CHEMWATCH

Bulletin Board

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ASIA PACIFIC

Engineered stone licence

2022-11-21

Engineered stone can have very high quantities of crystalline silica, which is released when the stone is cut, ground, drilled or abrasively polished. Without appropriate control measures in place, exposure to dust containing crystalline silica can lead to diseases like silicosis.

A licence is granted to a business (either an employer or self-employed person) to work with engineered stone if they meet the necessary safety requirements.

Read More

Work Safe Victoria, 21-11-22

https://www.worksafe.vic.gov.au/crystalline-silica

Chinese industrial air pollution emissions based on the continuous emission monitoring systems network

2023-03-22

As the world's largest industrial producer, China has generated large amount of industrial atmospheric pollution, particularly for particulate matter (PM), SO2 and NOx emissions. A nationwide, time-varying, and up-to-date air pollutant emission inventory by industrial sources has great significance to understanding industrial emission characteristics. Here, we present a nationwide database of industrial emissions named Chinese Industrial Emissions Database (CIED), using the real smokestack concentrations from China's continuous emission monitoring systems (CEMS) network during 2015–2018 to enhance the estimation accuracy. This hourly, source-level CEMS data enables us to directly estimate industrial emission factors and absolute emissions, avoiding the use of many assumptions and indirect parameters that are common in existing research. The uncertainty analysis of CIED database shows that the uncertainty ranges are quite small, within ±7.2% for emission factors and ±4.0% for emissions, indicating the reliability of our estimates. This dataset provides specific information on smokestack concentrations, emissions factors, activity data and absolute emissions for China's industrial emission sources, which can offer insights into associated scientific studies and future policymaking.

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Background & Summary

China has been suffering from severe air pollution1. Industrial sectors contributed the majority of China's air pollutant emissions, representing 72.8–86.1%, 74.3–91.0% and 40.7–79.1% of national anthropogenic particulate matter (PM, comprising all PM particle sizes)1,2, sulphur dioxide (SO2)1,2,3 and nitrogen oxide (NOX)1,2,3 emissions, respectively, between 2010 and 2018. These air pollutants constituted the primary precursors of PM2.5 (PM with an aerodynamic diameter within 2.5 μm) pollution, which poses severe environmental problems and public health burden

Read More

Scientific Data, 22-03-23

https://www.nature.com/articles/s41597-023-02054-w

Managing the risks of respirable crystalline silica at work

2023-02-28

Executive Summary

This Decision Regulatory Impact Statement (DRIS) provides an analysis of the regulatory impacts of options, under the model Work Health and Safety (WHS) laws, to manage the risks of respirable crystalline silica (RCS), to improve protection of the health and safety of workers. The DRIS provides recommendations to Ministers responsible for WHS (WHS ministers) for decision. The DRIS is informed by stakeholder feedback on a Consultation Regulation Impact Statement (CRIS). This DRIS has been prepared in accordance with the Regulatory Impact Analysis Guide for Ministers' Meeting and National Standard Setting Bodies (the Guide). The Office of Impact Analysis (OIA) has confirmed this DRIS meets the requirements set out in the Guide.

Statement of the problem

Workers in a broad range of industries including manufacturing, stonemasonry, construction, tunnelling, demolition, mining and quarrying are exposed to respirable crystalline silica (RCS). In 2011, an estimated 6.6 per cent of Australian workers were exposed, and 3.7 per cent of workers were heavily exposed, to RCS. There are also multiple reports of personal exposure above the current workplace exposure standard across industry sectors, where adequate engineering controls are not employed. There

has been a recent focus on compliance in the engineered stone sector given the high prevalence of silicosis in stonemasons and engineered stone workers. However, workers in a broad range of industries outside of the engineered stone sector have also developed silicosis. Stakeholder consultation highlighted that a lack of awareness of the risks associated with RCS and a lack of clarity on how to comply with the model WHS laws contributes to the number of cases of silicosis and silica-related diseases. Despite several awareness campaigns being undertaken since 2018, awareness of silica-related risks remains sub-optimal. Stakeholders also highlighted that requirements under the model WHS laws are difficult to understand for those without regulatory expertise and this may be associated with an inadequate level of compliance.

Read More

Safe Work Australia, 28-02-23

https://www.safeworkaustralia.gov.au/sites/default/files/2023-02/decision_ris_-_managing_the_risks_of_crystalline_silica_at_work_-_for_publication_pdf.pdf

Concern about chemicals in compostable food containers

2023-04-04

University of Queensland researchers are analysing compostable takeaway food packaging for potentially polluting chemicals.

Associate Professor Sarit Kaserzon from UQ's Queensland Alliance for Environmental Health Sciences (QAEHS) said little is known about the substances used in compostable paper or cardboard products and how they may impact the environment.

"Recent bans on single use plastic food packaging have led to an increase in alternatives, which is a really positive step," Dr Kaserzon said.

"However, we have a limited understanding of the chemicals within these alternate products and how they may pollute recycling or composting streams.

"We want to understand how these chemicals may persevere when the packaging is composted or recycled, leading to potential human and environmental exposure.

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"This knowledge is crucial as we divert waste from landfill and transition towards more sustainable practices."

Research has already found chemicals such as mineral oils, flame retardants and per- and polyfluoroalkyl substances (PFAS) in non-compostable paper containers, additives which enhance their structural integrity and resistance to heat, water and grease.

PFAS, synthetic compounds linked to human health problems, are estimated to be present in 40 per cent of food contact papers in the United States of America.

The UQ research project aims to understand if similar substances are present in compostable products.

Dr Fisher Wang from QAEHS said the research findings will inform regulatory decisions to ensure the safe and sustainable use and disposal of compostable food packaging in Australia.

"Food packaging is essential for the preservation, protection, transportation, storage and marketing of food," Dr Wang said.

"Working closely with government and industry partners, we will test compostable and/or biodegradable food contact materials to identify the concentrations of chemicals of concern and then determine the persistence of these chemicals in the organics resource recovery stream.

Read More

University of Queensland, 04-04-23

https://www.uq.edu.au/news/article/2023/03/concern-about-chemicals-compostable-food-containers

AMERICA

Nuclear industry seeks relief from TSCA decaBDE prohibition

2023-03-29

The nuclear energy sector has "urgently" requested that the US EPA pause enforcement of a TSCA prohibition on the flame retardant decaBDE in cables and wires used in nuclear facilities "to avoid imminent impacts" on a critical national energy source.

Concerns raised by the Nuclear Energy Institute (NEI) closely mirror those flagged by the electronics industry over the agency's prohibition on the flame retardant PIP (3:1) – another of five TSCA rules the EPA adopted in early 2021 to address certain persistent, bioaccumulative and toxic (PBT) substances. Together, the scenarios highlight the potential for TSCA restrictions to catch downstream chemical users off-guard, even as the EPA ramps up efforts to regulate more substances under the law.

Read More

Chemical Watch, 29-03-23

https://chemicalwatch.com/712648/nuclear-industry-seeks-relief-from-tsca-decabde-prohibition

EPA makes case to Congress for TSCA funding boost in fiscal year 2024

2023-03-31

The US EPA has called on Congress to provide it with additional funding to implement TSCA and modernise its chemical toxicity and assessment processes.

The agency said it needs $131m to help it implement TSCA in the next fiscal year, $47.9m more than Congress allocated to the programme this year. Achieving strategic goals for TSCA "will be a challenge" without the additional funding, the agency said in its budget justification to Congress.

Read More

Chemical Watch, 31-03-23

Can State-Level Regulations Help Reduce National Emissions from Passenger Vehicles?

2023-04-04

Two major policies have reduced fuel consumption and greenhouse gas emissions from US passenger vehicles: federal standards for fuel economy and greenhouse gas emissions, and California's Advanced Clean Car regulations. In California and in the 14 states that participate in California's program, a minimum percentage of vehicles that manufacturers sell have to be plug-in or fuel cell vehicles. (Plug-in vehicles include both fully electric plug-ins and plug-in hybrids that use gasoline and electricity.) In 2022, California adopted regulations that require all new passenger vehicles sold in the state to be plug-in or fuel cell vehicles by 2035, and

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other states are deciding whether to adopt California's new regulations, as well.

At the same time, vehicle manufacturers have to achieve federal standards for fuel economy and greenhouse gas emissions; the California standards are nested within the federal standards. The US Department of Transportation (DOT) and US Environmental Protection Agency (EPA) have set these standards for fuel economy and emissions through 2026, and the agencies are proposing post-2026 standards. The policies implemented by both the federal government and California aim to transform the new vehicle market: by 2026, the federal standards will have roughly halved the average rate of greenhouse gas emissions in new vehicles since 2012, and California effectively has banned sales of new vehicles that run purely on gasoline or diesel by 2035.

Read More

Resources, 04-04-23

https://www.resources.org/common-resources/can-state-level-regulations-help-reduce-national-emissions-from-passenger-vehicles/

EPA allows California to proceed with zero-emission truck regulation

2023-04-02

California can proceed with the groundbreaking zero-emission truck regulation it passed almost three years ago.

On Friday, the U.S. Environmental Protection Agency granted the state the waiver it needs to enact the Advanced Clean Trucks regulation that requires vehicles ranging from small delivery vans to shuttle buses to 18-wheelers to transition away from diesel fuel — in favor of less-polluting battery electrics and hydrogen fuel cells.

"This is a big deal for climate action," California Gov. Gavin Newsom said in a statement Friday. "Thanks to the Biden Administration, we're getting more zero-emission heavy duty trucks on the roads, expanding our world-leading efforts to cut air pollution and protect public health."

California became the first state in the country to mandate the sale of zero-emissions trucks in 2020. Poised to take effect with 2024 model year heavy-duty vehicles, the new rule requires truck makers to sell an increasing percentage of electric models annually through 2035. Forty

percent of big rigs, half of all cargo and travel vans and 75% of box truck and dump truck sales need to be zero emissions by 2035.

Federal law prohibits individual states from enacting emission standards for motor vehicles, but a provision in the federal Clean Air Act allows California to enforce its own standards if the EPA grants it a waiver. That waiver also applies to states that adopt the California standard.

Six states have adopted California's Advanced Clean Trucks regulation, including New York, New Jersey, Washington, Oregon, Massachusetts and Vermont.

The Advanced Clean Trucks regulation is similar to the Advanced Clean Cars program the California Air Resources Board adopted in 2012 to improve the fuel efficiency of passenger vehicles and accelerate the transition to zero-emission electrics. Seventeen other states now follow the California Clean Cars rule.

Read More

Spectrum News, 02-04-23

https://spectrumnews1.com/ca/la-west/environment/2023/03/31/epa-california-zero-emission-truck-regulation

Proposed EPA regulations could impact some Texas refineries, facilities

2023-03-30

The Environmental Protection Agency is expected to propose new regulations that would decrease the amount of air pollution created by chemical manufacturing plants and polymer and resin facilities.

Attorney Adam Kron, who works for Earthjustice, a nonprofit organization specializing in environmental health, said the driving factor for these proposed changes are the health impacts that these harmful pollutants force upon locals.

Historically, communities of color and communities of higher poverty rates are disproportionately more vulnerable to hazardous and toxic air pollutants than others, largely due to proximity. As a result of their prolonged exposure to potentially harmful chemicals and pollutants, communities of color are also two and four times as likely to be hospitalized and die from asthma as majority white communities.

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Lubbock Avalanche-Journal, 30-03-23

https://www.lubbockonline.com/story/news/environment/2023/03/30/proposed-epa-regulations-could-impact-texas-refineries-facilities/70052697007/

Companies that frack for oil and gas can keep a lot of information secret – but what they disclose shows widespread use of hazardous chemicals

2023-04-03

From rural Pennsylvania to Los Angeles, more than 17 million Americans live within a mile of at least one oil or gas well. Since 2014, most new oil and gas wells have been fracked.

Fracking, short for hydraulic fracturing, is a process in which workers inject fluids underground under high pressure. The fluids fracture coal beds and shale rock, allowing the gas and oil trapped within the rock to rise to the surface. Advances in fracking launched a huge expansion of U.S. oil and gas production starting in the early 2000s but also triggered intense debate over its health and environmental impacts.

Fracking fluids are up to 97% water, but they also contain a host of chemicals that perform functions such as dissolving minerals and killing bacteria. The U.S. Environmental Protection Agency classifies a number of these chemicals as toxic or potentially toxic.

The Safe Drinking Water Act, enacted in 1974, regulates underground injection of chemicals that can threaten drinking water supplies. However, Congress has exempted fracking from most federal regulation under the law. As a result, fracking is regulated at the state level, and requirements vary from state to state.

We study the oil and gas industry in California and Texas and are members of the Wylie Environmental Data Justice Lab, which studies fracking chemicals in aggregate. In a recent study, we worked with colleagues to provide the first systematic analysis of chemicals found in fracking fluids that would be regulated under the Safe Drinking Water Act if they were injected underground for other purposes. Our findings show that excluding fracking from federal regulation under the Safe Drinking Water Act is exposing the public to an array of chemicals that are widely recognized as threats to public health.

Read More

The Conversation, 03-04-23

https://theconversation.com/companies-that-frack-for-oil-and-gas-can-keep-a-lot-of-information-secret-but-what-they-disclose-shows-widespread-use-of-hazardous-chemicals-193915

EUROPE

UK could exempt heat pumps from PFAS regs

04-04-2023

A new report into the usage of PFAS chemicals in Great Britain has suggested that exemptions could be considered for refrigerants in heat pumps and refrigeration systems.

In what is said to be the most comprehensive British analysis of these chemicals ever, the new report from the Health and Safety Executive (HSE) has identified the most common and most harmful uses of PFAS and what measures could be put in place to control and manage them.

The HSE report makes a number of recommendations including to limit the use of PFAS-containing fire-fighting foams, as well as the use of PFAS in textiles, furniture, and cleaning products.

It does, however, suggest that exemptions could be considered for PFAS in "low risk uses" such as refrigerants in heat pumps and refrigeration systems, subject to the availability of alternatives.

The analysis is a regulatory management options analysis (RMOA), a preliminary step used within the UK REACH framework. It is not a legislative or legally binding document. It collates, combines and analyses information to understand the nature and extent of exposure to chemical substances.

HSE, as the Agency for UK REACH (Registration, Evaluation, Authorisation and Restriction of Chemicals), will work with the Environment Agency and the appropriate authorities (Defra, Scotland and Wales) to consider the recommendations and how action on these recommendations will be set out in the forthcoming UK REACH Work Programme for 2023-24.

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Cooling Post, 04-04-23

https://www.coolingpost.com/uk-news/uk-could-exempt-heat-pumps-from-pfas-regs/

"Save bees and farmers!": One million signatures in European Citizens' Initiative signals EU co-legislators to keep environmental ambition

2023-04-05

Today, the Commission is responding to the European Citizens' Initiative (ECI) "Save bees and farmers! Towards a bee-friendly agriculture for a healthy environment".

The Commission welcomes the initiative and acknowledges the importance of the ECI, in particular as the interlinked crises of climate change, pollution and biodiversity loss constitute growing challenges for Europe's agriculture and food security. In the EU, one in three bee, butterfly and hoverfly species is in decline, whereas 80% of crop and wild flowering plant species depend on animal pollination. Half of agricultural land in the EU already runs the risk of having a pollination deficit. The threat to the existence of pollinators is a threat to food security and to life on the planet.

The success of the Citizens Initiative is a clear sign of the large public support for action in favour of pollinators, biodiversity and sustainable farming. In this context, the Commission is calling on the European Parliament and the Council to find swift and ambitious agreements on the already submitted legislative proposals, that will help protect and restore European pollinators and translate the citizens' ambition into law.

Comprehensive action for sustainability of food systems

The Commission's European Green Deal actions to ensure the sustainability of food systems include notably: the EU Farm to fork and the Biodiversity strategies, the Nature Restoration Law, Sustainable Use of Pesticides Regulation, revised EU Pollinators' Initiative 'the New Deal for Pollinators', as well as the new EU common agricultural policy for the period 2023-2027. Taken together, the Commission's proposals and initiatives are a comprehensive response to the requests made in the ECI.

Read More

European Commission, 05-04-23

https://ec.europa.eu/commission/presscorner/detail/en/ip_23_2084

Integrating Policy: Water, Endocrine Disruptors, and Pharmaceuticals

2023-04-05

The links between policies on water and chemicals are straightforward but integrated policy is a challenge that needs to be addressed. The Strategic Approach to Integrated Chemicals Management (SAICM) has played an important role in bringing attention to emerging issues that cross these domains.

Two chemical groups recognized by SAICM that fall outside global agreements and have significant impacts on water, health, and biodiversity are endocrine disrupting chemicals (EDCs) and environmentally persistent pharmaceutical pollutants (EPPPs). SAICM recognized EDCs and EPPPs as emerging policy issues a decade ago, accelerating cooperative actions among governments and stakeholders to mobilize knowledge and awareness. EDCs and EPPPs are not only important topics for global governance on chemicals. Policy advancements addressing EDCs and EPPPs are also applicable to and can be strengthened by the voluntary commitments of the 2023 UN Water Conference, negotiations for a new international treaty on plastics and a science-policy body on chemicals and wastes, and the implementation of the Global Biodiversity Framework (GBF), among other decision-making forums.

EDC and EPPP Risks

Historically, the risks and harms of pollution have not been prioritized in policy agendas commensurate with their impact on the health of people and planet. Worldwide consumption and production patterns have pushed the planetary boundary for environmental pollutants past sustainability while at least 5,000 novel chemicals produced since 1950 are recognized to have nearly universal human exposure. Pollution contributes approximately 17-25% of the environmental burden of disease, or about 9 million deaths per year. This is a fraction of the amount of its sub-lethal harms that lead to a wide spectrum of diseases, many of which are not recognized.

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IISD, 05-04-23

https://sdg.iisd.org/commentary/policy-briefs/integrating-policy-water-endocrine-disruptors-and-pharmaceuticals/

European Parliament Approves Bans of HFCs and HFOs in Multiple Applications and HFC Phase Out by 2050

2023-03-30

In an historic vote, the European Parliament adopted an ambitious position on the revision of the EU F-gas Regulation, supporting an HFC phase out by 2050 and multiple bans on fluorinated greenhouse gases (f-gases, both HFCs and HFOs) in applications such as heat pumps and stationary refrigeration.

In particular, in Annex IV – Placing on the market prohibitions on new system – a number of amendments banning f-gases, which were subject to fierce debate among political groups, were adopted.

In addition, the phase out of HFCs by 2050 takes the phase down of 80% to 85% between 2036 and 2047 in the Kigali Amendment to the Montreal Protocol to a more ambitious level.

Among 587 voting, 426 were in favor and 109 against with 52 abstentions.

However, the regulation is far from complete. Now the European Parliament will start negotiations with the European Council, which is expected to adopt its general position on the file next week. Following this, the Trialogue between the European Parliament, the Commission and the Council will begin. An agreement is expected to be reached before this summer.

Still, the considerable ambition of the Parliament's vote today suggests that the final revision of the Regulation will reflect significant changes in the use of refrigerants in the EU, with a major boost to natural refrigerants.

Read More

R744, 30-03-23

https://r744.com/european-parliament-approves-bans-of-hfcs-and-hfos-in-multiple-applications-and-hfc-phase-out-by-2050/

ECHA reviews extended one-generation reproductive toxicity studies and recommends good practices

2023-03-28

In a review of 55 extended one-generation reproductive toxicity (EOGRT) studies, ECHA confirms their effectiveness in identifying substances of concern.

Helsinki, 28 March 2023 – Since their implementation as a REACH information requirement in 2015, EOGRT studies have proven effective in identifying substances of concern. The studies help to clarify if a substance has adverse effects on sexual function, fertility, and development. The results can be used for classifying substances or supporting identification of endocrine disruptors and to protect parents and their offspring against the unwanted effects of these chemicals.

To optimise the design, conduct, analysis, and reporting of future EOGRT studies, ECHA has provided several recommendations of good practices for test laboratories and registrants. These include the need to describe the testing methodology in sufficient detail and to choose a test laboratory that is equipped to carry out the tests.

The review found that in 20% of evaluated EOGRT studies, dose levels for testing were too low, leading to difficulties in identifying hazards and the need for repeated testing. To address this issue which is common in different types of toxicity studies, ECHA has published advice for registrants on how to set appropriate dose levels.

To support test laboratories and registrants in conducting EOGRT testing, ECHA will organise a workshop later this spring.

Background

The extended one-generation reproductive toxicity study (EU B.56, OECD TG 443) is requested to provide information mainly on the sexual function and fertility, but it may also provide information on developmental toxicity and endocrine activity as well as effects on or through lactation and other toxicity.

Read More

ECHA, 28-03-23

https://echa.europa.eu/-/echa-reviews-extended-one-generation-reproductive-toxicity-studies-recommends-good-practices-1

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Chemical dose is too low in one fifth of Eogrts cases, Echa review finds

2023-03-28

One fifth of extended one-generation reproductive toxicity studies in Echa's Eogrts review have used chemical doses that are too low to identify potential hazards effectively, according to the final report, published today.

Low doses increase the risk of false negatives and "may render studies invalid", the report says. In some cases, a "re-run of the Eogrts might be needed to meet regulatory requirements", it adds.

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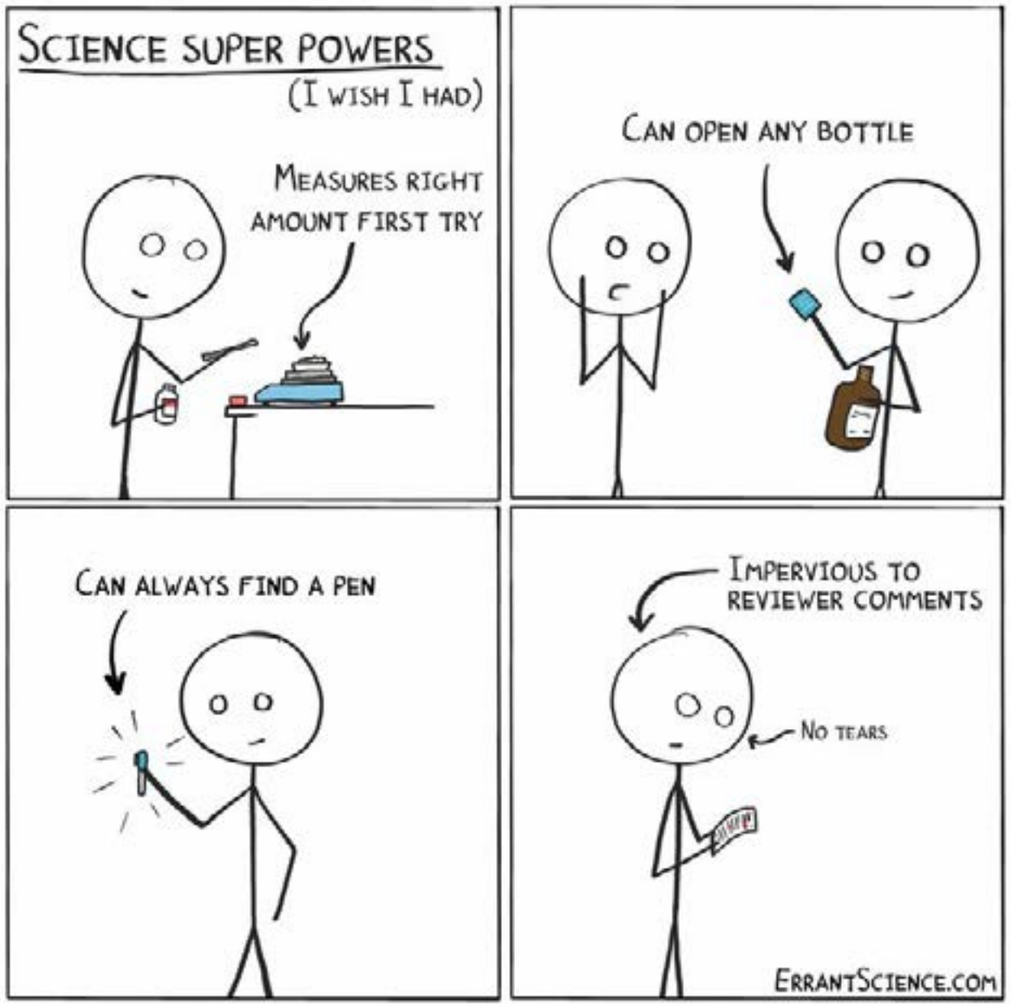
Chemical Watch, 28-03-23

https://chemicalwatch.com/712647/chemical-dose-is-too-low-in-one-fifth-of-eogrts-cases-echa-review-finds

Science Super Powers (I wish I had)

2023-04-14



twitter.com/ErrantScience/status/1616029129530294272

Acetamide

2023-04-14

Acetamide (IUPAC: ethanamide) is an organic compound with the formula CH_3CONH_2. It is the simplest amide derived from acetic acid. [1] It is a colourless, deliquescent hexagonal crystal. Acetamide is odourless when pure, but frequently has a mousy odour. It is soluble in water, alcohol, chloroform, glycerol, hot benzene, and slightly soluble in ether. Acetamide is combustible and when heated to decomposition, it emits toxic fumes of oxides of nitrogen. [2]

USES [2]

Acetamide is used in organic synthesis as a reactant, a solvent, and a peroxide stabiliser. It is also used as a general solvent, a hygroscopic agent, wetting agent, penetrating agent, in lacquers, in explosives, in soldering flux, as a solubiliser, and a plasticiser. Acetamide is also used in the manufacture of methylamine and the denaturing of alcohol.

SOURCES & ROUTES OF EXPOSURE

Sources of Exposure [3]

Occupational exposure to acetamide may occur for those workers in the plastics and chemical industries.

Routes of Exposure [2]

Probable routes of human exposure to acetamide are inhalation of vapours or dusts and dermal contact.

HEALTH EFFECTS [3]

Acute Effects

- Acetamide causes mild skin irritation in humans from acute exposure.
- Tests involving acute exposure of rats and mice have shown acetamide to have low to moderate acute toxicity from oral exposure.

Chronic Effects

- No information is available on the chronic effects of acetamide in humans or animals.
- The Reference Concentration (RfC) for acetamide is under review by EPA.

Acetamide (IUPAC: ethanamide) is an organic compound with the formula CH3CONH2.

- EPA has not established a Reference Dose (RfD) for acetamide.

Reproductive/Developmental Effects

- No information is available on the reproductive or developmental effects of acetamide in humans.
- Animal studies have not reported any significant developmental effects from exposure to acetamide.

Cancer Risk

- No information is available on the carcinogenic effects of acetamide in humans.
- Animal studies have reported liver tumours from oral exposure to acetamide.
- EPA has not classified acetamide for carcinogenicity.
- The International Agency for Research on Cancer (IARC) has classified acetamide as a Group 2B, possible human carcinogen.

SAFETY [4]

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. Cover the irritated skin with an emollient. Remove contaminated clothing and shoes. Cold water may be used. Wash clothing before reuse. Thoroughly clean shoes before reuse. Get medical attention.
- Serious Skin Contact: Wash with a disinfectant soap and cover the contaminated skin with an anti-bacterial cream. Seek medical attention.
- Inhalation: If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical attention.
- Ingestion: Do NOT induce vomiting unless directed to do so by medical personnel. Never give anything by mouth to an unconscious person. Loosen tight clothing such as a collar, tie, belt or waistband. Get medical attention if symptoms appear.

Fire & Explosion Information

- Acetamide may be combustible at high temperature.

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- Products of combustion include carbon oxides (CO, CO2) and nitrogen oxides (NO, NO2).
- Dry chemical powder should be use to extinguish small fires.
- Large fires should be extinguished with water spray, fog or foam. Do not use water jet.
- Acetamide is combustible and when heated to decomposition it emits toxic fumes.

Exposure Controls & Personal Protection

Engineering Controls

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

Personal Protective Equipment

The following personal protective equipment is recommended when handling acetamide:

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

Personal protective equipment 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

No occupational exposure limits have been set for acetamide. However, it may pose a health risk. Safe work practices should be followed when handling this substance.

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Not only are PFAS toxic — they're bad at their job when applied to furniture: Study

2023-04-04

The group of chemicals referred to as PFAS are known for their ability to repel water and stains from fabric, but a new study found that treatments containing PFAS had a low impact on protecting furniture fabrics and that the fabric type did more to prevent stains.

PFAS, also known as "forever chemicals," are a family of chemicals added to fabrics, non-stick cookware, food packaging and other consumer goods for their purported ability to repel water and oil. They contain a strong chemical bond that makes them difficult to break down. This persistence has made PFAS, short for per- and polyfluoroalkyl substances, a widespread environmental pollutant found in drinking water, the blood of about 97% of Americans and even wild polar bears. PFAS are endocrine-disrupting chemicals, meaning they can impact the body's hormones, and elevated levels of some PFAS have been linked to health concerns including kidney and testicular cancer, high cholesterol levels, low birth weights and decreased vaccine effectiveness in children, according to the Centers for Disease Control and Prevention.

"PFAS have been detected in the dust of homes," Jaime DeWitt, a professor of pharmacology and toxicology at East Carolina University who is unaffiliated with the study, told Environmental Health News (EHN). When textiles with PFAS coatings, including furniture, wear down they can release the toxics and increase exposure, she said.

In the new study, published today in the AATCC Journal of Research, scientists put PFAS fabric treatments to the test after hearing from textile manufacturers that the coatings might not be effective, Carol Kwiatkowski, an author on the study and science and policy senior associate at the Green Science Policy Institute, told EHN.

Coffee stains were easily cleaned from both PFAS-treated and untreated fabrics under varying levels of pressure, sit-times and fabric wear, meaning the PFAS coating provided no benefit. For fabrics with abrasion representing normal wear and tear, balsamic vinegar stains also impacted PFAS-treated and untreated fabrics equally.

The one scenario where PFAS-treatments outperformed untreated fabric was a balsamic vinegar stain under ideal conditions: no abrasion to the fabric, no pressure and a short sit-time. "Those are pretty unusual conditions," Kwiatkowski pointed out.

In many cases, the stain and water repellency of untreated furniture fabrics is compa-rable to treatments containing PFAS, commonly known as "forever chemicals."

"What really stood out is that the PFAS don't provide that protection in the long term," DeWitt said.

The most important variable for stain resistance was the type of fabric, Kwiatkowski explained. "That's a cost effective approach. We don't have to look for some new replacement for the PFAS," she said. Not using PFAS treatments and picking furniture with fabrics that naturally repel stains can be more impactful, the study shows.

Cutting PFAS exposure

The Environmental Protection Agency recently announced standards for six types of PFAS in drinking water that are "very low," said Kwiatkowski. She explained that manufacturing of PFAS and products that contain the toxic chemicals is a major source of drinking water contamination. Water treatment facilities will soon need to upgrade equipment to filter PFAS and find a way to dispose of it once collected. Meanwhile, workers and communities around manufacturing sites where PFAS are used face elevated levels of exposure that could lead to poor health outcomes, DeWitt said.

"We're spending all this time to clean up, but we're still adding more and more PFAS that are ending up in the water," Kwiatkowski said. "Why not stop it on the front end?"

It's important to think about what uses of PFAS are essential versus which are avoidable, DeWitt echoed. "This [study] doesn't tell us about every PFAS coated fabric that's out there," she said, "but it does suggest that the qualities that PFAS confer aren't really all that necessary, and in fact, don't outperform untreated fabrics."

Environmental Health News, 4 April 2023

https://enh.org

A new design that equips robots with proprioception and a tail

2023-04-07

Researchers at Carnegie Mellon University (CMU)'s Robomechanics Lab recently introduced two new approaches that could help to improve the ability of legged robots to move on rocky or extreme terrains. These two approaches, outlined in a paper pre-published on arXiv, are inspired by the innate proprioception abilities and tail mechanics of animals.

"We noticed that animals use their tails to assist their agile locomotion, but most robots do not have tails."

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"Our paper aims to bring legged robots from the ideal lab environments into real-world environments, where they may encounter challenging terrains such as rocky hills and curbs," Yanhao Yang, one of the researchers who carried out the study, told Tech Xplore. "To achieve this, we drew inspiration from both animals and engineering principles."

Many animals, including cats and other felines, are known to walk along their own footprints, as this allows them to ground themselves and maintain their stability on different terrains. Yang and his colleagues tried to replicate this behavior in robots, merging proprioception and motion planning techniques.

The techniques they used allow robots to "sense" the environment and move more reliably by gathering information about their own body's position, actions and location. This capability, known as "proprioception," overcomes the limitations of computer vision systems, which are known to be adversely impacted by sensor noise, obstacles in the environment, light reflections on nearby objects, and poor lighting conditions.

Animals and humans are innately born with proprioception, yet most existing robots make sense of their surrounding environment using the data provided by vision systems. Instead of using vision systems, which rely on cameras, lidar technology and other external sensors, Yang and his colleagues propose the use of data collected by sensors integrated inside the robot, such as motors, encoders and inertial measurement devices.

"This helps the robot detect when it slips or falls, and adjust its movements to avoid tipping over," Yang said. "The main advantage of this system is that it's more robust to environmental noise like obstacles, reflections, or lighting conditions. The challenge is to make correct control and planning decisions under uncertainty when the proprioception senses an accident."

In addition to their proposed proprioception system, the researchers created a computational model that allows robots to control an artificial tail, similarly to how animals move their tail when navigating environments. Many animals, including squirrels and cats, use their tail to keep their balance when jumping or hopping onto surfaces.

"We noticed that animals use their tails to assist their agile locomotion, but most robots do not have tails," Yang said "For example, cheetahs use their tails to achieve rapid acceleration, deceleration, and quick turns, while squirrels use their furry tails to balance when jumping between branches. We adapted this idea by adding a tail to our quadruped robots, which helps balance when the robot misses a foothold or falls off."

Yang and his colleagues also created a control system that allows a legged robot's artificial tail to work in coordination with its legs, helping it to retain its balance even when one or more of its legs are lifted off the ground. This can significantly improve the robot's navigation in rough or uneven terrains, while also maximizing its efficiency in narrow or small spaces.

Yang and his colleagues evaluated their motion planning approaches in a series of simulations. Their findings are highly promising, as their bio-inspired proprioception and tail control methods allowed simulated legged robots to reduce unexpected slips and falls, while also improving their ability to reliably move in extreme and changing terrains.

These new motion planning methods could be applied and tested on real legged robots, potentially allowing them to navigate challenging environments more reliably, reducing collisions and falls. This could make these robots better equipped to successfully complete search & rescue missions, environmental monitoring operations and other real-world tasks that entail moving on uneven or challenging terrains.

"One of our main goals for future research is to test our proposed method on actual hardware," Yang said. "This will be a challenge because we need to accurately estimate the state and contact information, which are crucial for the proprioception and control of the robot."

In their next works, Yang and his colleagues also plan to improve how their framework models and controls the tails of robots. This could further reduce collisions, including those between the tail and other parts of the robot's body or the environment.

"Another area of improvement is to extend the method to more complex terrains, such as narrow ravines or stepping stones," Yang added. "Currently, our approach assumes relatively simple terrain variations, but on more challenging terrains, the robot's legs may trip or hang. In these cases, our controller will still try to lower the robot's body to maintain stability, but we can further improve this by adding more events to the gait planning process."

Tech Xplore, 7 April 2023

https://techxplore.com

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Busted! Evidence of ritualistic drug use found at Bronze Age site

2023-04-06

Mandrake, henbane, thorn apple. The names alone conjure up images of witch's brews and secret rituals. In fact, new evidence points to the fact that plants like these were likely used about 3,000 years ago on the Spanish island of Menorca, to induce hallucinogenic states during ceremonies. A research team came to this conclusion by analyzing hair samples contained in a ritualistic box found in a sealed chamber inside a burial cave.

The researchers say that the cave, Menorca's Es Càrritx, was in use about 3,600 years ago and served as a ritual and funerary site for about 800 years. Inside the cave was a burial chamber in which 210 people were interred. Often after the burial ceremony, a cutting of the deceased's hair would be placed in a wood or horn container and laid beside the body.

The researchers say that the cave, Menorca's Es Càrritx, was in use about 3,600 years ago and served as a ritual and funerary site for about 800 years.

In the Es Carritx cave though, the researchers found a cache of hair-filled containers that had been hidden away deep in a different chamber inside the cave. These hair samples had been dyed red before having been placed in the storage vessels. The cache also included other items including a blade, a hairpin, a comb and a wooden bowl and spatula.

"By ca. 800 cal BCE, populations at the Balearic Islands underwent a transformation of its social structures," write the researchers. "Archaeological evidence points to demographic growth, abandonment of the burial places, and a slight decrease in extra-insular contacts. In this context, in the cave of Es Càrritx, some individuals reluctant to abandon ancient traditions, concealed a collection of ritual objects belonging to certain members of the community, possibly shamans, in the hope that the former social order could be re-established in the future. And the best location to assure the protection of the assemblage was found going deeper inside the burial ground of the ancestors."

The researchers, who hail from universities in Spain and Chile, analyzed some of the hair samples using two well-known techniques for revealing the chemical makeup of materials: High-Resolution Mass Spectroscopy and Ultra-High Performance Liquid Chromatography. They found that the hair strands included the chemical signatures of atropine, scopolamine, and ephedrine.

The first two of these are found in plants in the nightshade family, such as mandrake and henbane, and belong to a family of drugs

known as deliriants. They can dramatically alter perceptions and cause hallucinations, confusion, and, naturally, delirium. Ephedrine is a stimulant that comes from plants as well, including the joint pine.

Although traces of drugs have been found in vessels and on tools at other Bronze Age sites, the researchers say this is the first time that direct evidence of drugs inside the bodies of these ancient peoples has been found. They believe that because the hair clippings were only taken and dyed from certain individuals lends itself to the idea of honoring shamans, as there were no political or economic benefits conferred amongst members of Bronze Age communities.

They also say that the concentric circles on the containers might have been an attempt at drawing an eye to indicate the inner vision that can accompany the use of certain drugs.

A paper on the research has been published in the journal, Scientific Reports.

New Atlas, 6 April 2023

https://newatlas.com

This Dime-Sized Battery Is a Step Toward an EV With a 1,000-Mile Range

2023-04-06

Researchers at Argonne National Laboratory and the Illinois Institute of Technology have created a solid-state battery that could be used to vastly expand the range of EVs, and it could unlock the ability to use batteries on short-haul aircraft and heavy trucks.

But for now it's a lab-scale battery cell, about the size of a dime.

I spoke with two of the leaders of the research this week.

"I was doubtful in the beginning," said Larry Curtiss, a senior chemist at Argonne.

He has been at the lab for more than 40 years and knows from experience that initial results might not be repeatable. But he and his colleagues from the two Chicago-area institutions found that their work could be replicated, with the results published in February in the journal Science.

Before I go on, some battery basics:

Two Chicago-area institutions teamed up to develop a solid-state battery that packs a huge energy punch—one that could eventually even power airplanes.

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Most EVs today run on lithium-ion batteries. When the batteries are charging, ions flow from one side (the cathode) to the other side (the anode), and then reverse when discharging. The ions make this trip by passing through an electrolyte, which is a liquid or gel.

In solid state batteries, the electrolyte is solid, often a ceramic material. The overall battery can hold more electricity per unit of mass than current lithium-ion batteries for a variety of design reasons.

Automakers and battery manufacturers are working to develop solid-state batteries. They see the potential for longer ranges due to higher energy density, and the batteries would be safer because they are less flammable than current lithium-ion systems.

The design at Argonne and Illinois Tech is a version of a lithium-air battery, a category that has been around for about a decade but hasn't yet had a commercial breakthrough.

In this specific battery, the anode is made of a solid form of lithium. The "air" part comes from outside air that flows in through tiny holes in the cathode. Oxygen from the air reacts with lithium ions that have passed through the solid electrolyte. The electrolyte is made from a combination of ceramic and polymer materials—a solid that still allows for the passage of ions.

To understand what makes this battery different, it helps to know that in previous lithium-air batteries each oxygen molecule would react with one or two electrons.

In this new battery, each oxygen molecule reacts with up to four electrons.

Think of this like when you're unloading a trunkful of grocery bags from the car. It's a lot more efficient if you can carry four bags on each trip as opposed to one or two.

So why are the oxygen molecules in this battery reacting with more electrons? It's complicated, and the researchers are still in the process of answering that question. But the most likely answer is that the combination of materials results in an environment that cajoles the oxygen to have the four-electron reaction.

The real world implications of the technology are substantial, with the potential for batteries that could power an EV for 1,000 miles on a single charge. That's a lot, even when compared to other designs for solid state batteries, and it's three to four times more than most current EVs.

Mohammad Asadi, a chemical engineer at Illinois Tech, was another leader of the team that developed the battery and a co-author of the paper.

"It's all about the chemistry and energy density," he said about what makes this battery special.

For him, one of the most exciting aspects of this research is the potential to develop batteries for use in maritime transport and aviation. Those modes of transportation need so much energy that battery packs have been impractical because of the substantial size and weight that would be needed.

When looking at the potential for cars, the battery could be used for EVs with super long ranges, but I don't see that as the most practical use. A better use would be in helping to make EVs that have much smaller battery packs than today but can still have substantial ranges. This would reduce a car's weight and its cost.

But this is early stage research that's probably a decade or so away from hitting the market, if it ever hits the market. One of the initial challenges would be turning the lab-scale cell into a prototype, which would be about 100 times larger.

In the meantime, automakers and battery manufacturers are just a few years from releasing the first cars with solid state batteries.

Toyota said last year that it would have a solid-state battery by 2025, but it would be in a gas-electric hybrid as opposed to an all-electric vehicle. The decision not to build an EV is a head-scratcher, but it is in line with Toyota's continuing fondness for hybrids.

Every major automaker is working on solid-state batteries, either in-house or through partnerships with battery manufacturers like QuantumScape and Solid Power. The plans vary, but they point toward having a few EVs with the batteries on the market within about five years, and having a lot more on the market in the early 2030s.

Nissan set a goal two years ago to ramp up solid state battery production at a pace to begin selling an EV with the technology by 2028, and a company executive said last month that the company is on track to hit that goal.

But there also is some skepticism about the prospects and timetables. The chairman of CATL, the global leader in EV battery market share, said last month that his company was having a difficult time developing a solid-

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state battery. China-based CATL is a supplier for Tesla, among others, and it has been able to expand its battery ranges and reduce costs while still using liquid electrolytes.

The rush of development activity by the auto industry, and the continuing research at places like Argonne and Illinois Tech, shows the promise of solid-state batteries to help make EVs much more attractive to consumers.

In the near future, EVs are likely to be less expensive than equivalent gasoline vehicles, and EVs should be able to travel for longer on a single charge than gasoline models can go on a single tank.

Or, as Curtiss puts it, solid-state batteries "can make the cars cheaper as well as go farther."

Inside Climate News, 6 April 2023

https://insideclimatenews.org

Researchers Discover How Too Much Oxygen Can Cause Lasting Health Problems in Humans

2023-04-09

Scientists have discovered why elevated levels of oxygen can result in enduring health issues in humans.

When it comes to oxygen, you can have too much of a good thing. Breathing air with oxygen levels higher than the standard 21 percent found in Earth's atmosphere can lead to organ damage, seizures, and even death in both humans and animals. This is known as oxygen toxicity, or hyperoxia, and occurs when there is an excess of oxygen beyond the body's needs. While scientists have been aware of this phenomenon, they have mostly relied on speculation to understand the underlying mechanisms of oxygen toxicity until now.

A recent study by Gladstone Institutes has revealed how excessive oxygen levels alter certain iron and sulfur-containing proteins within our cells, similar to the process of iron rusting. As a result, these "rusty" proteins trigger a chain reaction that causes damage to cells and tissues. The research, which has been published in the journal Molecular Cell, shed light on the implications for conditions like heart attacks and sleep apnea.

"This study allowed us to put together a very specific timeline for what happens in hyperoxia," says Gladstone Assistant Investigator Isha Jain, PhD, senior author of the new study. "The results weren't at all what we were expecting, but it's very interesting and exciting to now know how this sequence of events unfolds."

An Understudied Question

At high levels, oxygen is toxic to every form of life, from bacteria and plants to animals and people. Of course, not enough oxygen is also fatal; there's an intermediate, "Goldilocks" amount under which most life on Earth thrives—not too much and not too little.

While clinicians have long studied the details of how oxygen shortage impacts cells and tissues (for example, in heart attacks and strokes), the effects of excess oxygen have been relatively understudied.

"For many years, the medical teaching was that, to a certain degree, more oxygen was better, or at least benign, when treating patients with conditions such as heart attacks," says Alan Baik, MD, a postdoctoral scholar in Jain's lab and a cardiologist at UC San Francisco (UCSF). "But there has now been a growing number of clinical studies showing that excess oxygen actually leads to worse outcomes. This motivated us to better understand why excess oxygen can be toxic."

Studies have recently revealed, for instance, that breathing too much supplemental oxygen might be detrimental to heart attack patients and premature infants. Similarly, in obstructive sleep apnea, the sudden bursts of oxygen that follow pauses in breathing have been shown to be a key component of how the disorder increases patients' risks of chronic health problems.

Still, the mechanisms of these effects remained murky. Many researchers assumed that reactive oxygen species—unstable and highly reactive oxygen derivatives that can damage our genome and many molecules in our cells—likely played a role in hyperoxia, but there was little evidence to demonstrate how excess oxygen affects specific enzymes and pathways.

How CRISPR Found the Answer

Jain's group—including Baik, postdoctoral fellow Galih Haribowo, Ph.D., and graduate student Kirsten Xuewen Chen, who are co-first authors of the new paper—turned to the genome editing technology CRISPR to test the roles of a variety of genes in hyperoxia.

Using CRISPR, the researchers removed, one at a time, more than 20,000 different genes from human cells grown in the lab and then compared the growth of each group of cells at 21 percent oxygen and 50 percent oxygen.

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"This kind of unbiased screen let us probe the contributions of thousands of different pathways in hyperoxia rather than just focusing on those we already suspected might be involved," says Jain, who is also an assistant professor of biochemistry at UCSF. "It led us toward molecules that have never been uttered before in the same sentence as oxygen toxicity."

Four molecular pathways stood out in the screen as being involved in the effects of hyperoxia. They related to diverse cellular functions including the repair of damaged DNA, the production of new DNA building blocks, and the generation of cellular energy.

Protein Clusters in Common

At first, the team couldn't pinpoint what the four pathways had in common and why they were all impacted by high oxygen levels. It took some molecular sleuthing to discover that each pathway had a critical protein that contained iron atoms connected to sulfur atoms—so-called "iron-sulfur clusters"—in its molecular structure.

The researchers went on to show that, in as little as 30 percent oxygen, the iron-sulfur clusters in the four proteins become oxidized—they chemically react with oxygen atoms—and that change causes the proteins to degrade. As a result, cells stop functioning correctly and consume even less oxygen, causing a further increase in oxygen levels in the surrounding tissues.

"One important takeaway is that hyperoxia is not impacting cells and tissues solely through reactive oxygen species, as many had assumed," says Jain. "That means the use of antioxidants—which can combat reactive oxygen species to some degree—is unlikely to be sufficient to prevent oxygen toxicity."

Sci Tech Daily, 9 April 2023

https://scitechdaily.com

Study reveals that pollution can cause lung cancer in thousands of non-smokers

2023-04-06

In recent years, oncologists have faced a growing phenomenon that they don't know how to explain: more and more people develop lung cancer without ever smoking. Such patients make up about 15% of all cases.

A new study indicates one of the causes: the tiny particles suspended in polluted air. The work analyzes the levels of 2.5 micra particles (PM 2.5) — the tiniest ones in the fuel combustion smoke— and the incidence of lung cancer in 33,000 non-smokers in the United Kingdom, Canada, South Korea and Taiwan. The authors focus on people with mutations in the EGFR gene, a marker of lung cancer in people who have never smoked or have done so very sporadically. The results show a clear association between air pollution levels and the appearance of tumors.

"The study demonstrates a new paradigm for how cancer appears," says oncologist Charles Swanton, researcher at London's Francis Crick Institute and the main author of the study, which scientists from Europe, Asia and North America participated in.

Until now, it was thought that cancerogenic agents in the environment damaged DNA, producing mutations, and that genetic changes provoked the later development of tumors. But the new study demonstrates that particles in the air cause cancer in healthy people who happen to have mutations that predispose them to lung cancer, like EGFR.

The study indicates that just three years of breathing polluted air can cause the incidence of lung cancer in non-smokers to take off. In Europe, according to the European Union, 96% of the urban population is exposed to levels of PM 2.5 particles above the recommendations by the World Health Organization.

Swanton emphasizes the importance of the findings, published in the magazine Nature. "Air pollution kills eight million people every year around the world. Some of those are people who have never smoked but have the EGFR mutation," he explains. In Europe, they make up about 15% of patients, but in Asia the percentage can reach 75%. "It's the first time that it's been shown that a carcinogenic compound can lead to cancer without causing mutations. We think this is just the beginning. It's very possible that the other 19 known carcinogenic compounds generate tumors via similar mechanisms," he adds.

The researchers demonstrated in mice that fine particles provoke inflammation of the respiratory system, which leads to lung tumors in patients with mutations that predispose them to cancer.

Esteve Fernández, a lung cancer expert and researcher at the Catalan Oncology Institute, explains that PM 2.5 particles "penetrate the lungs, pass through the bronchioles and reach the bloodstream." "They have a diameter of 2.5 micras, while epithelial cells are about 10 micras. So

The analysis of more than 30,000 patients in Europe, America and Asia suggests that fine particles cause tumors.

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their effect is like throwing stones at a person," he says. Though it was already known that air contamination provokes thousands of deaths via cardiovascular accidents and cancer, the researcher believes that the study reveals key details about the particles' role in causing cancer. "With this information, governments and companies should feel more responsibility and understand that their actions have a price on health," he says.

Mariano Provencio, lung cancer expert and oncologist at the Puerta de Hierro Hospital of Madrid, says, "There was already consensus about how pollution affects lung cancer in non-smokers. This demonstrates it." "The study opens new possibilities, like detecting people who have the EGFR or KRAS mutations, which increase their risk of suffering the illness if they're exposed to pollution," he adds.

Luis Paz-Ares, director of the lung cancer unit at the National Center of Oncological Research in Spain, explains another conclusion from the new study. Researchers have demonstrated in rats that fine particles cause the immune system to generate inflammation, which leads to tumors. The inflammatory protein interleukin-1 beta is key in that process. Scientists have demonstrated that blocking the molecule can stop the appearance of lung tumors. "There is an experimental drug called canakinumab that blocks interleukin-1 beta. In a study with more than 10,000 patients, the drug showed a significant reduction in lung cancer, which was unexpected as it was developed to prevent myocardial heart attacks," Paz-Ares explains. "This opens the door to anti-inflammatory treatments to prevent lung cancer," she adds.

Laura Mezquita, spokesperson for the Spanish Society of Medical Oncology, believes that the work supports a "paradigm shift" regarding lung cancer. Although 85% of lung tumors are due to tobacco, "not everything can be attributed to that." "What the study demonstrates is that, if you have two lungs, you have a risk of lung cancer even if you don't smoke and have a healthy lifestyle, because you can't escape pollution. Reducing that risk factor depends on the authorities. And the most important thing is that risk factors add to each other, like, for example, smoking and living in a big city with a lot of pollution," she explains.

The geneticist at the Clinical Hospital of Barcelona gives a caveat to the new work. It is very difficult to know if those patients' tumors were caused by pollution or other environmental factors. For example, radon gas is the second-greatest carcinogenic agent after tobacco. It is not yet clear how to calculate its effects on these patients.

Swanton's group wants to go on to study other external factors, like the impact of alcohol on esophageal cancer or obesity's effect on different types of tumors. "We have an enormous field to explore," he says.

El País, 6 April 2023

https://elpais.com

New Hope for Those Living With Paralysis: Nerve Stimulation Therapy Could Allow Patients To Regain Arm Function

2023-04-08

A promising nerve stimulation therapy has been developed at Columbia University's Vagelos College of Physicians and Surgeons, which has shown positive results in animal studies. This therapy has the potential to restore arm function in individuals with spinal cord injuries, offering a new hope for those affected by this debilitating condition.

"The stimulation technique targets the nervous system connections spared by injury," says Jason Carmel, MD, Ph.D., a neurologist at Columbia University and NewYork-Presbyterian who is leading the research, "enabling them to take over some of the lost function."

The findings were recently published in the journal Brain.

A personal quest to develop treatments for people with paralysis

In 1999, when Carmel was a second-year medical student at Columbia, his identical twin brother suffered a spinal cord injury, paralyzing him from the chest down and limiting the use of his hands.

Carmel's life changed that day, too. His brother's injury ultimately led Carmel to become a neurologist and a neuroscientist, with the goal of developing new treatments to restore movement in people living with paralysis.

In recent years, some high-profile studies of spinal cord electrical stimulation have allowed a few people with incomplete paralysis to begin to stand and take steps again.

Carmel's approach is different because it targets the arm and hand and because it pairs brain and spinal cord stimulation, with electrical stimulation of the brain followed by stimulation of the spinal cord. "When the two signals converge at the level of the spinal cord, within about 10

Damage from a spinal cord injury can result in a loss of movement, sensation, and other bodily functions below the site of the injury.

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milliseconds of each other, we get the strongest effect," he says, "and the combination appears to enable the remaining connections in the spinal cord to take control."

In his latest study, Carmel tested his technique—called spinal cord associative plasticity (SCAP)—on rats with moderate spinal cord injuries. Ten days after injury, the rats were randomized to receive 30 minutes of SCAP for 10 days or sham stimulation. At the end of the study period, rats that received SCAP targeted to their arms were significantly better at handling food, compared to those in the control group, and had near-normal reflexes.

"The improvements in both function and physiology persisted for as long as they were measured, up to 50 days," Carmel says.

The findings suggest that SCAP causes the synapses (connections between neurons) or the neurons themselves to undergo lasting change. "The paired signals essentially mimic the normal sensory-motor integration that needs to come together to perform skilled movement," says Carmel.

From mice to people

If the same technique works in people with spinal cord injuries, patients could regain something else they lost in the injury: independence. Many spinal cord stimulation studies focus on walking, but "if you ask people with cervical spinal cord injury, which is the majority, what movement they want to get back, they say hand and arm function," Carmel says. "Hand and arm function allows people to be more independent, like moving from a bed to a wheelchair or dressing and feeding themselves."

Carmel is now testing SCAP on spinal cord injury patients at Columbia, Weill Cornell, and the VA Bronx Healthcare System in a clinical trial sponsored by the National Institute of Neurological Disorders and Stroke. The stimulation will be done either during a clinically indicated surgery or noninvasively, using magnetic stimulation of brain and stimulation of the skin on the front and back of the neck. Both techniques are routinely performed in clinical settings and are known to be safe.

In the trial, the researchers hope to learn more about how SCAP works and how the timing and strength of the signals affect motor responses in the fingers and hands. This would lay the groundwork for future trials to test the technique's ability to meaningfully improve hand and arm function.

Looking further ahead, the researchers think that the approach could be used to improve movement and sensation in patients with lower-body paralysis.

In the meantime, Jason Carmel's twin is working, married, and raising twins of his own. "He has a full life, but I'm hoping we can get more function back for him and other people with similar injuries," says Carmel.

Sci Tech Daily, 8 April 2023

https://scitechdaily.com

Turn Back Time: Lifestyle Program Reverses Biological Age

2023-04-05

A new research paper published in the journal Aging examines the impact of a special diet/lifestyle program.

A case series of six women who underwent a methylation-supportive diet and lifestyle program, aimed at affecting DNA methylation and measures of biological aging, was reported on by researchers Kara N. Fitzgerald, Tish Campbell, Suzanne Makarem, and Romilly Hodges. These researchers are associated with the Institute for Functional Medicine, Virginia Commonwealth University, and the American Nutrition Association.

"The modifiable lifestyle intervention used by participants in this case series was first investigated in a pilot clinical trial in which participants (all men between the ages of 50-72 years) reduced their biological age by an average of 3.23 years as compared to controls. The case series reported on herein was conducted to further the investigation of a modifiable lifestyle intervention that was largely the same in other populations; importantly in women."

The team carried out an intervention consisting of an eight-week program. This program included guidance on diet, sleep, exercise, and relaxation, supplemental probiotics and phytonutrients, and nutritional coaching. DNA methylation and biological age analysis (Horvath DNAmAge clock (2013), normalized using the SeSAMe pipeline) were conducted on blood samples at baseline and at the end of the eight-week period.

Five of the six participants exhibited a biological age reduction of between 1.22 and 11.01 years from their baseline biological age. There was a statistically significant (p=.039) difference in the participants' mean biological age before (55.83 years) and after (51.23 years) the 8-week

The data suggest "that a methylation-supportive diet and lifestyle intervention may favorably influence biological age in both sexes during middle age and older."

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diet and lifestyle intervention, with an average decrease of 4.60 years. The average chronological age at the start of the program was 57.9 years and all but one participant had a biological age younger than their chronological age at the start of the program, suggesting that biological age changes were unrelated to disease improvement and instead might be attributed to underlying aging mechanisms.

"This case series of women participants extends the previous pilot study of this intervention in men, indicating that favorable biological age changes may be achievable in both sexes. In addition, the investigation of otherwise-healthy individuals, rather than those with diagnosed disease, suggests an influence directly on underlying mechanisms of aging instead of disease-driven aging."

Sci Tech Daily, 5 April 2023

https://scitechdaily.com

Potent Greenhouse Gases and Ozone Depleting Chemicals Called CFCs Are Back on the Rise Following an International Ban, a New Study Finds

2023-04-03

Emissions of a small group of chlorofluorocarbons (CFCs), man-made chemicals that destroy Earth's protective ozone layer and fuel global warming, are back on the rise after their production was all but banned more than a decade ago, a new study concludes.

Emissions of the vast majority of CFCs have steadily declined since countries phased out production and use of the pollutants in 2010 under an international environmental treaty known as the Montreal Protocol. However, emissions of a subset of five CFCs have risen since the ban took effect, according to the study, published Monday in the journal Nature Geoscience.

The study did not determine the source of emissions, but suggested that manufacturing of hydrofluorocarbons (HFCs), chemical refrigerants that replaced CFCs and other ozone depleting chemicals, may be to blame, because at least some of the CFCs detected in the atmosphere are permitted byproducts in the manufacture of HFCs, which are produced primarily in China and the United States.

At current levels, the increasing CFC emissions will have little impact on the ongoing recovery of the atmospheric ozone layer, which protects the

A U.S. chemical plant may be partly to blame for increased emissions of CFCs—chemicals thousands of times more potent at warming the planet than carbon dioxide.

planet from harmful ultraviolet radiation. The ozone hole over Antarctica is on track to be fully restored by 2066.

However, the chemicals' climate impact may be of greater concern. Emissions of the five chemicals–CFC-13, CFC-112a, CFC-113a, CFC-114a and CFC-115—equaled 47 million metric tons of carbon dioxide emissions in 2020 alone, according to the study. That is equal to the annual greenhouse gas emissions from 10 million cars or 13 coal-fired power plants, according to the EPA's greenhouse gas equivalency calculator.

"Any delay to Antarctic ozone hole recovery will only be very small, but they are still quite potent greenhouse gases," said the study's lead author, Luke Western, a researcher at the University of Bristol in the United Kingdom and the National Oceanic and Atmospheric Administration in the U.S.

The five CFCs that were monitored in the current study are thousands of times more effective at warming the atmosphere than carbon dioxide on a pound for pound basis. However, their atmospheric concentrations are quite low compared to CO2, the primary driver of climate change.

Total annual emissions for all CFCs are down by approximately 95 percent from their peak in the late 1980s, when countries first began a mandatory phase out of their production and use under the Montreal Protocol, Western said.

If the sources of ongoing CFC emissions can be found and eliminated, it could have a significant impact on greenhouse gas emissions reductions in the near term while countries continue to work on the larger challenge of reducing emissions of carbon dioxide and other greenhouse gases, Western said.

"It has the potential to be an easy win," he said.

Three of the five pollutants—CFC-113a, CFC-114a and CFC-115—are unwanted byproducts formed during the production of HFC-125, and "may account for at least some of the observed emissions," Western and colleagues wrote in the study. HFC-125 is one of two ingredients in R-410A, a widely used chemical refrigerant for air conditioners.

While production and use of CFCs are banned under the Montreal Protocol, their creation is allowed if they are unwanted by-products in the manufacturing of other chemicals. CFCs can be eliminated through incineration, but such pollution control measures are not required

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under the Montreal Protocol, which grants exemptions for their required elimination in the case of byproduct emissions.

Previous studies have identified "eastern China or the Korean Peninsula" as a source of emissions for two of the five pollutants, CFC-113a and CFC-115, and noted that eastern China is a leading producer of HFC-125. Production of HFC-134a, another chemical commonly used as a refrigerant and produced in large quantities in China, may also be a source of CFC emissions according to the current study.

"It makes sense that we link some of these things to China," Western said. "China is a huge chemical producer."

Western added, however, that HFC production in China is "not enough to explain the entire global picture."

A chemical plant owned by chemical manufacturer Honeywell in Geismar, Louisiana, is likely the largest producer of HFC-125 outside of China. In 2003, Honeywell announced the opening of a $100 million chemical plant that, at the time, was the "largest production facility of HFC-125 in the world."

The plant's HFC-125 production capacity when it opened was 20,000 metric tons per year, according to a 2002 report prepared for the World Bank. The U.S. International Trade Commission confirmed that, as of 2021, Honeywell continued to produce HFC-125 and was the sole U.S. producer of the chemical. "The R-125 equipment at its Geismar, Louisiana, plant cannot be used to produce other [chemical] components," the commission said.

The study noted that an estimated 205,000 metric tons of HFC-125 was produced globally in 2020. If Honeywell's Geismar plant is producing at full capacity, its annual production would account for approximately 10 percent of global HFC-125 production.

Honeywell did not respond to multiple requests from Inside Climate News for information about its HFC-125 production and any potential CFC emissions from its Geismar plant. The company does report the use of "thermal oxidizers" to destroy fluorinated gases at its Geismar facility, but it is not clear if the pollution controls are used to destroy any of the CFCs mentioned in the current study, and, if so, the extent to which those chemicals are eliminated.

Federal regulations do not require chemical producers to destroy unwanted byproduct CFC emissions. The EPA's Greenhouse Gas Reporting

Program, which provides detailed emissions data on a wide number of the gases, does not note the release of any CFCs from Honeywell's Geismar plant. The agency did not immediately respond to questions about whether they require companies to report CFC emissions and, if not, why CFCs are not included in their greenhouse gas reporting requirements.

Any CFC emissions from HFC production in the U.S. should begin to decline sometime over the next decade. The U.S. and other developed countries must reduce HFC production and use by 85 percent by 2036 under a recent update to the Montreal Protocol. China and other developing countries are required to reduce HFCs by 80 percent by 2045.

But before HFC production decreases, it will likely continue to increase, Western said. "For the next decade, we'll likely still see an increase in production of HFCs or many HFCs at least," he said.

Stephen Andersen, director of research at the Institute for Governance and Sustainable Development, said that countries should accelerate the phase down of HFCs as the chemicals are potent greenhouse gases in their own right and their breakdown can result in the formation of "forever chemicals." At the same time, Andersen said the Montreal Protocol should tighten or eliminate current exemptions for things like CFC emissions from HFC production.

As a party to the Montreal Protocol, the U.S. government could play a key role in eliminating remaining exemptions for CFC emissions, Andersen said.

"Everyone knows how to do this," Andersen said. "They're just not motivated enough to do it."

Inside Climate News, 3 April 2023

https://insideclimatenews.org

A gold pill could be our superbug secret weapon

2023-04-10

There's no underselling the role antibiotics has had on our lives; when widespread use of penicillin ushered in the 'golden age' of antibiotics after World War II, and discovery of many new antibiotics, the infectious diseases that used to be massive killers seemed a thing of the past. Prior to the 20th century, the average life expectancy in the US was 47. As of 2021, it was 76.4.

The future path of antibiotics may be paved in gold.

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However, given that bacteria is the oldest form of life on earth, it's no surprise it's been able to fight back. Helping this is its dazzling ability to reproduce, meaning that any microbes that evolve to be resistant to drugs can quickly dominate a population, rendering the antibiotic ineffective.

The latest promising research on fighting these stubborn, smart superbugs is, quite simply, gold. Presenting their novel research in Copenhagen this week, researchers from the Barcelona Institute for Global Health found very promising results when they lined up 19 gold compounds against several types of multidrug-resistant bacteria isolated from patients.

With its antibacterial properties, it's not the first time the precious mineral has been touted as a potential life-saver, with research into gold nanoparticles on their own, and also combined with infrared light treatments, to fight off infections.

Metalloantibiotics – compounds with a gold ion at their core – has the potential to kill bacteria and prevent its adaptation to form resistance.

"Gold complexes use a variety of techniques to kill bacteria," said Sara Soto Gonzalez of the Barcelona institute. "They stop enzymes from working, disrupt the function of the bacterial membrane and damage DNA."

The team tested the gold compounds against bugs including Methicillin-resistant Staphylococcus aureus (MRSA), Staphylococcus epidermidis, Pseudomonas aeruginosa; Stenotrophomonas maltophilia, Acinetobacter baumannii and bacterial pneumonia.

There was evidence of high efficacy against MRSA and S. epidermis in 16 of the 19 compounds, and 16 were effective in fighting gram-negative bacteria – the types with the greatest resistance to current antibiotics.

"It is particularly exciting to see that some of the gold complexes were effective against MRSA and multidrug-resistant A. baumannii, as [these are the} two biggest causes of hospital-acquired infections," Soto Gonzalez said. "With research on other types of gold metalloantibiotics also providing promising results, the future is bright for gold-based antibiotics."

While in a preliminary study stage, the researchers point out that development of this kind of antibiotic would be neither expensive nor difficult.

"The type of gold complexes we studied, known as gold (III) complexes, are relatively straightforward and inexpensive to make," Soto Gonzalez

added. "They can also be easily modified and so provide a vast amount of scope for drug development."

The new research paper will be presented at the European Congress of Clinical Microbiology and Infectious Diseases in Copenhagen between April 15-18.

New Atlas, 10 April 2023

https://newatlas.com

Pig blood and cobra venom used to increase human lung transplant viability

2023-04-04

Medical researchers at Vanderbilt University Medical Center, Nashville, have found a way to maintain donor lung viability for transplantation. The method was even shown to return viability to transplant tissues that would otherwise have been deemed too damaged to use. The technique could substantially increase the ratio of donor-to-recipient transplants, saving lives and speeding access to treatment.

In the paper, "Immune characterization of a xenogeneic human lung cross-circulation support system," published in Science Advances, the researchers detail how they kept lungs viable for 24 hours.

In the introduction of the paper, the authors point to the low rate of donated lung use, citing estimates that only around 25% of lungs taken from donors make it to recipients. The study references time as the main obstacle, as even the best lung preservation methods have just a six-hour window for the transplant to take place. Beyond this time frame, the lungs begin to acquire damage that makes them ill-suited for the already difficult task of implantation in another human.

Pig blood to the rescue

The researchers developed a cross-circulation method of connecting the circulatory system of a living pig to the removed donor lungs. The method is not unlike what takes place during some open-heart surgeries, where a blood donor's circulatory system is connected to that of the patient providing oxygenated blood in a real-time transfusion.

The researchers showed that their method not only works to keep the viability window open longer but also supports the viability and functional recovery of human donor lungs that would otherwise be declined for transplantation.

While the lungs were healthy enough for a transplant, another problem presented itself. There is already a strong donor rejection response in transplant recipients, and the pig-blood-preserved lungs were found to be rich in cellular infiltrates and deposits of pig antibodies.

Cobra venom will make it better

Researchers neutralized the pig blood deposited immunoglobulin in the lungs using cobra venom factor, a nontoxic protein in the venom

The researchers showed that their method not only works to keep the viability window open longer but also supports the viability and functional recovery of human donor lungs.

from the cobra species Naja kaouthia. Previous research has found that this cobra venom component protein is a much more stable analog of a protein found in the human immune system. Where the human version (complement C3) lasts for a few minutes at most, the cobra venom factor remains stable for several hours, making it ideal for this application. Still, having piggy antibodies in donor tissue is not ideal.

After 24 hours of the xenogeneic cross-circulation, donor lungs maintained the preservation of global architecture and showed improvements in appearance and recruitment of consolidated segments. The lungs actually improved in overall viability for transplant over time, the opposite of what is seen in typical transplant preservation techniques.

Future research will look to improve upon this impressive proof of concept. One possible direction the authors are interested in is the possibility that genetically immunodeficient pigs could be developed for the express purpose of being transplant chaperones to avoid the antibody intrusion issue.

Medical Xpress, 4 April 2023

https://medicalxpress.com

Spider, silkworm silk combined to create new nerve-repairing material

2023-04-03

Current methods for repairing injured nerves can be hit-and-miss and are restricted to repair over short distances. For the first time, researchers have combined two kinds of silk to create a promising biocompatible method of regenerating injured nerves over longer distances.

Peripheral nerves send messages from the brain and spinal cord to the rest of the body to, for example, move your muscles when you walk or let you know that your feet are cold. Peripheral nerves are easily damaged, interrupting the brain's ability to communicate with muscles and organs.

The standard treatment for repairing an injured peripheral nerve is an autograft, where surgeons excise the damaged section and replace it with a nerve from elsewhere in the body. The graft nerve is taken from a sensory nerve, usually the sural nerve, that provides sensation to an area of the skin where sensation is not vital. But the success rate of nerve grafts can be hit-and-miss.

Peripheral nerves are easily damaged, interrupting the brain's ability to communicate with muscles and organs.

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Nerve guides, the tubular structures sutured to both ends of a severed nerve to bridge the gap, have been around for about 30 years. However, they can only be used to bridge small gaps. Currently, FDA-approved nerve guides are restricted to short-distance nerve defects of up to 1.2 in (3 cm). Longer distances require an internal framework that provides the requisite structural and cellular support.

Enter researchers from the University of Oxford and the Medical University of Vienna, who've created a novel nerve guide by combining two different kinds of natural silk taken from silkworms (Bombyx mori) and golden orb weaving spiders (Trichonephila edulis) that has the potential to regenerate nerves over longer distances.

Previous studies have demonstrated the benefits of using silk as a biomaterial. Silkworm cocoon silk is composed of fibroin and sericin proteins. Both are biocompatible, elastic, and tough. Silk fibroin has been shown to induce wound healing by increasing cell proliferation and growth. Dragline silk from the orb weaving spider has remarkable mechanical properties, including high tensile strength and flexibility.

For the first time, the researchers combined the features of silk fibroin reconstituted into tubes and natural spider silk filaments to create a silk-in-silk conduit. The conduit wall was made from silkworm silk fibroin, filled with orb weaving spider dragline silk fibers that acted as an internal guiding structure, kind of like a handrail for the nerves.

The nerve guide was tested on rats whose right sciatic nerves had been severed, resulting in a significant gap of 0.4 in (10 mm). The researchers found that the damaged nerves adapted to the silk nerve guides and grew along the silk threads, successfully reconnecting the severed endings.

"In our study, it turned out that peripheral nerves function well when such threads are made of silk, with spider silk apparently being preferred for the guide rails," said Lorenz Semmler, first author of the study.

The researchers also gained a greater understanding of the molecular structure of the silkworm silk tubes, finding that their porosity allows for the exchange of nutrients and waste products that is vital to the healing process. Moreover, the cells that are responsible for nerve regeneration were seen to adhere to both types of silk.

"As part of our study, we not only succeeded in nerve repair, we were also able to analyze the components of the healing process in detail," Semmler said.

Using natural materials for nerve guides has obvious advantages over synthetic substances. Spider silk is biodegradable and produces only a very small immune response in animal models. It's also scalable. A single harvest from an orb weaving spider can yield around 33 ft (10 m) of silk, enough to fill a 0.4 in (10 mm) long nerve guide. The porous nature of silkworm silk could allow for the incorporation of bioactive molecules to promote nerve regeneration over longer distances.

"Animal silks offer exceptional mechanical and biological properties and versatile manufacturing possibilities to assist the re-engineering of tissue," said Fritz Vollrath, a co-author of the study. "Our advanced silk-in-silk nerve guides combine the excellent ability fo silkworm silk to be processed into three-dimensional structures with the outstanding cell adhesion qualities of spider dragline silk."

The researchers hope that their discovery will pave the way for the development of "off-the-shelf" nerve guides to treat peripheral nerve injuries in humans.

The study was published in the journal Advanced Healthcare Materials.

New Atlas, 3 April 2023

https://newatlas.com

Elephants may be domesticating themselves

2023-04-03

Elephants are the gentle giants of the animal kingdom. They will often empathetically reach out their trunks to console a distressed sister or attempt to lift up those that are ill and suffering. They recognize the bones of deceased elephants and appear to mourn their dead. They also recognize themselves in mirrors—a sign they're self-aware. These traits may have evolved because elephants have domesticated themselves, according to a study published today in the Proceedings of the National Academy of Sciences. If so, that would make them the only known animal besides humans and bonobos to have done so. But not everyone sees it as an open-and-shut case.

Proving that any animal, let alone elephants, has self-domesticated is a challenge, says Richard Wrangham, a Harvard University primatologist who was not involved in the new study. Yet he and evolutionary anthropologist Brian Hare of Duke University have long held that self-domestication—a phenomenon where wild animals develop traits that are similar to domesticated animals—must be "widespread," Wrangham says,

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Find would put pachyderms in a rare group that only includes humans and bonobos

perhaps found in numerous species from mice to whales and elephants. Showing it in pachyderms would bolster that argument.

Most of us are familiar with the outward signs of domestication: a tamer personality and babylike features. Domesticated animals also tend to have smaller brains than their wild counterparts. By all of these metrics, dogs, cats, and pigs easily qualify.

But in each of these cases, humans played a direct role. Our ancestors favored (either consciously or unconsciously) desirable traits that became engrained over thousands of years. Not so with humans ourselves.

Studies have shown that over the past 80,000 years, our faces have shortened and our brow ridges and brains have shrunk. These changes accelerated about 10,000 years ago after the invention of agriculture. Perhaps because of a greater need for cooperative males, highly aggressive males were eliminated, researchers like Wrangham have suggested. Via self-domestication, we lengthened our childhoods, came to prefer more gregarious men (and to dislike bullies), and increased our ability to communicate and share complex ideas with language.

Since then, researchers have shown something similar in one of our closest relatives, bonobos. Close cousins of chimpanzees, bonobos are far less aggressive, have softer and rounder facial features, and a much-celebrated love of sex (they use it not just for mating, but also to make friends and soothe social conflicts) that Wrangham and Hare point to as clear signs of self-domestication. Certainly, humans were not involved in the process. But via natural selection and an abundance of food, more aggressive males were weeded out in favor of those with milder temperaments, helping to create a more peaceful society, Hare has theorized.

Other examples of self-domestication in the animal kingdom have proven elusive—until now. In the new study, Limor Raviv, an evolutionary linguist at the Max Planck Institute for Psycholinguistics, and colleagues plowed through the scientific literature, looking for species besides bonobos that showed features of being domesticated, but had limited historical contact with humans.

Only elephants—all three species (African savanna and forest elephants, as well as Asian elephants)—qualified. Like humans and bonobos, these species have low levels of aggression, and violence within and among groups is relatively rare, the researchers assert. They exhibit "increased prosociality"—going out of their way to protect and comfort others. And like humans (but not bonobos), their cortisol levels—the primary stress

hormone—rise when the animals face socially difficult situations, such as mass deaths from poaching or culling. In all, the researchers documented 19 cognitive, behavioral, and physiological traits common to humans, bonobos, and elephants, but not other species.

Next, the team drilled into the genome of African elephants, finding 674 genes that appear to be evolving rapidly. They compared these genes with a set of 764 genes others have identified as important to mammal domestication, such as those involved with sociality and the management of aggression. Their analysis revealed that several of the 674 genes were associated with domestication.

It's not yet clear what types of environmental pressures might have led elephants to develop traits that we associate with domestication, Raviv says. But she speculates that their massive size alone helps protect them from possible predators. "They can be slightly less concerned and more relaxed."

"It's nice to see the correlations with bonobos and humans and the genetic similarities tied to the reduction of aggression," says Melinda Zeder, an emeritus archaeologist and domestication expert at the Smithsonian Institution. But she's still skeptical of the self-domestication idea in general, arguing it is a "meaningless term that muddies the waters." For her, domestication requires "two to tango"—a domesticator and a domesticate.

Wrangham agrees that the study reveals some hints of self-domestication in elephants. "The preliminary genetic evidence is promising," he says. The work, he adds, supports a prediction that he and others have made that self-domestication is likely to be more prevalent in the animal kingdom than many researchers had assumed.

Still, Wrangham argues that many of the behavioral traits the researchers saw may simply be due to elephants' large brains, not necessarily to self-domestication. The authors "need to consider alternate hypotheses," he says.

As such, he says, more work will need to be done before scientists add elephants to the exclusive club that seemingly only humans and bonobos belong to. "I fear we are a long way from being able to say elephants are self-domesticated."

Science, 3 April 2023

https://science.org

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The big idea: will fusion power save us from the climate crisis?

2023-04-03

One look at your energy bills this winter might have convinced you that the 1950s idea that electricity would, in the near future, become "too cheap to meter" was not so much a false promise as a sick joke. That over-excited claim was prompted by hopes that nuclear fusion – the process triggered in an uncontrolled manner in hydrogen bombs – would soon be harnessed for power generation. In the type of nuclear power we have today, disintegration of radioactive atoms such as uranium produces heat but also a troublesome legacy of radioactive waste that will stay active for millennia. Fusion power plants would instead generate energy using the same process that powers the sun: fusing of the dense nuclei of hydrogen atoms, releasing some of the formidable energy held in the atomic nucleus, with only helium as the byproduct, and without the pollution.

Today the allure of fusion energy lies not so much in its price as its almost negligible carbon emissions, and therefore its potential to save us from the ravages of global heating. But will it arrive in time to stop the planet frying?

Recent breakthroughs have been wildly hyped – but there's still reason to hope.

There are plenty of uncertainties and unknowns around fusion energy, but on this question we can be clear. Since what we do about carbon emissions in the next two or three decades is likely to determine whether the planet gets just uncomfortably or catastrophically warmer by the end of the century, then the answer is no: fusion won't come to our rescue. But if we can somehow scramble through the coming decades with makeshift ways of keeping a lid on global heating, there's good reason to think that in the second half of the century fusion power plants will gradually help rebalance the energy economy.

Perhaps it's this wish for a quick fix that drives some of the hype with which advances in fusion science and technology are plagued. Take the announcement last December of a "major breakthrough" by the National Ignition Facility (NIF) of the Lawrence Livermore National Laboratory in California. The NIF team reported that, in their efforts to develop a somewhat unorthodox form of fusion called inertial confinement fusion (ICF), they had produced more energy in their reaction chamber than they had put in to get the fusion process under way.

Problem solved? Sadly not. As NIF scientists readily admitted, the energy generated by super-intense laser needed to spark fusion was less than

a hundredth of the total amount of energy consumed by the lasers themselves. So they still have to do about a hundred times better to break even. And that's even before factoring in the energy losses in converting the heat created by fusion into electricity. What's more, the hi-tech pellets containing special forms of hydrogen used as fuel each cost more than $100,000, whereas a working ICF reactor would need to burn up 10 pellets a second at a cost of less than $1 each.

ICF has so far been little studied as a source of energy anyway; NIF's principal mission is to study nuclear reactions in order to help maintain the US stockpile of atomic weapons. Most work on fusion energy uses a different approach called magnetic confinement, in which the fuel – at temperatures of around a hundred million degrees, several times hotter than the centre of the sun and fiery enough to melt any material instantly – is suspended by magnetic fields, typically in a large doughnut-shaped chamber called a tokamak.

Making and operating such a device raises eye-watering engineering challenges, with which fusion scientists and technicians have been grappling for decades. Many current hopes are pinned on the International Thermonuclear Experimental Reactor (Iter) being built in southern France. As the name suggests, Iter won't be a power plant – it is strictly an experimental facility, its goal being to solve some of the engineering problems so that we can work out what a commercial fusion plant should look like.

The construction of Iter's massive tokamak started in 2013 (the project itself began in 1988) – but the facility is already way over budget (the current estimated cost is €20bn) and behind schedule. When a further delay in Iter was announced in January – it might not switch on until 2035 or so – some cynics wheeled out the old saw that fusion is perpetually just 20 years away. But such setbacks are to be expected when you consider the magnitude of what's being attempted: to make a piece of a star on Earth.

Not all of the fusion eggs are in this one basket. The EU is planning a smaller prototype plant called Demo. Another, called Sparc, is now being built in Massachusetts in a collaboration between MIT and the private fusion company Commonwealth Fusion Systems. China, Japan and Russia have their own plans, and there are several dozen private companies worldwide with ambitious goals.

All the same, most fusion experts believe we'll be lucky to have a prototype plant producing a net gain by 2040, and it's unlikely that fusion

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energy will be going into the grid in significant amounts before 2050. When fusion start-ups announce that they'll have a working reactor generating power within a decade, it's a message for investors, not a realistic promise. These companies will have their part to play – not as the plucky underdogs who crack the problem but as providers of parts and expertise in the fusion industrial ecosystem. All the same, some researchers worry that over-promising could foster complacency that stymies investment in the urgently needed stopgap alternatives to fossil fuels, such as renewables and nuclear fission.

The Soviet fusion pioneer Lev Artsimovich once said that humankind would have fusion energy "when society needs it". In one sense he was sadly mistaken: we needed it years ago, before the lethal heatwaves, the wildfires, the shrinking ice caps. But it's not too much to hope that we will have it before we make the planet uninhabitable, and that it can eventually turn the climate crisis into a catastrophe averted. Cynicism about fusion is cheap, but the progress is undeniable, and even exciting – so long as we keep it in perspective.

The Guardian, 3 April 2023

https://theguardian.com

Decoding Aspirin: New Research Unveils the Secrets Behind Its Powerful Effects

2023-04-08

Understanding how aspirin reduces inflammation could lead to alternatives with fewer side effects.

New research has revealed important information about how aspirin works. Even though this drug has been available commercially since the late 1800s, scientists have not yet fully elucidated its detailed mechanism of action and cellular targets. The new findings could pave the way to safer aspirin alternatives and might also have implications for improving cancer immunotherapies.

Aspirin, which is a nonsteroidal anti-inflammatory drug, is one of the most widely used medications in the world. It is used to treat pain, fever, and inflammation, and an estimated 29 million people in the U.S. take it daily to reduce the risk of cardiovascular diseases.

Scientists know that aspirin inhibits the cyclooxygenase enzyme, or COX, which creates messenger molecules that are crucial in the inflammatory

Although aspirin's inhibition of the cyclooxygenase enzyme (COX) is known, its detailed cellular targets have remained unclear.

response. Researchers led by Subhrangsu Mandal, a professor of chemistry and biochemistry at the University of Texas at Arlington, have discovered more about this process.

Prarthana Guha, a graduate student in Mandal's lab, presented the team's findings at Discover BMB, the annual meeting of the American Society for Biochemistry and Molecular Biology, March 25–28 in Seattle. Avisankar Chini also made significant contributions to the study.

"Aspirin is a magic drug, but long-term use of it can cause detrimental side effects such as internal bleeding and organ damage," Mandal said. "It's important that we understand how it works so we can develop safer drugs with fewer side effects."

The team found that aspirin controls transcription factors required for cytokine expression during inflammation while also influencing many other inflammatory proteins and noncoding RNAs that are critically linked to inflammation and immune response. Mandal said this work has required a unique interdisciplinary team with expertise in inflammation signaling biology and organic chemistry.

They also showed that aspirin slows the breakdown of the amino acid tryptophan into its metabolite kynurenine by inhibiting associated enzymes called indoleamine dioxygenases, or IDOs. Tryptophan metabolism plays a central role in the inflammation and immune response.

"We found that aspirin downregulates IDO1 expression and associated kynurenine production during inflammation," Mandal said. "Since aspirin is a COX inhibitor, this suggests potential interplay between COX and IDO1 during inflammation."

IDO1 is an important target for immunotherapy, a type of cancer treatment that helps the body's immune system seek out and destroy cancer cells. Because COX inhibitors modulate the COX–IDO1 axis during inflammation, the researchers predict that COX inhibitors might also be useful as drugs for immunotherapy.

Mandal and his team are now creating a series of small molecules that modulate COX–IDO1 and will explore their potential use as anti-inflammatory drugs and immunotherapeutic agents.

Sci Tech Daily, 8 April 2023

https://scitechdaily.com

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Electrifying Discovery: A Way Earth's Atmosphere Cleans Itself

2023-04-09

Researchers have discovered a new mechanism that creates hydroxide (OH) through a strong electric field at the surface between airborne water droplets and surrounding air, which can help the atmosphere clear itself of pollutants and greenhouse gases. This finding challenges previous beliefs and could significantly change air pollution models.

Human activities emit many kinds of pollutants into the air, and without a molecule called hydroxide (OH), many of these pollutants would keep aggregating in the atmosphere.

How OH itself forms in the atmosphere was viewed as a complete story, but in new research published on April 3 in Proceedings of the National Academy of Sciences, a research team that includes Sergey Nizkorodov, a University of California, Irvine professor of chemistry, report that a strong electric field that exists at the surface between airborne water droplets and the surrounding air can create OH by a previously unknown mechanism.

It's a finding that stands to reshape how scientists understand how the air clears itself of things like human-emitted pollutants and greenhouse gases, which OH can react with and eliminate. "You need OH to oxidize hydrocarbons, otherwise they would build up in the atmosphere indefinitely," said Nizkorodov.

"OH is a key player in the story of atmospheric chemistry. It initiates the reactions that break down airborne pollutants and helps to remove noxious chemicals such as sulfur dioxide and nitric oxide, which are poisonous gases, from the atmosphere," said Christian George, an atmospheric chemist at the University of Lyon in France and lead author of the new study. "Thus, having a full understanding of its sources and sinks is key to understanding and mitigating air pollution."

Before, researchers assumed that sunlight was the chief driver of OH formation.

"The conventional wisdom is that you have to make OH by photochemistry or redox chemistry. You have to have sunlight or metals acting as catalysts," Nizkorodov said. "What this paper says in essence is you don't need any of this. In the pure water itself, OH can be created spontaneously by the special conditions on the surface of the droplets."

New research has found that a strong electric field at the surface between airborne water droplets and the surrounding air can create hydroxide (OH) through a previously unknown mechanism.

The team built on research from Stanford University scientists led by Richard Zare that reported spontaneous formation of hydrogen peroxide on the surfaces of water droplets. The new findings help interpret the unexpected results from the Zare group.

The team measured OH concentrations in different vials – some containing an air-water surface and others containing only water without any air – and tracked OH production in darkness by including a "probe" molecule in the vials that fluoresces when it reacts with OH.

What they saw is that OH production rates in darkness mirror those and even exceed rates from drivers like sunlight exposure. "Enough of OH will be created to compete with other known OH sources," said Nizkorodov. "At night, when there is no photochemistry, OH is still produced and it is produced at a higher rate than would otherwise happen."

The findings, Nizkorodov reported, alter understanding of the sources of OH, something that will change how other researchers build computer models that attempt to forecast how air pollution happens.

"It could change air pollution models quite significantly," Nizkorodov said. "OH is an important oxidant inside water droplets and the main assumption in the models is that OH comes from the air, it's not produced in the droplet directly."

To determine whether this new OH production mechanism plays a role, Nizkorodov thinks the next step is to perform carefully designed experiments in the real atmosphere in different parts of the world.

But first, the team expects the results to make a splash in the atmospheric research community.

"A lot of people will read this but will not initially believe it and will either try to reproduce it or try to do experiments to prove it wrong," said Nizkorodov. "There will be many lab experiments following up on this for sure."

He added that UCI is a prime place for such science to continue happening, because other labs at UCI, like that of Ann Marie Carlton, professor of chemistry, focus their efforts on the role water droplets play in the atmosphere.

Sci Tech Daily, 9 April 2023

https://scitechdaily.com

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Quantum computers can't teleport things—yet

2023-04-07

Last November, a group of physicists claimed they'd simulated a wormhole for the first time inside Google's Sycamore quantum computer. The researchers tossed information into one batch of simulated particles and said they watched that information emerge in a second, separated batch of circuits.

It was a bold claim. Wormholes—tunnels through space-time—are a very theoretical product of gravity that Albert Einstein helped popularize. It would be a remarkable feat to create even a wormhole facsimile with quantum mechanics, an entirely different branch of physics that has long been at odds with gravity.

And indeed, three months later, a different group of physicists argued that the results could be explained through alternative, more mundane means. In response, the team behind the Sycamore project doubled down on their results.

Their case highlights a tantalizing dilemma. Successfully simulating a wormhole in a quantum computer could be a boon for solving an old physics conundrum, but so far, quantum hardware hasn't been powerful or reliable enough to do the complex math. They're getting there very quickly, though.

It's almost impossible to simulate a good wormhole without more qubits.

The root of the challenge lies in the difference of mathematical systems. "Classical" computers, such as the device you're using to read this article, store their data and do their computations with "bits," typically made from silicon. These bits are binary: They can be either zero or one, nothing else.

For the vast majority of human tasks, that's no problem. But binary isn't ideal for crunching the arcana of quantum mechanics—the bizarre rules that guide the universe at the smallest scales—because the system essentially operates in a completely different form of math.

Enter a quantum computer, which swaps out the silicon bits for "qubits" that adhere to quantum mechanics. A qubit can be zero, one—or, due to quantum trickery, some combination of zero and one. Qubits can make certain calculations far more manageable. In 2019, Google operators used Sycamore's qubits to complete a task in minutes that they said would have taken a classical computer 10,000 years.

There are several ways of simulating wormholes with equations that a computer can solve. The 2022 paper's researchers used something

called the Sachdev–Ye–Kitaev (SYK) model. A classical computer can crunch the SYK model, but very ineffectively. Not only does the model involve particles interacting at a distance, it also features a good deal of randomness, both of which are tricky for classical computers to process.

Even the wormhole researchers greatly simplified the SYK model for their experiment. "The simulation they did, actually, is very easy to do classically," says Hrant Gharibyan, a physicist at Caltech, who wasn't involved in the project. "I can do it in my laptop."

But simplifying the model opens up new questions. If physicists want to show that they've created a wormhole through quantum math, it makes it harder for them to confirm that they've actually done it. Furthermore, if physicists want to learn how quantum mechanics interact with gravity, it gives them less information to work with.

Critics have pointed out that the Sycamore experiment didn't use enough qubits. While the chips in your phone or computer might have billions or trillions of bits, quantum computers are far, far smaller. The wormhole simulation, in particular, used nine.

While the team certainly didn't need billions of qubits, according to experts, they should have used more than nine. "With a nine-qubit experiment, you're not going to learn anything whatsoever that you didn't already know from classically simulating the experiment," says Scott Aaronson, a computer scientist at the University of Texas at Austin, who wasn't an author on the paper.

If size is the problem, then current trends give physicists reason to be optimistic that they can simulate a proper wormhole in a quantum computer. Only a decade ago, even getting one qubit to function was an impressive feat. In 2016, the first quantum computer with cloud access had five. Now, quantum computers are in the dozens of qubits. Google Sycamore has a maximum of 53. IBM is planning a line of quantum computers that will surpass 1,000 qubits by the mid-2020s.

Additionally, today's qubits are extremely fragile. Even small blips of noise or tiny temperature fluctuations—qubits need to be kept at frigid temperatures, just barely above absolute zero—may cause the medium to decohere, snapping the computer out of the quantum world and back into a mundane classical bit. (Newer quantum computers focus on trying to make qubits "cleaner.")

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Some quantum computers use individual particles; others use atomic nuclei. Google's Sycamore, meanwhile, uses loops of superconducting wire. It all shows that qubits are in their VHS-versus-Betamax era: There are multiple competitors, and it isn't clear which qubit—if any—will become the equivalent to the ubiquitous classical silicon chip.

"You need to make bigger quantum computers with cleaner qubits," says Gharibyan, "and that's when real quantum computing power will come."

For many physicists, that's when great intangible rewards come in. Quantum physics, which guides the universe at its smallest scales, doesn't have a complete explanation for gravity, which guides the universe at its largest. Showing a quantum wormhole—with qubits effectively teleporting—could bridge that gap.

So, the Google users aren't the only physicists poring over this problem. Earlier in 2022, a third group of researchers published a paper, listing signs of teleportation they'd detected in quantum computers. They didn't send a qubit through a simulated wormhole—they only sent a classical bit—but it was still a promising step. Better quantum gravity experiments, such as simulating the full SYK model, are about "purely extending our ability to build processors," Gharibyan explains.

Aaronson is skeptical that a wormhole will ever be modeled in a meaningful form, even in the event that quantum computers do reach thousands of qubits. "There's at least a chance of learning something relevant to quantum gravity that we didn't know how to calculate otherwise," he says. "Even then, I've struggled to get the experts to tell me what that thing is."

Popular Science, 7 April 2023

https://popsci.com

EPA announces rules curbing cancer-causing pollution from chemical plants

2023-04-06

For decades, residents living near large petrochemical facilities in the nation's industrial corridors have struggled to secure even a basic understanding of the health risks that they face. These Americans have asked the government for monitoring devices to measure the quality of the air they breathe, and environmental advocates have demanded formal health assessments that account for the full spectrum of industrial

The agency claims the proposed rules will result in a 96% reduction in the population facing cancer risk from 200 polluters.

emissions in their neighborhoods, rather than ones that only examine pollution sources in isolation. The Environmental Protection Agency has long failed to develop a robust response to these calls — until now.

Standing behind a podium in Louisiana's St. John the Baptist Parish on Thursday, EPA Administrator Michael Regan announced a proposal to cut more than 6,000 tons of toxic air pollution a year, as well as vastly reduce the number of people exposed to cancer-causing chemicals such as ethylene oxide and benzene. (For comparison, industrial facilities in the U.S. released some 32,000 tons of cancer-causing chemicals in 2021).

The rules affect roughly 200 chemical plants across the nation's industrial landscape, many of which are concentrated near communities of color in Texas and Louisiana and have evaded environmental laws in recent years. These are some of the most toxic plants in the nation, together releasing millions of pounds of cancer-causing pollutants each year, sometimes mere feet from schools and residential neighborhoods.

The Wednesday press conference marks Regan's second visit to the town of LaPlace, where residents have spent the past six years fighting a synthetic rubber manufacturer owned by the Japanese chemical giant Denka. In February, the federal government sued the company for its emissions of the highly toxic chemical chloroprene in the vicinity of a predominantly Black elementary school.

In perhaps the most significant innovation introduced in the new rules, the EPA conducted a "community risk assessment" to inform residents of the consequences of the proposed regulations — the first time it has ever done so. Typically, when the agency measures a community's health risk from toxic air pollution, it examines industrial sites in isolation. It's an approach that fails to account for the true threat to public health in communities hosting multiple pollution sources and, according to numerous studies, has put millions of Americans at a greater risk of developing cancer simply by breathing.

The agency's most recent analysis, however, examined cancer risks from all large facilities within six miles of the plants affected by the proposed rules. It found that roughly 104,000 people within these areas are exposed to a level of cancer risk that the agency considers unacceptable. If the proposed rules take effect, the analysis found that they would reduce the number of people exposed to unacceptable cancer risks in these communities by 96 percent.

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"I pledged to prioritize and protect the health and safety of this community and so many others that live in the shadows of chemical plants," Regan said Wednesday. "I'm proud that this proposal would help deliver on that commitment."

The roughly 200 facilities targeted by the new rules release toxic chemicals from a variety of sources. Flares, which companies use to burn off chemical byproducts, are a key culprit. The proposed rules require facilities to increase the efficiency of flares, ensuring that smaller amounts of toxic chemicals are released into the air. The EPA is also proposing stricter standards for other sources of emissions such as storage tanks, process vents, and leaks from equipment.

In order to assess whether the new regulations are in fact reducing emissions, the agency is requiring that facilities using, producing, storing, or emitting one of six toxic chemicals — including ethylene oxide and chloroprene — conduct air monitoring at the edges of their properties. This fenceline monitoring data is expected to be posted to a public website. If facilities detect levels above thresholds set by the EPA, they'll be required to identify the source of the emissions and reduce it. (Currently, only companies operating petroleum refineries are required to monitor the air on their industrial sites, and they exclusively measure benzene concentrations.)

The EPA found that the biggest risk reductions would result from curbing emissions from just eight plants in Texas and Louisiana that are particularly large ethylene oxide emitters.

The agency estimated that it will cost polluters roughly $1.6 billion to comply with the rules. It did not calculate a monetary value for the health benefits of reduced exposure to ethylene oxide, chloroprene, benzene and the other toxic chemicals that the rules target. However, the EPA estimated that reductions in ozone levels and volatile organic compounds would decrease health costs by more than $700 million.

"Toxic air pollution from petrochemical facilities has been poisoning communities, especially the many low-income areas and communities of color that live in the shadow of these facilities," said Dionne Delli-Gatti, an associate vice president at the nonprofit Environmental Defense Fund, in a press release. "EPA's proposal includes vital measures to reduce toxic petrochemical pollution, to hold polluters accountable, and to protect the people who have borne the brunt of the health threats from this pollution."

The rules now face a long road before they can be finalized and take effect. Once the proposals are posted in the Federal Register, the EPA will accept written comments from the public for 60 days. The agency is then required to consider the comments and update the rules based on feedback before finalizing them. Along the way, it may also face legal challenges from industry groups.

The American Chemistry Council, a trade group that represents a number of the facilities affected by the rule, has previously challenged the agency's assessment of the risk posed by ethylene oxide. In 2016, the EPA found that ethylene oxide is 30 times more toxic for adults than previously estimated, and it set the safe threshold for exposure to ethylene oxide at 11 parts per trillion. The Council has supported values around 2.4 parts per billion — orders of magnitude weaker than the EPA figure. As a result, the trade group has argued that it's inappropriate for the agency to use the stricter ethylene oxide risk value when developing the rules proposed Thursday.

Congress asked the EPA to write these rules when it amended the Clean Air Act in 1990 to stop acid rain and tighten regulations on businesses that emit cancer-causing chemicals. The rules cover just two of more than 150 different categories of facilities across the nation's industrial landscape. While it could take the agency years to comparably strengthen rules for other types of pollution sources, advocates heralded the EPA's announcement as an important precedent-setting measure.

"The protections that these new EPA rules propose for the petrochemical sector are long overdue," said Jane Williams, chair of the Sierra Club National Clean Air Team, in a press release. Passing rules that protect communities in the nation's industrial corridors "renews the promise that Congress gave to the American people in 1990 when the Clean Air Act Amendments were enacted," she added.

Grist, 6 April 2023

https://grist.org

Plastics touching our food may be making us gain weight

2023-04-07

When it comes to keeping off extra pounds, watching what we eat may not be enough – we have to keep an eye on our food's packaging, too.

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Rates of obesity among US adults have increased from 14% in 1980 to 42% today, and half the world is expected to be overweight or obese by 2035, with children and teens facing the sharpest increase in obesity and its consequences. Because data doesn't support the idea that overeating and lack of exercise are squarely to blame, the scientific community is exploring other factors that may contribute – including metabolic disruption caused by eating products packaged in plastic.

For a study published last year, researchers at the Norwegian University of Science and Technology set out to determine what chemical compounds exist in 34 common plastic items that touch things we eat, such as yogurt cups, juice bottles, styrofoam meat trays, gummy-candy packages, and plastic wrap used for produce and cheese, as well as items often found in kitchens, like polyurethane placemats and sponges.

Of the 55,000 chemicals the researchers found in these items, only 629 were identifiable, with 11 being known metabolic disruptors such as phthalates and bisphenols, which interfere with our bodies' ability to regulate weight, among other troubling health effects. However, when exposed to in vitro human cell cultures (studies have not used human or animal test subjects), far more chemicals than the identified 11 metabolic disruptors triggered adipogenesis – the process underlying obesity, in which cells proliferate and accumulate an excess of fat.

"[W]e're quite certain [that] there are many chemicals in plastic products that disrupt metabolism, but we just couldn't identify all of them," Martin Wagner, a study co-author said. Strikingly, Wagner and his colleagues found that a third of all the common products they tested contain chemicals that trigger the adipogenic process. Although we are exposed to them daily, most of these mystery chemicals are unknown, unstudied and unregulated.

Plastics are made when chemical compounds from refined fossil fuels are mixed with various other, often toxic, chemicals to promote desired characteristics like flexibility and water resistance. We now understand that chemicals don't just stay put in the material but can leach from packaging into our food. This March, scientists at McGill University proved that the carcinogenic and obesogenic bisphenol BPS, found in food labels such as produce stickers, can "migrate through packaging materials into the food people eat", Stéphane Bayen, an associate professor of food science and agricultural chemistry, said in a release. For years, experts have been cautioning against plastic food containers, particularly for hot or

Hormone-disrupting chemicals are entering our bodies. We eat 44lbs of plastic in our lifetimes

oily foods which can render the plastics unstable and increase the risk of chemical leaching.

The scientists I speak to frequently argue that we need to start reducing our exposure to plastic without waiting for more slow-moving research to unequivocally prove that the plastics in our food, products, blood and organs are risk factors for bad health outcomes. Wagner is no exception. While he cannot make a causal link between metabolism-disrupting chemicals in plastic and the obesity epidemic, "How much evidence do we need before we do something right?" Wagner asks.

There is potentially positive news from the Norwegian study: while some plastic products carried chemicals that made fat cells proliferate, other similar products did not. For instance, PET, the transparent plastic used mainly for water bottles, doesn't contain metabolism-disrupting chemicals and is in fact relatively chemically simple. Some polystyrene styrofoam fruit trays had an obesogenic effect on cell cultures, but others didn't.

That means some plastic producers, whether intentionally or not, are making less harmful forms of plastic. If industry manufacturers were transparent about the entire suite of chemicals present in their products, consumers could choose plastics with safer formulations and better overall industry safety standards could be developed.

Really, reducing our plastic exposure should be our overall goal; the FDA's approach to regulating chemicals used in food packaging has been described by experts as "woefully outdated", and there's a chance that even plastic producers are not sure what chemicals end up in the products they make. But it's clear that these plastics and the chemicals associated with them are making their way into our bodies – by transference from packaging, but also in the form of microplastics, with humans eating an estimated 44lbs of plastic in our lifetimes.

When we think about cutting junk out of our diets, the culprits shouldn't just be candy and soda – plastic needs to go, too.

The Guardian, 7 April 2023

https://theguardian.com

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Lunar laws could protect the moon from humanity

2023-04-10

On Earth, we've decided that some places are worth saving. Whether it's the pyramids of Giza or the battlefield lands at Gettsyburg, sites that epitomize our cultural heritage are safeguarded by legal frameworks.

But human history extends beyond our planet. In 1969, astronaut Neil Armstrong became the first human to walk on the moon and left behind that first footprint. Some view it as comparable to any archeological site on Earth—without the same protections. Undisturbed, the footprint could last for a million years. But a revived interest in the moon means the lunar surface is about to be busier than ever. No law specifically defends the footprint or sites like it from being run over by a lunar rover or astronauts on a joyride.

"Just in this year alone, we have four or five missions planned," says Michelle Hanlon, a space lawyer and co-founder of the nonprofit For All Moonkind. "Not just from nations, but from private companies." While some upcoming lunar expeditions will be flybys, others will actually land on the moon.

Some space law experts want to treat the moon like a national park. Here's why.

In some ways, it's a race against the clock—and Hanlon is making moves. On March 27, while attending a meeting of the legal subcommittee of the United Nations Committee on the Peaceful Uses of Outer Space (COPUOS), she announced the creation of the For All Moonkind Institute on Space Law and Ethics. This new nonprofit organization will go beyond advocating for protecting off-world heritage sites and contemplate the ethics around some activities in space that are not fully covered in existing international law.

There is some precedent to lunar law. The Outer Space Treaty of 1967 governs activities in outer space and sets important boundaries: Anything but peaceful use of the moon is prohibited, and nations are not allowed to claim territory on the satellite or any celestial body.

The Outer Space treaty is also quite vague, according to Christopher Johnson, a space lawyer with the Secure World Foundation, a nonprofit dedicated to space sustainability. You can use resources in space but not appropriate them. In addition, you must give other nations and companies "due regard" and avoid "harmful contamination" of the extraterrestrial environment.

However, these general principles have never been applied to solving practical problems. "We are realizing that we just have a couple of broad dictums," Johnson says. "You know, be nice to your neighbor, observe the golden rule, show people a little bit of respect."

Because these rules have not really been tested, Johnson says we can't be sure people will follow them. The experiment is about to begin: India and Russia plan to launch their unscrewed Chandrayaan 3 and Luna 25 missions to the lunar surface this summer, for instance, while Japanese company iSpace hopes to place a lander on the lunar surface in late April. SpaceX aims to ferry a billionaire customer around the moon in a Starship vehicle by year's end.

It was with an eye on increasing human activity on and around the moon that Hanlon co-founded For All Moonkind in 2017, an all-volunteer organization dedicated to lobbying for legal protections for areas of cultural heritage on the moon and elsewhere in space. That includes the Apollo program landing sites and the lunar landers left behind by the Soviet Union. These protections could eventually extend to natural wonders like Olympus Mons, the largest volcano on Mars and in the solar system.

Together with For All Moonkind, the Secure World Foundation produced a Lunar Policy Handbook, which they distributed at the United Nations in Vienna during the For All Moonkind Institute announcement at the end of March. Both For All Moonkind and the Secure World Foundation are official observer organizations at COPUOS and are allowed to sit in on meetings.

The new institute and the handbook represent a modern interest among policymakers, space lawyers, and private companies to create clearer rules of the road for how humans will actually behave on the moon when there are multiple parties present around the same time. These are issues Johnson says policymakers need to be wary of and that they should think through the precedents that could be set by actions that are not necessarily against international law but might not be a good idea.

"This is why we created the Institute on Space Law and Ethics because there are people who want to know what it means to be responsible," Hanlon says. "The problem is we don't have a blueprint for that."

Johnson points to the 2019 crash landing of the Israeli Beresheet lunar lander as an example, where unknown to the other parties of the mission, the nonprofit Arch Mission Foundation had included freeze-dried tardigrades, also known as water bears, in the payload. Tardigrades

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are hardy and known to be able to survive in the vacuum of space, so their spilling onto the lunar surface could present a form of biological contamination, although some follow-up research suggests the microscopic creatures did not survive the violent impact.

"Smuggling tardigrades to the moon doesn't seem to clearly violate any international law that I can point to," Johnson says. "The ethical component steps in to fill a gap about the law to say, 'Well, is it a good idea?'"

Protecting cultural heritage sites like the Apollo landing sites, on the other hand, could actually be interpreted as violating the probation on claiming territory in space, according to Hanlon. That's why For All Mankind is involved in discussions around the ethics of lunar activity generally, she says. The hope is that—if the world's nations can agree that there's significant, shared cultural heritage on the moon—the aftereffect could be better relations between major players in the current space race.

"The ultimate goal is a new treaty, not an amendment to the Outer Space Treaty, that recognizes cultural heritage beyond Earth," Hanlon explains. "It's going to be a long time, especially now with the Russian invasion of Ukraine, for us to all agree on something here at the UN. But we think it can start with that heritage, that kinship that way."

Or as US President Lyndon Johnson put it when signing the Outer Space Treaty, we "will meet someday on the surface of the moon as brothers and not as warriors."

Popular Science, 10 April 2023

https://popsci.com

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Contact Allergy to Shellac. Retrospective Cross-Sectional Study With Data From the Spanish Registry of Research in Contact Dermatitis and Cutaneous Allergy (REIDAC)

A dynamic inventory database for assessing age-, gender-, and route-specific chronic internal exposure to chemicals in support of human exposome research

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Insight into mixed chlorine/chloramines conversion and associated water quality variability in drinking water distribution systems

Impacts of hydraulic fracturing wastewater from oil and gas industries on drinking water: Quantification of 69 disinfection by-products and calculated toxicity

Molecular insights into the dissolved organic matter of leather wastewater in leather industrial park wastewater treatment plant

PHARMACEUTICAL/TOXICOLOGY

Connections Between Air Pollution, Climate Change & Cardiovascular Health

Lead exposure disturbs ATP7B-mediated copper export from brain barrier cells by inhibiting XIAP-regulated COMMD1 protein degradation

Amniogenesis in Human Amniotic Sac Embryoids after Exposures to Organophosphate Flame Retardants

OCCUPATIONAL

Bitumen fumes and PAHs in asphalt road paving: Emission characteristics, determinants of exposure and environmental impact

Review of Antimicrobial Nanocoatings in Medicine and Dentistry: Mechanisms of Action, Biocompatibility Performance, Safety, and Benefits Compared to Antibiotics