives action, says Boettcher. While some governments are working to deal with the problem, overall, he says, there's no unified consensus among all countries involved.

Boettcher fears that leaving this problem unaddressed could potentially harm these countries' economies, not only because it could hurt the sustainability of their fishing industries, but also because in the last couple of years, some companies have started exploring the possibility of taking legal action.

Since governments are reluctant to take responsibility for these munitions, he says, wind farm, drilling, and cable companies that use the seabed often have to remove the toxic munitions themselves—or spend

additional money to avoid passing through those sites. "I expected that they would do it last year. But I believe in the near future, these large enterprises will start to go to court," he says.

One thing is certain: The clock is ticking. In 2015, researchers from the Polish Naval Academy threw into the ocean hundreds of pieces of the same kind of metal used in the bombs, shells, and munitions that had been dumped after the two World Wars. Two years later, they recovered the metal and created a model to calculate how fast these objects are disintegrating.

They found that barrels are probably already completely corroded, because they weren't as thick as other objects. Bombs will erode sometime between 2020 and 2030, according to their model. "It's quite soon, and of course, this is only a simulation," says Beldwoski. "We may never be sure, but we should be assuming the worst-case scenario."

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https://www.popsci.com

A coronavirus epidemic may have hit East Asia about 25,000 years ago

2021-04-14

An ancient coronavirus, or a closely related pathogen, triggered an epidemic among ancestors of present-day East Asians roughly 25,000 years ago, a new study indicates.

Analysis of DNA from more than 2,000 people shows that genetic changes in response to that persistent epidemic accumulated over the next 20,000 years or so, David Enard, an evolutionary geneticist at the University of Arizona in Tucson, reported April 8 at the virtual annual meeting of the American Association of Physical Anthropologists. The finding raises the possibility that some East Asians today have inherited biological adaptations to coronaviruses or closely related viruses.

The discovery opens the way to exploring how genes linked to ancient viral epidemics may contribute to modern disease outbreaks, such as the COVID-19 pandemic. Genes with ancient viral histories might also provide clues to researchers searching for better antiviral drugs, although that remains to be demonstrated.

Enard's group consulted a publicly available DNA database of 2,504 individuals from 26 ethnic populations on five continents, including

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Chinese Dai, Vietnamese Kinh and African Yoruba people. The team first focused on 420 proteins known to interact with coronaviruses, including 332 that interact with SARS-CoV-2, the virus that causes COVID-19. These interactions could range from boosting immune responses to making it easier for a virus to hijack a cell.

Substantially increased production of all 420 proteins, a sign of past exposures to coronavirus-like epidemics, appeared only in East Asians. Enard's group traced the viral responses of 42 of those proteins back to roughly 25,000 years ago.

An analysis of the genes known to orchestrate production of those proteins determined that specific variants became more common around 25,000 years ago before leveling off in frequency by around 5,000 years ago. That pattern is consistent with an initially vigorous genetic response to a virus that waned over time, either as East Asians adapted to the virus or as the virus lost its ability to cause disease, Enard said. Twenty-one of the 42 gene variants act either to enhance or deter the effects of a wide array of viruses, not just coronaviruses, suggesting that an unknown virus that happened to exploit similar proteins as coronaviruses could have instigated the ancient epidemic, Enard said.

These findings "show that East Asians have been exposed to coronavirus-like epidemics for a long time and are more [genetically] adapted to epidemics of these viruses," says evolutionary geneticist Lluis Quintana-Murci of the Pasteur Institute in Paris, who was not involved in the new study.

It's possible that DNA adjustments to coronavirus epidemics over many thousands of years may contribute to lower COVID-19 infection and death rates reported in East Asian nations, versus European countries and the United States, Quintana-Murci speculates. But it's unknown at this point what, if any, effect those DNA tweaks could have. Many factors, including jobs that can't be done remotely and lack of health care access, drive COVID-19 infections, he says (SN: 11/11/20; SN 7/2/20). And social factors, such as quick, strict lockdowns and widespread mask wearing, may have deterred infections in some East Asian nations.

Large-scale genetic studies in modern East Asians and probes of ancient human DNA spanning the past 25,000 years are needed to explore how the 42 identified gene variants may contribute to COVID-19 or other coronavirus infections. Those variants may also present opportunities for developing COVID-19 treatments, Enard said. So far, though, only four of

those genes are targets of 11 drugs being used or investigated in studies of COVID-19 treatments, he said.

Enard's findings follow related evidence that a set of inherited Neandertal gene variants raise the risk of developing severe COVID-19 in some South Asians and Europeans, while others may provide some level of protection (SN: 10/2/20; SN: 2/17/21).

sciencenews.org, 14 April 2021

https://www.sciencenews.org

Butterflies provide 'extraordinary' help pollinating cotton fields

2021-04-12

Bees are great pollinators—and so important for crops such as almonds and apples that they're driven in to farms and orchards by the truckload each spring. But when it comes to cotton, butterflies play an unexpected role. A new study suggests that by cross-fertilizing cotton flowers that bees don't visit, other kinds of insects—principally hoverflies and butterflies—add about $120 million per year to the cotton harvest in Texas alone.

"This paper will drive people to look at the importance of butterflies as pollinators," says Karen Oberhauser, a butterfly biologist at the University of Wisconsin, Madison, who was not involved in the research. If the results hold up in other crops, butterflies might be added to a short list of commercially important pollinators including honey bees, bumble bees, hoverflies, and beetles.

Until now, biologists haven't rigorously examined butterfly pollination in agriculture. Butterflies aren't as abundant as bees, and they don't go out of their way to collect pollen. Unlike bees, whose hairy bodies are easily coated in the yellow dust, butterflies have long, delicate legs that seldom brush up against a flower's pollen-producing anthers. When it comes to pollination, the dainty nectar sippers "have been scoffed at," says Sarah Cusser, a landscape ecologist at the University of Vermont who conducted the new study.

Cusser studies how habitat and pollinator diversity contribute to agriculture. For her Ph.D. in landscape ecology at the University of Texas, Austin, she researched these factors in cotton. There was no shortage of

Until now, biologists haven't rigorously examined butterfly pollination in agriculture.

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field sites along the Gulf Coast. "You can stand on top of your car and see nothing but cotton," she says.

To find out how well cotton was being pollinated, Cusser counted a lot of insects. Three times over 3 years, she slowly traversed 9 hectares of cotton fields, hunched over and looking for pollinators. She often went barefoot, because the mud would have sucked off her shoes. Each time Cusser saw an insect visiting a flower, she tried to capture it with a net and stow it in a vial of ethanol.

Back in the lab, she identified the insects—2444 in all—and the kind of pollen they were carrying. She had expected to find mostly honey bees. But she also frequently encountered a native bee, the long-horned bee, and she came across hundreds of flies and butterflies. All told, she counted 40 bee species, 16 fly species, and 18 butterfly species, including the gray hairstreak (Strymon melinus) and the little yellow (Eurema lisa). "I was really surprised by the awesome diversity of insects."

That wasn't her only revelation. Cusser noticed that various pollinators visited the flowers at different times throughout the day. Flies would be out early, perhaps because they tend to nest in the fields. Then, butterflies would arrive; by the time it got really hot, bees were out in force. Timing matters because each cotton flower is receptive to pollen for just a few hours and withers by sunset.

Cusser also discovered that various insects tended to visit different parts of the cotton plant. Bees preferred to forage on inner flowers, closer to the main stem (though it's not known why). Flies and butterflies landed on outer flowers, possibly because they're less nimble fliers. These preferences essentially mean roughly 50% more flowers are visited, thanks to flies and butterflies, than if bees were the only pollinators, Cusser and her advisers report this month in Agriculture, Ecosystems & Environment. "It was extraordinary, the extent of it," Cusser says.

This phenomenon, which goes by the technical term pollination complementarity, isn't unique to cotton. In almond orchards, wild bees and domesticated honey bees visit different parts of the trees. Complementarity could be more common than currently realized, Cusser says. "I find the whole idea fascinating," Oberhauser says. "We just don't give butterflies enough credit for their role."

Granted, bees still do most of the work. In cotton fields, Cusser found they're responsible for about 66% of the pollination. But the work of butterflies and flies still adds up to about $120 million per year of extra

cash for cotton farmers in Texas, she estimates. "We kept joking that butterflies aren't quite as useless as everyone thought they were."

Cusser hopes the findings will encourage farmers to conserve or restore habitat that benefits the overlooked pollinators. As a postdoc at the University of Vermont, she plans to study whether habitat restoration benefits cotton farmers by boosting the diversity of pollinators.

"People value butterflies because they're charismatic, and people can see them in their gardens, but now I can point to them as pollinators and know that they can have a significant effect," says Nick Haddad, a butterfly biologist at Michigan State University and co-author. "It really has changed my world."

sciencemag.org, 12 April 2021

https://www.sciencemag.org

Male fertility: how everyday chemicals are destroying sperm counts in humans and animals

2021-04-15

Within just a few generations, human sperm counts may decline to levels below those considered adequate for fertility. That's the alarming claim made in epidemiologist Shanna Swan's new book, "Countdown", which assembles a raft of evidence to show that the sperm count of western men has plunged by over 50% in less than 40 years.

That means men reading this article will on average have half the sperm count of their grandfathers. And, if the data is extrapolated forwards to its logical conclusion, men could have little or no reproductive capacity from 2060 onwards.

These are shocking claims, but they're backed by a growing body of evidence that's finding reproductive abnormalities and declining fertility in humans and wildlife worldwide.

It's difficult to say whether these trends will continue – or whether, if they do, they could lead to our extinction. But it's clear that one of the main causes of these issues – the chemicals we're surrounded by in our everyday lives – requires better regulation in order to protect our reproductive capacities, and those of the creatures with which we share our environment.

Declining sperm count

That means men reading this article will on average have half the sperm count of their grandfathers.

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Studies revealing declining sperm counts in humans aren't new. These issues first received global attention in the 1990s, though critics pointed to discrepancies in the way sperm counts were recorded to downplay the findings.

Then, in 2017, a more robust study that accounted for these discrepancies revealed that the sperm count of western men had declined by 50%-60% between 1973 and 2011, dropping on average 1%-2% per year. This is the "countdown" to which Shanna Swan refers.

The lower a man's sperm count, the lower their chance of conceiving a child through sexual intercourse. The 2017 study warns that our grandchildren could possess sperm counts below the level considered suitable for successful conception – likely to force "most couples" to use assisted reproduction methods by 2045, according to Swan.

Equally alarming is an increase in the rate of miscarriages and developmental abnormalities in humans, such as small penis development, intersexuality (displaying both male and female characteristics) and non-descended testes – all found to be linked to declining sperm count.

Why fertility is falling

Many factors could explain these trends. After all, lifestyles have changed dramatically since 1973, including changes in diet, exercise, obesity levels and alcohol intake – all of which we know can contribute to low sperm counts.

But in recent years, researchers have pinpointed the foetal stage of human development, before any lifestyle factors come into play, as a decisive moment for men's reproductive health.

During the "programming window" for foetal masculinisation – when the foetus develops male characteristics – disruptions in hormone signalling have been shown to have a lasting impact on male reproductive capabilites into adulthood. This was originally proven in animal studies, but there's now growing support from human studies.

This hormonal interference is caused by chemicals in our everyday products, which have the capacity to either act like our hormones, or to prevent them from functioning properly at key stages in our development.

We call these "endocrine-disrupting chemicals" (EDCs), and we're exposed to them through what we eat and drink, the air we breathe, and the

products we put on our skin. They're sometimes called "everywhere chemicals", because they're very difficult to avoid in the modern world.

Exposure to EDCs

EDCs are passed to the foetus by the mother, whose exposure to the chemicals during her pregnancy will determine the degree to which the foetus experiences hormonal interference. That means that present-day sperm count data speaks not to the chemical environment today, but to the environment as it was when those men were still in the womb. That environment is undoubtedly becoming more polluted.

It's not just one specific chemical causing the disruption. Different types of everyday chemical – found in everything from washing up liquids to pesticides, additives and plastics – can all disrupt the normal functioning of our hormones.

Some, like those in the contraceptive pill, or those used as growth promoters in animal farming, were specifically designed to affect hormones, but are now found throughout the environment.

Are animals suffering too?

If chemicals are to blame for declining sperm counts in humans, you'd expect the animals that share our chemical environments to be affected too. And so they are: a recent study found that pet dogs are suffering the same decline in sperm counts for the same reasons as we are.

Studies of farmed mink in Canada and Sweden, meanwhile, have also linked industrial and agricultural chemicals with the creatures' lower sperm counts and abnormal testicular and penis development.

In the wider environment, the effect has been seen in alligators in Florida, in shrimp-like crustaceans in the UK, and in fish living downstream of wastewater treatment plants around the world.

Even species thought to roam far away from these sources of pollution are suffering from chemical contamination. A female killer whale that washed up on the shores of Scotland in 2017 was found to be one of the most contaminated biological specimens ever reported. Scientists say she never calved.

Regulating chemicals

In some instances, the abnormalities observed in wildlife are linked with very different chemical compounds to those observed in humans. But they

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all share a capacity to disrupt the normal functioning of the hormones that dictate reproductive health.

In the UK, the Department for Environment, Food and Rural Affairs is currently building a chemicals strategy that could address these issues. The EU, meanwhile, is changing chemical regulations to prevent banned substances being replaced with other harmful ones.

Ultimately, public pressure could demand stronger regulatory interventions, but as chemicals are invisible – less tangible than plastic straws and smoking chimneys – this may prove difficult to achieve. Shanna Swan's book, which presents the urgency of our reproductive situation, is certainly an important contribution to this end.

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https://www.theconversation.com

Were the first humans superpredators?

2021-04-19

The first humans were mega-carnivores who took down prey with savvy hunting skills, a controversial new study suggests.

In a new research paper, scientists argue that humans and their close relatives were expert hunters from early on, starting at least 2 million years ago. Not only that, but the earliest human species were superpredators, taking down animals twice as large as any terrestrial creature alive today, said Miki Ben-Dor and Ran Barkai, researchers at Tel Aviv University in Israel, and Raphael Sirtoli, a doctoral student at the University of Minho in Portugal.

"So far, attempts to reconstruct the diet of Stone Age humans were mostly based on comparisons to 20th-century hunter-gatherer societies," Ben-Dor said in a statement. "This comparison is futile, however, because 2 million years ago, hunter-gatherer societies could hunt and consume elephants and other large animals — while today's hunter-gatherers do not have access to such bounty. The entire ecosystem has changed, and conditions cannot be compared."

A limited record

Fossil evidence from the earliest human ancestors is scarce. But based on archaeological evidence, Ben-Dor told Live Science, it's clear that Homo sapiens and their close relatives ate "anything edible." But how much of

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their diets comprised plants versus animals is the sticking point. (Another sticking point: When did humans start hunting meat themselves, rather than scavenging it?) Many animals considered omnivorous actually have diets weighted one way or another. Chimpanzees, for example, are technically omnivores, but meat makes up only about 6% of their diets, according to the Jane Goodall Institute of Canada. Dogs and wolves eat mostly meat but sometimes gorge on grains, leading to a debate over whether they should be classified as omnivores or carnivores.

The ancient human species Homo habilis was eating meat at least 2.6 million years ago, Ben-Dor said. Another early human species, Homo erectus, seems to have been a particularly enthusiastic meat eater by 1.8 million years ago; its teeth and gut shrank compared with earlier ancestors — adaptations for digesting meat instead of plants — and it used stone tools capable of butchering meat.

Ben-Dor and Barkai argue in their paper, published March 5 in the American Journal of Physical Anthropology, that meat wasn't just a bonus for these human species and the first Homo sapiens. Instead, the authors believe large animals weighing over 2,200 lbs. (1,000 kilograms) — such as elephants, hippopotamuses and rhinoceroses — made up most of humans' diets. These huge herbivores were much more common — and much larger — in the Pleistocene epoch, starting about 2.5 million years ago, than they are today. .

"Elephants 500,000 years ago could weigh 12 tons, compared to 4 to 6 tons today," Ben-Dor said.PLAY SOUND

These animals would have been walking buffets of fatty meat, well suited to feeding humans' energy-hungry brains, according to the researchers. The authors argued in another recent paper that hunting large prey might have been what drove human brain evolution.

This idea is controversial, however, and researchers do not agree on how useful a huge influx of meat would have been to hunter-gatherers in the days before refrigeration, nor on how skilled ancient humans would have been at taking down prey that other apex carnivores, like lions, struggle to defeat.

"There are some archaeologists who'd say, 'Yeah, they hunted elephant once in a while, but that was like a once-in-a-lifetime hunt; that's the thing grandparents would tell their kids stories about,'" said John Hawks, a paleoanthropologist at the University of Wisconsin-Madison who was not involved in the research. "There are others who said 'No, meat from

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an elephant can last a long time. … Without storage, it's less than you think, but it was a regular part of their subsistence, and it was important to them.'"

A fatty diet?

Eating large, fatty animals would have been a benefit to the earliest humans, Ben-Dor and his colleagues wrote in their paper, because bringing down that many calories in one hunting trip — rather than multiple attempts to stalk smaller prey —— would have freed up time for other pursuits, such as toolmaking and child-rearing. The researchers argue that humans show adaptations for this high-fat, meat-heavy life, ranging from particularly acidic stomach juices (also found in other animals with meat-heavy diets) to small jaws (because meat eaters have to chew less than herbivores that must break down large amounts of fibrous vegetation for the same calories).

Archaeologically speaking, it's difficult to categorize humans and their relatives as one level of predator prior to about 50,000 years ago, Ben-Dor said. That's because the only reliable biochemical way to distinguish whether an animal is a top predator or fits lower on the food chain is a method called stable nitrogen isotope analysis, which requires testing collagen for molecules introduced into the body via the diet. Consumers contain a few percentage points more of the isotope nitrogen-15 than what is found in either the plants or animals they eat, making it possible to determine their level in the food web, also known as their trophic level.

Collagen, the connective tissue found in abundance in bones, doesn't preserve well prior to 50,000 years ago, though. The samples from that era hail from Europe, where cooler temperatures allow for better preservation, and they do indicate that humans were eating large mammals. However, 50,000 years ago in Europe is a far cry from 300,000 years ago in Africa, when and where the first H. sapiens arose, Hawks said.

Adding to the difficulties in determining ancient humans' diets, it's hard to determine precise dates for archaeological materials from the crucial time periods in the middle Pleistocene, when human diets were evolving, Hawks added.

"This is a time frame when our ability to determine the age of things relies on methods that have about a 100,000-year, sometimes 50,000-year, span of uncertainty about them. … That's a lot of error," Hawks told Live Science. And there are far fewer sites to make inferences from that are older than 100,000 years compared with those younger than 100,000 years, he said.

Despite the limited evidence from humanity's early evolution, the researchers said there is more work to be done to show whether these human ancestors truly were specialized carnivores. This might include more work on the abundance of animals of different sizes throughout the Pleistocene, explorations of genetic changes over time that would have altered humans' ability to digest different foods and comparisons of trends in prey size over time.

"I feel that we have only scratched the surface, exploring paleobiology's potential to discover our past and present adaptation to consuming meat and animal fat," Ben-Dor said.

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https://www.livescience.com

Corals' hidden genetic diversity corresponds to distinct lifestyles

2021-04-12

Stony corals that build reefs have been hiding their diversity in plain sight. A genetic analysis of the most widespread reef coral in the Indo-Pacific revealed that rather than being a single species (Pachyseris speciosa), it was actually four distinct species of coral, researchers report April 2 in Current Biology.

Coral reefs are the condominiums of ocean biodiversity, supporting more species per square meter than any other marine habitat. Understanding which coral species foster that biodiversity and how those corals behave is vital to taking care of them, especially as a warming climate threatens overall ocean biodiversity (SN: 5/6/20). "Just knowing what's there is critical to tracking what we are losing," says Rebecca Vega-Thurber, a marine microbiologist at Oregon State University in Corvallis, who was not involved in the new study. The results suggest other corals thought to be a single species may actually be much more diverse than researchers realized.

Using a combination of scuba gear and remotely operated vehicles, marine biologist Pim Bongaerts of the California Academy of Sciences in San Francisco and colleagues sampled more than 1,400 P. speciosa corals from the ocean surface down to 80 meters. In the lab, the samples looked identical, and their internal structures were indistinguishable in scanning

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electron microscope images. Yet, their genomes — their full genetic instruction books — revealed the corals had diverged millions of years ago. That made sense for one of the species in the Red Sea's Gulf of Aqaba, which was geographically separated from the others. But the other three newly identified species lived together on the same reefs in the waters off South Asia. If the corals were living together, why didn't one overtake the other two, the team wondered.

Examining habitat data from their dives, the researchers found the three distinct coral species favored different water depths, with one abundant in the top 10 meters and the other two flourishing deeper down. The three coral species also had different concentrations of photosynthetic algae and pigments, suggesting they had distinct strategies for hosting their algae partners that provide food. And spawning times of these three species were slightly spread out too. One released most of its gametes five days after the full moon, another seven days after, and the third at nine days and counting. The separation of spawning could help the eggs and sperm of each species hook up with its correct species match.

This study is the first to show how a set of cryptic reef corals are splitting up their shared ecological space — by depth, physiology and spawning time, Bongaerts says. "There are all these cryptic lineages occurring, but they've largely been ignored from an ecological point of view."

The results open the door to the possibility that many other doppelgänger corals may be multiple species that coexist thanks to ecological differences, says reef genomicist Christian Voolstra at the University of Konstanz in Germany. "There is a minimal chance that they picked the unicorn, but I highly doubt it. This paper shows that in all likelihood there is a huge diversity of reef corals with distinct ecologies."

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