CHEMWATCH

Bulletin Board

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ASIA PACIFIC

Australian petrol getting cleaner from 2024, legislation brought forward

2022-08-04

Australia's dirty fuel is getting cleaner, sooner, and the Government says any price increase at the pump should be marginal.

The Albanese Labor Government has introduced legislation to bring forward the introduction of lower-sulfur petrol sold in Australia from 2027 to 2024.

By December 15, 2024, all petrol at Australian service stations will have a maximum sulfur level of 10 parts per million. This applies to 91 RON, 95 RON, 98 RON and E85 unleaded fuel.

"The reduced sulfur petrol will have a marginal price premium of around 0.6–1.0 cents per litre, which equates to an additional cost of around $8 per household over three years," said a spokesperson for the Department of Climate Change, Energy, the Environment and Water.

Read More

Car Expert, 4-08-22

https://www.carexpert.com.au/car-news/australian-petrol-getting-cleaner-from-2024-legislation-brought-forward

Australian government confident of emissions reduction law

2022-08-03

The Australian government says it is confident its greenhouse gas reduction target will be enshrined in law after negotiating amendments with senators from outside the new administration's ranks

The Australian government said Wednesday it is confident its greenhouse gas reduction target will be enshrined in law after negotiating amendments with senators from outside the new administration's ranks.

A bill to enshrine the center-left Labor Party's election pledge to reduce Australia's greenhouse gas emissions by 43% below 2005 levels by 2030 was the first piece of legislation introduced to the Parliament when it sat last week for the first time since the May 21 elections.

Australia's dirty fuel is getting cleaner, sooner, and the Government says any price increase at the pump should be marginal.

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Prime Minister Anthony Albanese said his government had negotiated sufficient support for the bill to pass the Senate without changing the 43% commitment.

"I am very confident that it will be passed through the House of Representatives and through the Senate," Albanese told reporters.

All 12 senators of the minor Greens party, which wants a 75% emissions reduction by the end of the decade, had agreed to support the amended bill, Greens leader Adam Bandt said.

"The Greens have improved a weak climate bill and we will pass it," Bandt told the National Press Club.

Read More

Associated Press, 3-08-22

https://www.wfmz.com/news/australian-government-confident-of-emissions-reduction-law/article_764ca096-2bb0-56cb-98cc-30c1b2e5ef49.html

Vietnam Introduces Administrative Sanctions for Environmental Violations: Decree 45

2022-08-02

The Vietnamese government recently issued Decree 45 in July 2022, regulating fines in the field of environmental protection. The Decree is a step in the right direction as Vietnam transitions to a green economy, showing serious commitment to environmentally responsible practices as is effective August 25.

In July, the Vietnamese government, with an aim of reinforcing environmental compliance and responsibility on every level, issued Decree 45/2022/ND-CP (Decree 45) on sanctions of administrative violations against environmental protection. The Decree will enter force from August 25, 2022, and apply to all domestic/foreign individuals/organizations of all forms (enterprises, investors, non-business units), household/business households, and residential communities.

The sanctions apply to violations against:

- Regulations on environmental registration/assessment/permits;
- Environmental protection in commercial activities;

"The Greens have improved a weak climate bill and we will pass it," Bandt told the National Press Club.

- Causing environmental pollution including air, water, and land pollution;
- Improper waste management;
- Improper destruction or disposing of machinery;
- Improper control of noise and vibration;
- Improper exploitation of natural resources, and
- Improper development of genetically modified organisms (GMO).

Vietnam Briefing explores the key elements of Decree 45 and how businesses can effectively comply with the required regulations.

Decree 45 highlights: Sanction categories, forms, and levels

Decree 45 sanctions in four main categories: warning, monetary fine, additional sanctions, and restoration measures.

The fine at its maximum is VND 1 billion (US$42,808) for individuals and VND 2 billion (US$85,616) for organizations. A point to note is that, for the same violation, organizations are subject to fines two times higher than individuals.

Read More

Vietnam Briefing, 2-08-2022

https://www.vietnam-briefing.com/news/vietnam-introduces-administrative-sanctions-for-environmental-violations-decree-45.html/

Malaysia Public Support For Proposed Amendments To The Occupational Safety And Health (Classification, Labeling And Safety Data Sheets Of Hazardous Chemicals) Regulations 2013

2022-08-01

For your information, the Occupational Safety and Health Department (JKKP) is currently in the process of public consultation for the Amendment to the Occupational Safety and Health Regulations (Classification, Labeling and Safety Data Sheets of Hazardous Chemicals) 2013.

Accordingly, the Department needs comments, views or feedback from you as a stakeholder among authorities, competent people, industry, laboratories, researchers and academics. Share your comments, views or feedback by filling out the feedback form as in the attachment.

Decree 45 sanctions in four main categories: warning, monetary fine, additional sanctions, and restoration measures.

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Status: Open

Start Date: June 13, 2022

End Date: August 15, 2022

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Malaysia Department of Occupational Health and Safety, 1-08-22

https://www.dosh.gov.my/index.php/ms/highlights/2218-seranta-awam-bagi-cadangan-pindaan-kepada-peraturan-peraturan-keselamatan-dan-kesihatan-pekerjaan-pengelasan-pelabelan-dan-helaian-data-keselamatan-bahan-kimia-berbahaya-2013

AMERICA

EPA Issues Guidance to Help Communities Locate Lead Pipes that can Contaminate Drinking Water

2022-08-04

Today, the U.S. Environmental Protection Agency is releasing guidance that will help communities and water utilities identify lead pipes that connect drinking water service to homes and other buildings. This action marks a key milestone in implementing the Biden-Harris Administration's Lead Pipe and Paint Action Plan. Together with unprecedented funding from the Bipartisan Infrastructure Law, this guidance will help water utilities comply with the requirements of the Lead and Copper Rule Revisions that went into effect in December 2021 and make rapid progress on removing harmful lead from America's drinking water.

"There is no safe level of lead exposure, and it is essential that we accelerate progress on locating lead pipes that deliver drinking water where people live, work, and play," said EPA Assistant Administrator for Water Radhika Fox. "Under President Biden's leadership, EPA is committed to working with states, Tribes, and water utilities to get the lead out of our drinking water. We are using every tool available, including providing this important guidance, strengthening the Lead and Copper Rule, and investing $15 billion through the Bipartisan Infrastructure Law to remove lead pipes."

Specifically, EPA's new *Guidance for Developing and Maintaining a Service Line Inventory:*

"There is no safe level of lead exposure, and it is essential that we accelerate progress on locating lead pipes that deliver drinking water where people live, work, and play."

- Provides best practices for inventory development and risk communications.
- Contains case studies on developing, reviewing, and communicating about inventories.
- Includes a template for water systems, states, and Tribes to use or adapt to create their own inventory.
- Highlights the importance of prioritizing inventory development in disadvantaged communities and where children live and play.

Under the Lead and Copper Rule Revisions, water systems are required to prepare and maintain an inventory of service line materials by October 16, 2024. EPA's new guidance will assist water systems in developing and maintaining service line inventories, support notifications to consumers served by lead pipes, and provide states with needed information for oversight and reporting to EPA.

This guidance will also facilitate investment of $15 billion in funding through the Bipartisan Infrastructure Law (BIL) that is dedicated to lead service line replacement. BIL funding can be used for lead service line replacement projects and associated activities directly connected to the identification, planning, design, and replacement of lead service lines, including development of service line inventories themselves.

EPA will continue to strengthen actions to protect communities from lead in drinking water. This guidance alongside regulatory improvements, infrastructure investments and other actions, are significant steps toward the goal of replacing 100% of lead service lines.

Learn more about safe drinking water , EPA's new guidance (including an upcoming webinar) and efforts to strengthen the Lead and Copper Rule, and EPA's water infrastructure investments through the Bipartisan Infrastructure Law.

Read More

US EPA, 4-08-22

https://www.epa.gov/newsreleases/epa-issues-guidance-help-communities-locate-lead-pipes-can-contaminate-drinking-water

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PFAS: The latest toxic concern for those near fracking

YYYY-MM-DD

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Environmental Health News, 4-08-22

https://www.ehn.org/pfas-fracking-in-drinking-water-2657776204/pfas-pennsylvania

PFAS: The latest toxic concern for those near fracking

2022-08-04

For more than a decade, Bryan Latkanich has discussed his concerns about fracking chemicals contaminating the water and air near his home with anyone who would listen.

Latkanich is a resident of Washington County, Pennsylvania, one of the state's most heavily fracked regions. In 2020, an Environmental Health Newsinvestigation found evidence that Latkanich and his son Ryan had been exposed to harmful chemicals like benzene, toluene and styrene.

Now, researchers have uncovered more harmful substances in Latkanich's tap water —"forever chemicals."

Last year it was revealed that these chemicals, collectively referred to as PFAS (per-and polyfluoroalkyl substances), have been used in U.S. oil and gas wells for decades. As far as the experts we spoke with know, this is the first time PFAS that may be linked to fracking have been detected in household drinking water.

The chemicals don't break down naturally, so they linger in the environment and human bodies. Exposure is linked to health problems including kidney and testicular cancer, liver and thyroid problems, reproductive problems, lowered vaccine efficacy in children and increased risk of birth defects, among others.

Read More

Environmental Health News, 4-08-22

https://www.ehn.org/pfas-fracking-in-drinking-water-2657776204/pfas-pennsylvania

Last year it was revealed that these chemicals, collectively referred to as PFAS (per-and polyfluoroalkyl substances), have been used in U.S. oil and gas wells for decades.

EPA: Chemical in medical-device cleanser poses cancer risk

2022-08-03

The Environmental Protection Agency is warning residents who live near medical sterilizing plants in 13 states and Puerto Rico about potential health risks from emissions of ethylene oxide, a chemical widely used in their operations.

Laredo, Texas; Ardmore, Oklahoma; and Lakewood, Colorado, are among the communities facing the highest risk from ethylene oxide emissions, EPA said.

The agency has notified 23 commercial sterilizers — 19 in the continental U.S. and four in Puerto Rico — that their operations pose an elevated risk of cancer and other ailments. The notice follows a recent survey of emissions data from almost 100 commercial sterilizers nationwide.

Ethylene oxide is used to clean everything from catheters to syringes, pacemakers and plastic surgical gowns.

While short-term or infrequent exposure to ethylene oxide does not appear

to pose a health risk, EPA said long-term or lifetime exposure to the chemical could lead to a variety of health impacts, including lymphoma and breast cancer. EPA said it is working with commercial sterilizers to take appropriate steps to reduce emissions.

Read More

The Hill, 3-08-22

https://thehill.com/homenews/ap/ap-health/epa-chemical-in-medical-device-cleanser-poses-cancer-risk/

Coolants in Puff electronic cigarettes present health hazard

2022-08-02

Electronic cigarettes, or ECs, contain nicotine, solvents, and flavor chemicals, and are especially popular among young adults. In 2020, the Food and Drug Administration, or FDA, banned cartridge-based flavored EC pods, but this ban did not extend to "disposable" flavored EC products,

The agency has notified 23 commercial sterilizers [...] that their operations pose an elevated risk of cancer and other ailments.

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such as Puff ECs. Unfortunately, the chemical composition and toxicity of the fluids in Puff ECs are largely unknown.

Researchers at the University of California, Riverside and Portland State University have now examined 16 disposable Puff devices to determine their flavor chemicals, synthetic coolants, and nicotine concentrations. Synthetic cooling agents, like WS-23, provide a cooling sensation.

Using gas chromatography and mass spectrometry, the team identified 126 flavor chemicals in Puff EC fluids and tested how toxic these chemicals were on human bronchial epithelial cells. They report in the journal Chemical Research in Toxicology that the chemicals in disposable Puff ECs are at high levels and cytotoxic — or toxic to living cells.

"Our data support the regulation of flavor chemicals and synthetic coolants in Puff ECs to limit their potentially harmful health effects," said Esther Omaiye, a former graduate student in the Environmental Toxicology Graduate Program and the first author of the research paper. "The high levels of nicotine, flavor chemicals, and synthetic coolants in Puff ECs, which exceed those used in other consumer products, bring into question the safety of Puff products."

Prue Talbot, in whose lab Omaiye now works as postdoctoral researcher, said one area of regulatory concern with respect to ECs is the evolving use of novel chemicals in e-cigarette fluids.

"For years, we have been aware that EC designs are evolving," said Talbot, a professor of cell biology who led the research team. "Only recently have we also realized that the chemicals used in EC liquids are likewise changing. These changes usually make the EC product more attractive to adolescents or attempt to circumvent FDA regulation — for example by using synthetic nicotine in lieu of tobacco derived nicotine to escape FDA regulation."

Read More

UC Riverside News, 2-08-2022

https://news.ucr.edu/articles/2022/08/02/coolants-puff-electronic-cigarettes-present-health-hazard

"Our data support the regulation of flavor chemicals and synthetic coolants in Puff ECs to limit their potentially harmful health effects."

EUROPE

Explainer: What are Seveso risk sites and where are they in France?

2022-08-04

There are over 1,300 French chemical plants or other sites classed under EU directives as posing a particular risk to the surrounding environment

Yesterday (August 3), an explosion occurred at a factory located on the Eurenco site in Bergerac (Dordogne), injuring eight people – one seriously – and leading to a fire requiring the deployment of 60 firefighters.

The factory was a powder mill classed as a high-level Seveso site, but what does this mean in terms of regulation and risk to local populations?

Seveso sites are named after a 1976 industrial accident which occurred near the town of Seveso, in the Lombardy region of Italy.

The factory only had very rudimentary safety systems and environmental protection had not been considered.

Therefore, when a valve broke at the factory and released a chemical cloud containing the toxic dioxin TCDD, the local population were caught unaware.

Land and vegetation surrounding the factory were contaminated and thousands of animals died.

The company which ran the plant only admitted to the accident nearly a week after it occurred, but by then, cases of dioxin poisoning were already being reported, and 600 people had to be evacuated from their homes.

Some 2,000 local residents were treated for dioxin poisoning.

It was later ranked as the eighth worst man-made environmental disaster by Time magazine in 2010.

Read More

The Connexion, 4-08-22

https://www.connexionfrance.com/article/Practical/Environment/Explainer-What-are-Seveso-risk-sites-and-where-are-they-in-France

There are over 1,300 French chemical plants or other sites classed under EU directives as posing a particular risk to the surrounding environment.

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Europe urged to clamp down on growing greenhouse gases black market

2022-08-03

Illegal hydrofluorocarbons smuggled into the EU amount to nearly 30% of the legal trade, according to the Environmental Investigation Agency

The London-based Environmental Investigation Agency (EIA) has urged the European Public Prosecutor's Office to launch an investigation into the illegal multi-million euro trade in climate-damaging hydrofluorocarbons (HFCs) in Europe.

HFCs are industrial refrigerant gases used in, among other things, air-conditioning and supermarket cooling units.

As part of a gradual phase down in using HFCs, the EU has introduced a quota system through its F-Gas Regulation to limit the volume of these greenhouse gases on the market.

The measure cut the supply by 37% in 2018 which in turn caused prices to soar while fuelled a black market across Europe.

The EIA said Romania has become a major gateway for HFC smuggling.

Read More

Energy Live News, 3-08-22

https://www.energylivenews.com/2022/08/03/europe-urged-to-clamp-down-on-growing-greenhouse-gases-black-market/

The measure cut the supply by 37% in 2018 which in turn caused prices to soar while fuelled a black market across Europe.

INTERNATIONAL

How will the packaging industry navigate upcoming regulations on chemicals?

2022-08-04

Chemicals frequently used in packaging, including BPA and PFAS, are set to be more strictly regulated by both the European Union and the US in the coming years as awareness of their environmental and health implications expands. According to McKinsey, packaging companies should take a proactive approach to tightening regulations on chemicals, with technology, supply chain collaboration, and clear internal and external communication identified as key strategies for successful adoption.

Re-evaluating BPA

Bisphenol A (BPA) is an industrial chemical used in the production of polycarbonate plastics for applications including food containers, reusable beverage bottles, and tableware. It is also present in epoxy resins, which are used as protective coatings and liners, such as for food cans and bottle tops.

A key concern related to BPA is that traces of the chemical can migrate from food contact materials into food and beverages. The Mayo Clinic cites research that suggests BPA can disrupt endocrine (hormonal) systems, as well as a potential link between BPA and increased blood pressure, type 2 diabetes, and cardiovascular disease.

The European Food Safety Authority (EFSA) has previously concluded that "BPA poses no health risk to consumers of any age group (including unborn children, infants and adolescents)", claiming that everyday exposure remained "considerably under" the tolerable daily intake (TDI). However, McKinsey notes that in December 2021, the EFSA published a revised risk assessment of BPA, followed by a draft scientific opinion re-evaluating the TDI in 2022.

According to McKinsey, the re-evaluation places the TDI of BPA at a level 100,000 times lower than the amount previously stated in 2015. Public consultation on the opinion closed in February 2022, but the final regularity verdict and adoption aren't expected until December 2022. McKinsey says that, if this new regulation is approved, BPA used in all food-contact products would need to be replaced by BPA-free alternatives across EU member states.

Some regulation on BPA is already in place in the EU, including a ban on the use of BPA in the manufacturer of polycarbonate infant feeding bottles implemented by the European Commission in January 2011. In addition, France reportedly prohibited BPA from being used in all food-contact materials in 2015.

McKinsey says that regulation on BPA in the EU has typically been slower than in the US, where a number of companies have apparently already removed BPA from their packaging. Notably, however, the US Food and Drug Administration (FDA) also stated that "BPA is safe at the current levels occurring in foods", mirroring a similar historic position to the EFSA.

A key concern related to BPA is that traces of the chemical can migrate from food contact materials into food and beverages.

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McKinsey is seemingly expecting further regulation on BPA in the US, in addition to the EU, as consumer and institutional pressure continues to grow.

Read More

Packaging Europe, 4-08-22

https://packagingeurope.com/news/how-will-the-packaging-industry-navigate-upcoming-regulations-on-chemicals/8551.article

REACH Update

AUG. 12, 2022

ECHA Reminds Registrants of Substances with a Harmonized Classification to Update Their Dossiers

2022-08-03

The European Chemicals Agency (ECHA) recently reminded registrants of substances with a harmonized classification to update their dossiers. According to an item in the August 13, 2022, ECHA Weekly, ECHA will soon begin a second screening project to check that companies are keeping their registrations updated. The project will focus on substances with a harmonized classification and labeling and will examine registrations where this information is not used correctly. ECHA will pass cases where incompliance is suspected to national enforcement authorities. ECHA will publish the results of its first screening project, which focused on registrations of substances that are on the Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH) Authorization List, "next autumn." ECHA states that these projects "remind registrants of their obligation to keep their registrations up to date." ECHA provides information on keeping registration dossiers up to date.

Read More

Lexology, 3-08-22

https://www.lexology.com/library/detail.aspx?g=69a0bce7-57ff-445c-90d7-fdcb528d4ec9

ECHA will soon begin a second screening project to check that companies are keeping their registrations updated.

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Janet's Corner

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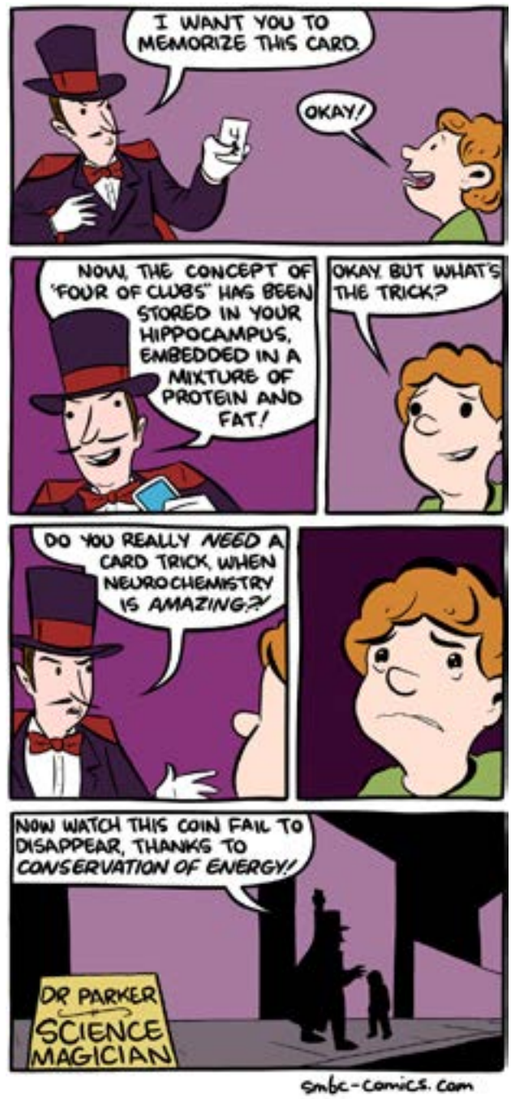
Science Magic

2022-08-12



https://www.smbc-comics.com/comic/science-magic

Dibenzofuran

2022-08-12

Dibenzofuran is a heterocyclic organic compound with the molecular formula $C_{12}H_8O$. It is an aromatic compound that has two benzene rings fused to a central furan ring. All the numbered carbon atoms have a hydrogen atom bonded to each of them. It is a volatile white solid that is soluble in non-polar organic solvents. [1] Dibenzofuran is created from the production of coal tar. [2]

USES [2]

Dibenzofuran is used as an insecticide and to make other chemicals.

SOURCES AND ROUTES OF EXPOSURE

Sources of Exposure [3,4]

- Dibenzofuran has been detected in emissions from combustion of coal, biomass, refuse, diesel fuel, and tobacco.
- It is also found in leachates from commercial coal tar and is formed from the incomplete combustion of propane.
- Dibenzofuran also is a photolytic product of environmental photolysis of chlorinated biphenyl ethers in surface waters by sunlight.
- The primary stationary sources that have reported emissions of dibenzofuran in California are lumber and wood products manufacturers, and manufacture of fabricated metal ordnance and accessories.
- It may be found in coke dust, grate ash, fly ash, and flame soot.

Routes of Exposure [3,4]

- Occupational exposure may occur through inhalation and dermal contact, particularly at sites engaged in combustion/carbonisation processes, such as coal tar and coal gasification operations.
- Dibenzofuran is released to the ambient air from combustion sources. The general public may be exposed to dibenzofuran through the inhalation of contaminated air or through the consumption of contaminated drinking water or food.
- Since it has been found in tobacco smoke, you can be exposed if you smoke cigarettes or breathe cigarette smoke.

Dibenzofuran is a heterocyclic organic compound with the molecular formula C12H8O.

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HEALTH EFFECTS [5]

Acute health Effects

- Dibenzofuran causes skin irritation.
- Exposure to dibenzofuran can irritate the eyes, nose and throat.

Chronic Health Effects

Repeated contact with Dibenzofuran can cause:

- Skin growths;
- Rashes (may be made worse by exposure to sunlight); and
- Changes in skin colour.

Cancer Hazard

Dibenzofuran has not been tested for its ability to cause cancer in animals. The U.S. Environmental Protection Agency has determined that there is not enough information available to classify dibenzofuran as a cancer causing substance.

Reproductive Hazard

Dibenzofuran has not been tested for its ability to affect reproduction.

SAFETY [6]

First Aid Measures

- Inhalation: If breathed in, move person into fresh air. If not breathing, give artificial respiration. Consult a physician.
- Skin Contact: Wash off with soap and plenty of water. Consult a physician.
- Eye Contact: Flush eyes with water as a precaution.
- Ingestion: Never give anything by mouth to an unconscious person. Rinse mouth with water. Consult a physician.

Exposure Controls and Personal Protection

Engineering Controls

- Ensure there are appropriate engineering controls in place.
- Handle in accordance with good industrial hygiene and safety practice.
- Wash hands before breaks and at the end of workday.

Personal Protective Equipment

The following personal protective equipment is recommended when handling dibenzofuran:

Eye/face Protection:

- Safety glasses with side-shields conforming to EN166 Use equipment for eye protection tested and approved under appropriate government standards such as NIOSH (US) or EN 166(EU).

Skin Protection:

- Handle with gloves.
- Gloves must be inspected prior to use.
- Use proper glove removal technique (without touching glove's outer surface) to avoid skin contact with this product.
- Dispose of contaminated gloves after use in accordance with applicable laws and good laboratory practices.
- Wash and dry hands.
- The selected protective gloves have to satisfy the specifications of EU Directive 89/686/EEC and the standard EN 374 derived from it.
- Full contact Material: Nitrile rubber

Body Protection:

- Complete suit protecting against chemicals.
- The type of protective equipment must be selected according to the concentration and amount of the dangerous substance at the specific workplace.

Respiratory Protection:

- For nuisance exposures use type P95 (US) or type P1 (EU EN 143) particle respirator.
- For higher level protection use type OV/AG/P99 (US) or type ABEK-P2 (EU EN 143) respirator cartridges.
- Use respirators and components tested and approved under appropriate government standards such as NIOSH (US) or CEN (EU).

REGULATION

United States [5]

No occupational exposure limits have been established by dibenzofuran.

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Australia

No occupational exposure limits have been established by dibenzofuran.

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Massive study links long COVID to hair loss and reduced libido

2022-07-31

A huge new study has offered the most robust investigation to date into the symptoms and prevalence of long COVID in non-hospitalized patients. The research identified a diverse set of symptoms associated with long COVID, including reduced libido and hair loss, and suggested the condition should be reclassified into three distinct groups rather than considering it one singular disease.

The clinical definition of long COVID, also known as PASC (post-acute sequelae of COVID-19), is still frustratingly unclear. The World Health Organization (WHO), for example, classifies the condition as COVID-19 symptoms that persist for longer than 12 weeks after an initial infection, whereas the US Centers for Disease Control and Prevention (CDC) only lets four weeks pass before a patient with lingering symptoms qualifies for long COVID. The CDC also lists around 20 symptoms that can fit under the umbrella of long COVID.

This new research presents a large-scale analysis of healthcare data incorporating 486,149 people in the United Kingdom with a reported history of mild COVID-19 (no patient was hospitalized due to their acute infection). This cohort was matched against a control of around two million patients with no record of COVID-19 infection. The study spanned a period early in the pandemic, from January 2020 to April 2021.

The study found those post-COVID patients were more likely to report 62 different symptoms to their local doctor at least 12 weeks after their acute infection, compared to the matched control group. After accounting for factors such as age, weight and pre-existing health conditions, the differences in symptom reporting between the two groups remained, suggesting the symptoms could be associated with COVID-19.

"Some of these symptoms were expected, like loss of sense of smell, shortness of breath and fatigue," write Shamil Haroon and Anuradhaa Subramanian in The Conversation. "But some of the symptoms that we found to be strongly associated with COVID beyond 12 weeks were surprising and less well known, such as hair loss and reduced libido. Other symptoms included chest pain, fever, bowel incontinence, erectile dysfunction and limb swelling."

Overall, the study listed 62 different symptoms that may be associated with long COVID. Interestingly, the researchers suggest it could be useful

New research argues long COVID should be classified in three distinct groups depending on symptoms.

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to reclassify long COVID as three more distinct conditions, depending on the nature of the symptoms.

"Our analysis suggests that long COVID can be characterized into three distinct groups based on clusters of symptoms reported," explained Haroon and Subramanian. "The largest group, consisting of roughly 80% of people with long COVID in our study, faced a broad spectrum of symptoms, ranging from fatigue, to headache, to pain. The second largest group, representing 15%, predominantly had mental health and cognitive symptoms, including depression, anxiety, brain fog and insomnia. The third and smallest group, capturing the remaining 5%, had mainly respiratory symptoms such as shortness of breath, cough and wheeze."

By breaking long COVID up into these three distinct groups it is possible future research could identify underlying pathophysiological differences that inform more novel targeted therapies.

This kind of study is of course subject to a number of limitations. A big research project such as this can never offer robust causal connections, so it is difficult to suggest every single patient presenting to a doctor with a strange symptom three months after COVID is actually suffering from long COVID. On the other hand, since the study only recorded symptoms that were formally reported to a doctor it is possible it didn't catch the breadth of long COVID's impact.

On this point, the study does actually indicate the prevalence of long COVID may be much lower than most previous research has found. About 4.4% of the uninfected control group presented to a doctor with one of the hundred symptoms being tracked in the study. This compares to 5.4% of the COVID group presenting with a potential long COVID symptom.

This means the prevalence of long COVID is possibly as small as 1% in those who experienced a SARS-CoV-2 infection not severe enough to send them to hospital. This rate is much lower than any previous study has identified.

It is still important to note, however, that a 1% prevalence of long COVID can lead to extraordinarily high numbers of patients suffering from chronic illness considering it is likely nearly everyone could be infected with SARS-CoV-2 at some point in time. Plus, this potentially low prevalence is only in non-hospitalized patients and plenty of prior research has found the more severe the acute disease, the more likely one is to suffer from long COVID.

Jennifer Camaradou, a co-author on the new study, said the new findings affirm how complex a condition long COVID may be, and how certain factors such as gender, age and ethnicity, can increase one's risk of developing persistent disease.

"This study is instrumental in creating and adding further value to understanding the complexity and pathology of long COVID," Camaradou said. "It highlights the degree and diversity of expression of symptoms between different clusters. Patients with pre-existing health conditions will also welcome the additional analysis on risk factors."

The new study was published in the journal Nature Medicine.

New Atlas, 31 July 2022

https://newatlas.com

Solar is the cheapest power, and a literal light-bulb moment showed us we can cut costs and emissions even further

2022-08-01

Recent extreme weather events have underscored the need to cut the CO_2 emissions that are driving up global temperatures. This requires a rapid transition of the energy economy to renewable energy sources, the cheapest being solar photovoltaics (PV). And our newly published research points to a way we can drive down costs of the shift even further using cheaper forms of silicon for highly efficient solar panels.

Australia has been leading the way with solar PV installations, but our solar energy journey is just beginning. This year, humanity hit a milestone of 1 terawatt (TW) – 1 million × 1 million watts – of installed solar capacity. However, experts predict 70TW of solar PV may be needed by 2050 to power all sectors of the economy.

To help drive this rapid uptake of solar PV, we need solar panels that are high efficiency and low cost. Over the past ten years, some new solar cell designs have led to record high efficiencies. The problem is these designs also need higher-quality materials, which cost more.

Our recent research suggests we might be able to rethink the type of silicon needed to make these high-efficiency solar cells.

Not all silicon is equal

More than 95% of solar panels are made using silicon. The silicon used to make solar cells is similar to that used in computer chips. It's effectively very pure sand.

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More than 95% of solar panels are made using silicon. The silicon used to make solar cells is similar to that used in computer chips. It's effectively very pure sand.

To make a solar cell work, we need to form an electric field so the generated current can all flow in one direction. This is done by adding impurity atoms into silicon, a process known as "doping".

In commercial panel manufacturing, the most commonly used type of silicon is "p-type" silicon. This material is doped with atoms that have one less electron than silicon, such as boron or more recently gallium.

We can then introduce a very thin layer on the surface full of atoms with one extra electron relative to silicon, which is called "n-type" silicon. Placing these two types of silicon together forms what is called a "p-n junction". The massive difference in the number of electrons between the p-type region and n-type region forces electrons to move rapidly, creating an electric field that drives the current in our solar cell.

Conventional solar panels on Australian roofs today are overwhelmingly made using p-type silicon, as it is about 10% cheaper than the alternative "n-type" silicon, doped with phosphorus.

Higher efficiency comes at a cost

Researchers are continually pushing to drive up the efficiency of solar panels so they can generate more power for consumers. In 2017, a record efficiency of 26.7% was achieved for a silicon solar cell. Last month, LONGi Solar announced an efficiency of 26.5% - very close to the world record - for the same type of solar cell made in a manufacturing environment, rather than in a laboratory.

This type of solar cell is called a "silicon heterojunction". The special element of silicon heterojunction solar cells is that the surface is capped with a very thin layer – about 1,000 times thinner than a human hair – of amorphous silicon. This thin layer smooths the surface and reduces a lot of the energy losses.

Sanyo developed this cell design in the 1990s. At the time, high-quality n-type silicon wafers were used to make silicon heterojunction cells, even though these wafers are more expensive.

The main reason for this is that sunlight degrades cheaper p-type wafers. However, our understanding of this phenomenon and how to treat it has come a long way since the 1990s.

Our light-bulb moment

For the past 30 years, all silicon heterojunction solar cells, including the record-breaking cells, have been made using n-type silicon wafers. In our research project, we wanted to test whether cheaper, p-type wafers could also be used.

Through comprehensive testing, we found heterojunction solar cells made with p-type silicon did not perform as well. We were puzzled by this. But one day we had a literal light-bulb moment.

We realised that accidental exposure to room lighting for as little as ten seconds before testing reduced the voltage of p-type cells by as much as 30mV, which can cut their efficiency by a percentage point (i.e. from 22% to 21%). This was causing our cells to perform much worse than expected. Much like someone who has severe allergies is more sensitive to pollen in the spring, we realised these high-efficiency silicon heterojunction solar cells made with p-type wafers are much more sensitive to light-induced degradation.

Problem identified, we now have the solution

We believe this observation is the reason high-efficiency cells have only previously been explored using expensive silicon. Past researchers were unaware of the sensitivity of p-type wafers to degrade and did not have the knowledge to overcome it.

Fortunately, we now know the bonding of boron and unwanted oxygen in the silicon wafer causes this degradation. Treatments with a high-intensity laser have been shown to stabilise cells in a matter of seconds.

The laser illumination can make hydrogen, which is already floating around in the silicon, more mobile to move around and "passivate" the unwanted boron-oxygen defects. Exactly how hydrogen does this is still an active area of research, but we know it solves the problem. Our research confirms a short laser treatment can stabilise the performance of p-type silicon heterojunction solar cells.

Armed with this new knowledge, we can further develop high-efficiency technologies with cheaper raw materials. This will reduce the cost of every watt of solar electricity produced. In March this year, solar panel manufacturer LONGi Solar announced an efficiency of 25.47% for a silicon heterojunction solar cell made using p-type wafers.

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To see manufacturers making high-efficiency solar cells that are potentially cheaper means our findings have a tangible impact on industry. Reducing solar cell costs will provide cheaper electricity to millions of consumers while addressing climate change.

The Conversation, 1 August 2022

https://theconversation.com

Heaviest neutron star to date is a 'black widow' eating its mate

2022-07-26

A dense, collapsed star spinning 707 times per second—making it one of the fastest spinning neutron stars in the Milky Way galaxy—has shredded and consumed nearly the entire mass of its stellar companion and, in the process, grown into the heaviest neutron star observed to date.

Weighing this record-setting neutron star, which tops the charts at 2.35 times the mass of the sun, helps astronomers understand the weird quantum state of matter inside these dense objects, which—if they get much heavier than that—collapse entirely and disappear as a black hole.

"We know roughly how matter behaves at nuclear densities, like in the nucleus of a uranium atom," said Alex Filippenko, Distinguished Professor of Astronomy at the University of California, Berkeley. "A neutron star is like one giant nucleus, but when you have one-and-a-half solar masses of this stuff, which is about 500,000 Earth masses of nuclei all clinging together, it's not at all clear how they will behave."

Roger W. Romani, professor of astrophysics at Stanford University, noted that neutron stars are so dense—1 cubic inch weighs over 10 billion tons—that their cores are the densest matter in the universe short of black holes, which because they are hidden behind their event horizon are impossible to study. The neutron star, a pulsar designated PSR J0952-0607, is thus the densest object within sight of Earth.

The measurement of the neutron star's mass was possible thanks to the extreme sensitivity of the 10-meter Keck I telescope on Maunakea in Hawai'i, which was just able to record a spectrum of visible light from the hotly glowing companion star, now reduced to the size of a large gaseous planet. The stars are about 3,000 light years from Earth in the direction of the constellation Sextans.

"We can keep looking for black widows and similar neutron stars that skate even closer to the black hole brink."

Discovered in 2017, PSR J0952-0607 is referred to as a "black widow" pulsar—an analogy to the tendency of female black widow spiders to consume the much smaller male after mating. Filippenko and Romani have been studying black widow systems for more than a decade, hoping to establish the upper limit on how large neutron stars/pulsars can grow.

"By combining this measurement with those of several other black widows, we show that neutron stars must reach at least this mass, 2.35 plus or minus 0.17 solar masses," said Romani, who is a professor of physics in Stanford's School of Humanities and Sciences and member of the Kavli Institute for Particle Astrophysics and Cosmology. "In turn, this provides some of the strongest constraints on the property of matter at several times the density seen in atomic nuclei. Indeed, many otherwise popular models of dense-matter physics are excluded by this result."

If 2.35 solar masses is close to the upper limit of neutron stars, the researchers say, then the interior is likely to be a soup of neutrons as well as up and down quarks—the constituents of normal protons and neutrons—but not exotic matter, such as "strange" quarks or kaons, which are particles that contain a strange quark.

"A high maximum mass for neutron stars suggests that it is a mixture of nuclei and their dissolved up and down quarks all the way to the core," Romani said. "This excludes many proposed states of matter, especially those with exotic interior composition."

Romani, Filippenko and Stanford graduate student Dinesh Kandel are co-authors of a paper describing the team's results that has been accepted for publication by The Astrophysical Journal Letters.

How large can they grow?

Astronomers generally agree that when a star with a core larger than about 1.4 solar masses collapses at the end of its life, it forms a dense, compact object with an interior under such high pressure that all atoms are smashed together to form a sea of neutrons and their subnuclear constituents, quarks. These neutron stars are born spinning, and though too dim to be seen in visible light, reveal themselves as pulsars, emitting beams of light—radio waves, X-rays or even gamma rays—that flash Earth as they spin, much like the rotating beam of a lighthouse.

"Ordinary" pulsars spin and flash about once per second, on average, a speed that can easily be explained given the normal rotation of a star before it collapses. But some pulsars repeat hundreds or up to 1,000

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times per second, which is hard to explain unless matter has fallen onto the neutron star and spun it up. But for some millisecond pulsars, no companion is visible.

One possible explanation for isolated millisecond pulsars is that each did once have a companion, but it stripped it down to nothing.

"The evolutionary pathway is absolutely fascinating. Double exclamation point," Filippenko said. "As the companion star evolves and starts becoming a red giant, material spills over to the neutron star, and that spins up the neutron star. By spinning up, it now becomes incredibly energized, and a wind of particles starts coming out from the neutron star. That wind then hits the donor star and starts stripping material off, and over time, the donor star's mass decreases to that of a planet, and if even more time passes, it disappears altogether. So, that's how lone millisecond pulsars could be formed. They weren't all alone to begin with—they had to be in a binary pair—but they gradually evaporated away their companions, and now they're solitary."

The pulsar PSR J0952-0607 and its faint companion star support this origin story for millisecond pulsars.

"These planet-like objects are the dregs of normal stars which have contributed mass and angular momentum, spinning up their pulsar mates to millisecond periods and increasing their mass in the process," Romani said.

"In a case of cosmic ingratitude, the black widow pulsar, which has devoured a large part of its mate, now heats and evaporates the companion down to planetary masses and perhaps complete annihilation," said Filippenko.

Spider pulsars include redbacks and tidarrens

Finding black widow pulsars in which the companion is small, but not too small to detect, is one of few ways to weigh neutron stars. In the case of this binary system, the companion star—now only 20 times the mass of Jupiter—is distorted by the mass of the neutron star and tidally locked, similar to the way our moon is locked in orbit so that we see only one side. The neutron star-facing side is heated to temperatures of about 6,200 Kelvin, or 10,700 degrees Fahrenheit, a bit hotter than our sun, and just bright enough to see with a large telescope.

Filippenko and Romani turned the Keck I telescope on PSR J0952-0607 on six occasions over the last four years, each time observing with the

Low Resolution Imaging Spectrometer in 15-minute chunks to catch the faint companion at specific points in its 6.4-hour orbit of the pulsar. By comparing the spectra to that of similar sun-like stars, they were able to measure the orbital velocity of the companion star and calculate the mass of the neutron star.

Filippenko and Romani have examined about a dozen black widow systems so far, though only six had companion stars bright enough to let them calculate a mass. All involved neutron stars less massive than the pulsar PSR J0952-060. They're hoping to study more black widow pulsars, as well as their cousins: redbacks, named for the Australian equivalent of black widow pulsars, which have companions closer to one-tenth the mass of the sun; and what Romani dubbed tidarrens—where the companion is around one-hundredth of a solar mass—after a relative of the black widow spider. The male of this species, Tidarren sisyphoides, is about 1% of the female's size.

"We can keep looking for black widows and similar neutron stars that skate even closer to the black hole brink. But if we don't find any, it tightens the argument that 2.3 solar masses is the true limit, beyond which they become black holes," Filippenko said.

"This is right at the limit of what the Keck telescope can do, so barring fantastic observing conditions, tightening the measurement of PSR J0952-0607 likely awaits the 30-meter telescope era," added Romani.

Other co-authors of the ApJ Letters paper are UC Berkeley researchers Thomas Brink and WeiKang Zheng.

Phys Org, 26 July 2022

https://phys.org

US nuclear regulator greenlights its first small modular reactor

2022-08-01

The first generation-IV nuclear reactor design has been approved for certification by the US Nuclear Regulatory Commission (NRC). NuScale's small modular reactor design promises safe, clean energy at radically reduced cost, land use and installation time.

The NRC released news last week that its staff have been directed to make a final rule certifying the NuScale reactor design for use in the United States. This is just the seventh design approved by the NRC since it was

Like most other generation IV nuclear designs, the NuScale plant is designed to shut itself down safely in an emergency without any operator input or power requirements.

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established in 1974, and the first of a coming generation of next-gen technologies designed to make nuclear power cheaper, easier and safer to implement than ever before.

The keys to this small modular reactor's advantages lie in its small size and modularity. Rather than having to build each reactor on site, custom designed for the location, NuScale can mass-manufacture its light water reactor modules in a factory and then ship them worldwide for a relatively quick and painless installation.

Each roughly cylindrical module stands around 65 ft (20 m) high, with a 9-foot (2.7-m) diameter, and produces 77 megawatts by pushing steam out through a turbine. A given power plant could run anywhere between four and 12 of these modules, submerged in a water tank, so an overall power station will be good for between 308 and 924 MW. Nuclear will be a key baseline generator for renewables-based power grids in many areas, and NuScale says its mass production capabilities will make it cost-competitive even with some fossil-fueled options.

Like most other generation IV nuclear designs, the NuScale plant is designed to shut itself down safely in an emergency without any operator input or power requirements. The feedwater and steam exit valves will close in the event of an emergency situation, and a secondary set of valves will open to depressurize steam from the reactor core into the containment vessel surrounding the reactor. As this steam condenses, it'll be taken back into the core and circulated through this process again. NuScale says this'll put the plant in a stable, safe shutdown, and that if anything goes catastrophically wrong, the giant water tank housing the reactor modules, with its concrete roof, provides a final line of defense designed to be earthquake-proof and impermeable to aircraft impacts.

The plant's passive safety measures and tiny ground footprint compared with current-gen nuclear power make it possible – in the company's opinion, anyway – to put these plants much closer to where the energy's used, cutting down on transmission costs and losses.

The first NuScale power plant is set to begin generating power in 2029, with all six of its modules due to come online in 2030. Located at the Idaho National Laboratory, the Carbon Free Power Project will generate

some 462 MW, much of which is already contracted to be sold to power distribution companies for a 40-year period.

New Atlas, 1 August 2022

https://newatlas.com

New acne treatment 'exciting', but Europe will have to wait

2022-07-30

A new drug touted as the first real breakthrough in acne treatment in decades has been available for months in the United States, but when it will hit the shelves in Europe and elsewhere remains unclear.

The topical cream clascoterone could give fresh hope of respite from the red pimples and oily skin that plagues around three quarters of all teenagers—as well as many adults.

Despite being such a common affliction, new drugs to treat acne have been rare—though recent research has revealed the role played by diet.

But experts have hailed clascoterone as the first new type of acne treatment in nearly 40 years.

"What is so exciting about clascoterone is that it is a completely new mechanism of action that addresses the fundamental hormonal (causes) underlying all acne," US dermatologist John Barbieri told AFP.

There have long been two main types of acne treatment. One uses antibiotics to target the bacteria that causes acne, while the other stops dead skin cells from building up.

Clascoterone however makes the cells less receptive to the hormones that produce sebum, an oily substance that normally keeps skin moist but which acne sufferers produce in excess.

There are pills that also target these hormones. But they are often contraceptive pills, so are only prescribed for women. And by directly affecting the body's hormone production, they can have far worse side effects.

'Very small company'

Experts have hailed clascoterone as the first new type of acne treatment in nearly 40 years.

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A 2020 study published in the journal JAMA Dermatology found that clascoterone was more effective than a placebo—and did not have significant side effects.

The study was enough to convince US authorities to approve the treatment, which US doctors have been able to prescribe since the end of last year.

French dermatologist Emilie Sbidian cautioned that the study did not compare clascoterone to existing treatments, "so we don't really know where to place it".

However she said the cream was "very interesting" because it could give a new option to patients reluctant about other drugs—or be used in conjunction with those other treatments.

However people with acne in Europe are unlikely to get their hands on the drug any time soon.

The wait is not due to any reluctance on the part of the health authorities. The European Medicines Agency told AFP it has not even started evaluating the drug.

The time frame instead comes down to the company that produces the drug, Switzerland's Cosmo Pharmaceuticals.

"As a very small company, we were focused first on the biggest market of the world, which was the US," said Diana Harbort, the head of Cosmo's dermatology division.

Searching for a partner

She told AFP that "there isn't one big company who has interest in acne around the world", pointing out that big pharma firms like Pfizer, Sanofi and Novartis do not sell acne drugs.

This means that Cosmo needs partners to distribute the drug in each new world region. In the US, clascoterone is distributed by the firm Sun Pharma.

In its latest financial statement released this week, Cosmo announced it has found a distribution partner in China.

It has also agreed to a deal with Sun Pharma to expand into Japan, Brazil, Mexico, Russia, Australia and New Zealand.

So why is it taking so long to find a European partner? Cosmo pointed to the COVID-19 pandemic, saying it had slowed the market for such drugs.

However financial analyst Jamila El Bougrini said "the dermatology market is rather buoyant".

"I think there have been errors in the group's strategy," she told AFP.

The analyst found it hard to understand why Europe's medicine authorities had not started evaluating clascoterone.

She also pointed out that in recent years Cosmo had tried to sell its dermatology division—whose only product is clascoterone—but failed due to a lack of interest.

El Bougrini questioned whether it might be difficult to attract interest from investors if a treatment had not been shown to be more effective than existing drugs.

Medical Xpress, 30 July 2022

https://medicalxpress.com

Polymer bricks made of industrial waste bond together without mortar

2022-08-01

Construction is one of the largest sources of greenhouse gas emissions, so finding new materials and methods is a crucial goal. Researchers at Flinders University have now developed a new type of polymer, made out of industrial waste, that can be formed into building bricks that bond together without needing any mortar.

Concrete is an extremely versatile material, but the production of cement is alone responsible for as much as 8% of all carbon dioxide emissions caused by humans. That huge footprint could be reduced by finding ways to incorporate waste materials like wood or old tires into the mix, using different binders, or developing alternative materials entirely.

The new study explores one such alternative. The team had previously developed polymers made mostly of sulfur left over from industrial processes, which could be used to capture heavy metal pollution or for more sustainable fertilizers. Now, these polymers have been put to work as more environmentally friendly building blocks.

The new polymer bricks […] form their own mortar when a sprayable catalyst is applied.

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The polymer is made by mixing sulfur with varying ratios of canola oil and dicyclopentadiene (DCPD). The sulfur and DCPD are both byproducts of petroleum refining that currently go to waste, while the canola oil can be sourced from kitchen waste. The polymer is heated, molded and cured into bricks, with the whole process consuming far less energy than cement production.

But the really impressive thing is how these bricks stick together, essentially acting as their own mortar without the need for any other adhesive. In tests, the bonded bricks resisted shear forces better than superglue.

"An amine catalyst is sprayed onto the surface," Professor Justin Chalker, corresponding author of the study, told New Atlas. "The catalyst causes the S-S (sulfur-sulfur) bonds in the brick to rearrange and bind the two bricks together. The catalyst only needs to initiate the reaction, and it evaporates from the bricks after bonding."

The team says that the bricks are also lightweight, and resistant against water, acid and other weather conditions, even more so than conventional bricks and concrete. In other tests, the researchers added carbon fiber to the polymer, and found that the resulting bricks were almost 16 times stronger.

While further development is required, the Flinders team is collaborating with Clean Earth Technologies to work towards scaling the polymer bricks up for possible commercialization.

The research was published in the journal Macromolecular Chemistry and Physics.

New Atlas, 1 August 2022

https://newatlas.com

Review reinforces link between contraceptive pill and depression

2022-07-29

A review by Prof Jayashri Kulkarni and Dr Eveline Mu found that there were few oral contraceptive pills on the market that didn't cause depression in vulnerable women.

For some time, Monash Central Clinical School psychiatrist Professor Jayashri Kulkarni has treated women telling her they had developed

The review […] found that there were few oral contraceptive pills on the market that didn't cause depression in vulnerable women.

depression since being prescribed certain oral contraception or that their existing depression had become out of control.

"It was a very common story, repeated over and over again," said Professor Kulkarni, who heads the Women's Mental Health Clinic at Monash University's MAPrc (Monash Alfred Psychiatry Research Centre). "We needed to get more information," she said.

To this end Professor Kulkarni and MAPrc Research Fellow Dr Eveline Mu, conducted a review, published last month in 'Australian Prescriber'. It looks at hormonal contraceptive pills and other forms of contraception such as the IUD (intrauterine device) and subdermal implant.

The review, which also draws on research conducted at MAPrc, found that there were few oral contraceptive pills on the market that didn't cause depression in vulnerable women, (vulnerability described by Professional Kulkarni as being "emotionally sensitive to their hormonal milieu").

"It seems to be that the progestin, the synthetic progesterone pill or hormonal contraceptive, is the culprit in terms of creating worse depression or depression for the first time whereas the estrogen component by and large seems to be good for mental health," she said. "That's been backed by animal research and our own work in the field. So put bluntly, estrogen is good for mental health, progestin is not good except for a very few types of progestin.

"There's only one pill on the market that has a 'good' progestin, which we often prescribe, that is a nomegestrol - estradiol combination."

The paper ranks hormonal contraceptives from best to worst in terms of mental health for vulnerable women.

It concludes that general community education and better information about the relationship between oral contraceptive pills and depression is urgently needed for primary healthcare practitioners. "The global rate of depression is climbing, especially in young women; we need to get on top of this.

"If a general practitioner or other practitioner is starting to write a prescription for a woman it would be important to consider whether she has a history of depression on a hormonal contraceptive, whether she has premenstrual depression or whether she has a strong family history of depression and then in those cases we would urge people to prescribe the mood-neutral pill that's on the market, nomegestrol plus estradiol," she said.

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"I'm not by any means saying that this is the only factor that women of reproductive age are facing but it could be the tipping point factor for someone who is already facing work or relationship challenges and other stresses. If we could get rid of the hormone contraceptive that might be the 'tipping point' factor, that can really help the woman with depression."

Professor Kulkarni said health professionals should consider the huge impact that the hormones in the pill have in the brain and on women's mental health.

"While I'd be the first to say that good contraception is absolutely critical for women, hormone contraception is developed to focus on stopping ovulation and the implantation of the fertilised ovum and preventing those two processes – all below the waist considerations!" she said. "However, these hormones are also potent brain steroids, and their actions in the brain are multiple. New hormone contraceptives being developed must also include depression and other mental health measures as part of the clinical trials being done"

Professor Kulkarni said that not all women were sensitive to the effects of hormonal contraception and that more research needed to be done into why some women have mental health changes due to hormone contraception and others do not.

Monash University, 29 July 2022

https://monash.edu

What you need to know about chemicals in your sunscreen

2022-08-01

News stories have recently raised alarms about sunscreens. Last summer, several spray sunscreens were recalled after benzene, a known carcinogen, was detected in them. Other research has shown that some sunscreen ingredients can seep through skin into your bloodstream, and the Food and Drug Administration has asked manufacturers for more data on their safety. And Hawaii has banned certain ingredients because of concerns that they may harm ocean reefs.

With all that, you may be asking yourself whether sunscreen is still worth it.

The short answer: Absolutely. While those issues raise real concerns, at this point the risks are more theoretical than proved. Regular sunscreen

Concerns about sunscreen ingredients being absorbed through skin and into the bloodstream have prompted some researchers to look for alternatives.

use, on the other hand, clearly prevents skin cancers and saves lives. Some research suggests that it can lower the risk of melanoma, the most serious type of skin cancer, by about 50 percent.

In addition, there are smart choices you can make to ensure that the sunscreens you choose for yourself and your family are safe and effective, and maybe better for the environment.

To help in that effort, Consumer Reports tests dozens of sunscreens, identifying those that work best and those that don't protect you as well. We've also tested every spray sunscreen in our ratings for benzene: All were free of the harmful chemical. (Read "Benzene, a Known Carcinogen, Has Been Found in Some Spray Sunscreens, Deodorants, and Other Products" for more on benzene in aerosol personal care products.) We also delved into the research and talked with experts to understand the potential health and environmental health risks posed by some sunscreen ingredients. Here are answers to some important questions.

Are some of them safer?

Recent research has led to some concerns about chemical sunscreens — those that use one or more of a dozen chemical ingredients approved for use in the United States to filter the sun's damaging ultraviolet rays.

In 2019, the FDA announced that it wanted more information on the safety of those ingredients, including whether they are absorbed systemically — through the skin into the bloodstream. That's in part because Americans are now using a lot more sunscreen than in the past, and because today's products contain more combinations and higher concentrations of the ingredients.

Soon after, FDA scientists published studies showing that six common chemical ingredients — avobenzone, homosalate, octinoxate, octisalate, octocrylene and oxybenzone — do indeed get into the bloodstream.

The FDA stresses that absorption doesn't mean these ingredients are unsafe. But the amounts absorbed were higher than the levels the FDA says would exempt them from safety testing, so more research is needed.

"The key question is whether that systemic absorption actually causes harm," says Kathleen Suozzi, assistant professor of dermatology at the Yale School of Medicine in New Haven, Conn.

Definitive answers may be years away. "Generating the type of information the FDA desires is tough, time-consuming and very expensive," says Mark

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Chandler, president of ACT Solutions, which consults with sunscreen and other cosmetic manufacturers on product formulation.

Avoid chemical sunscreens?

The FDA, the American Academy of Dermatology and independent researchers say there is no need for people to stop using chemical sunscreens.

"These UV filters have been used for years by millions of people, and there have not been noticeable systemic effects," says Henry W. Lim, a leading sunscreen researcher and former chair of the department of dermatology at Henry Ford Health in Michigan, who has also consulted with sunscreen-makers. "I still feel very comfortable saying these are a safe way to prevent skin cancer and other damage from the sun."

But some of those chemicals may be more worrisome than others. "Oxybenzone and, to a lesser extent, octinoxate have emerged as the biggest concerns," Lim says.

That's primarily because preliminary research in animals suggests that oxybenzone might interfere with hormone production, which theoretically could affect fertility, puberty and thyroid function. But sunscreen research that has been done in humans hasn't raised any major concerns. For example, although a 2020 review of 29 studies that looked at the health effects of oxybenzone and octinoxate said more research was needed, it also did not identify clear links to any health problems.

Still, to play it safe, the American Academy of Pediatrics recommends that parents not use oxybenzone-containing sunscreens on children. And people of any age who want to avoid sunscreens with either of those chemicals can easily do so, because manufacturers are now using them less often. Few sunscreens in our ratings contain oxybenzone and none have octinoxate.

Use mineral sunscreen?

It's true that sunscreens with the minerals titanium dioxide and zinc oxide — which work by creating a physical barrier on your skin — aren't absorbed into the skin and don't make their way into the bloodstream.

Unfortunately, those mineral sunscreens might not be as effective as products with the most efficient chemical filters, Chandler says. All the mineral sunscreens CR has tested appear near the middle or bottom of our ratings.

One possible reason: It takes a lot of titanium or zinc to create a product with a high SPF, Chandler says, and it's difficult to do that without making the sunscreen thick, gloppy and hard to rub in. In addition, the minerals sometimes clump up in the product, so they don't get evenly dispersed on skin, leaving potential gaps in protection.

Try 'reef safe' products?

Some research suggests that oxybenzone and octinoxate may threaten coral in ocean reefs and harm other marine life. So far, that connection has primarily been studied at high doses and in the lab, not in the real world. And in research looking at sunscreen chemicals in ocean water, the amounts detected, even at popular beaches, are far below the levels linked to damage in lab studies.

Still, the potential concern has prompted Hawaii, the U.S. Virgin Islands and some other locations to ban sunscreens with either ingredient. And some sunscreen manufacturers now label their products as "reef safe." In most cases, the term is used when a product doesn't have either oxybenzone or octinoxate. But the FDA does not regulate the term, so it has no defined meaning.

So if you want a product without oxybenzone or octinoxate, your best bet is to check the ingredients list.

Does a spray or lotion work better?

Used correctly, both can do a good job.

But sprays can be tricky to apply. "The droplets can disperse into the air, making it easy to miss areas on your skin," Lim says. To avoid that, spray sunscreen onto the palm of your hand and then rub it in. Next best is to hold the nozzle just an inch from your skin, spray until you can see a film on your skin and then rub it in.

Also take care to make sure you don't inhale the spray, because the ingredients may irritate or even harm your lungs. (For that reason, CR's experts say it's best not to use sprays on kids.) Spraying it into your hand also helps prevent inhalation. Never spray directly into your face, and be careful using sprays when it's windy. The spray can blow into your face and mouth, or disperse and not adequately cover your skin.

Skip sunscreen if you cover up?

Not entirely. You still need it on exposed skin. Experts point to enormous amounts of research linking sun exposure to about 90 percent of skin

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cancers, and the proven effectiveness of sunscreens in blocking cancer-causing UV rays.

But covering up means you can use far less sunscreen. For example, if you wear a long-sleeved swim shirt or rash guard instead of a traditional bathing suit, you won't need to apply sunscreen to your arms, back and chest. That can reduce the amount of sunscreen that you need to use on your body and that might get into your skin or into the ocean.

Dermatologists say sunscreen should never be your only defense against UV rays. Try to avoid the sun at its strongest, between 10 a.m. and 4 p.m. And when you are outside, especially during those hours, cover up, wear a broad-brimmed hat and seek shade when possible.

Are safer ones coming?

Concerns about sunscreen ingredients being absorbed through skin and into the bloodstream have prompted some researchers to look for alternatives, says Christopher Bunick, associate professor of dermatology at the Yale School of Medicine.

Researchers there are exploring formulas that encapsulate chemical sunscreen ingredients, which would keep them on top of the skin and provide protection without being absorbed.

It's also possible that some of the sunscreen ingredients used in Europe and Canada will be approved for use here. A few are stuck in the FDA approval process. "So this is a glimmer of hope that we might eventually see [them] used in sunscreens in the U.S.," Lim says.

Washington Post, 1 August 2022

https://washingtonpost.com

Health care is responsible for 7% of our carbon emissions, and there are safe and easy ways this can be reduced

2022-08-03

While we think of carbon emissions coming from manufacturing and agriculture, we don't often think of those arising from health care. In Australia, health care is responsible for 7% of national carbon emissions, while globally, health care is responsible for 4.4% of emissions.

Around 5% of the UK's healthcare emissions come from anaesthetic gases and metered dose inhalers, commonly called puffers, used for the treatment of asthma.

If global health care was a country, it would be the world's fifth largest emitter. The warming resulting from health-care's emissions in turn cause harm to human health through heatwaves, wildfires, increased mosquito-borne infectious diseases, and undernutrition due to drought and lower fish stock.

In short, treating patients indirectly causes human harm, at odds with the mission of health-care professionals to increase the duration and quality of patients' lives.

What can health care do about its emissions?

Analysis of the UK's National Health Service's (NHS) emissions shows nearly 45% of its carbon emissions come from purchasing equipment and medicines, with only 10% coming from the electricity and gas needed to run hospitals and other health services.

We don't currently have detailed data on Australia's health sector emissions, but assuming we are similar to the UK, reducing emissions will require changes in how health-care professionals provide care.

There are things health care can start doing today to reduce its emissions, while not harming patients.

Scans

Our latest research has shown one MRI scan has a carbon footprint of 17.5kg CO_2 equivalent, which is the same as driving a car 145km, while one CT scan has a footprint of 9.2kg CO_2 equivalent, or driving 76km.

These are significantly higher than X-rays (0.76kg CO_2 equivalent, 6km) and ultrasound (0.53kg CO_2 equivalent, 4km).

While imaging is important in providing information to doctors in many circumstances, it is often unnecessary. For example, studies have shown 36-40% of imaging for lower back pain, and 34-62% of CT scans for lung blood clots are unnecessary. These scans were assessed as unnecessary because they were given to patients who didn't need them according to evidence-based guidelines or decision rules. Such scans offer little or no benefit to patients, may result in harm, and waste resources.

There are also opportunities to use low-carbon scans instead of high-carbon, such as using ultrasound rather than MRI for shoulder scans.

Other research we have performed has shown the impact of blood tests is between 49-116g CO_2 equivalent per test. While individually small,

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more than 70 million blood tests are performed annually in Australia. Like imaging, studies have shown 12-44% of blood tests are unnecessary.

Some specific tests are ordered unnecessarily at even higher rates. For example, it's estimated over 75% of Vitamin D blood tests in Australia are unnecessary, with this costing Medicare more than $80 million annually.

Gases

Around 5% of the UK's healthcare emissions come from anaesthetic gases and metered dose inhalers, commonly called puffers, used for the treatment of asthma.

Anaesthetists can use the clinically equivalent anaesthetic gas sevoflurane (144kg CO_2 equivalent per kilogram) instead of desflurane (2,540kg CO_2 equivalent per kilogram).

Nitrous oxide or laughing gas (265kg CO_2 equivalent) can be excluded from general anaesthesia without harm, and there are calls for a reduction in its use as acute pain relief for childbirth due to its high levels of emissions.

Midwives, however, have cautioned mothers should not be be made to feel guilty about their pain relief choices, and suggested hospitals could introduce nitrous destruction systems to allow its ongoing use.

Metered dose inhalers contain hydrofluorocarbons, which are potent greenhouse gases. A patient using a preventer and a bronchodilator to stop wheezing can be safely moved from using metered dose inhaler delivery to the same drugs, delivered using a dry-powder inhaler in most cases.

This shift reduces their annual carbon footprint from 439kg to 17kg CO_2 equivalent. Importantly, it can be achieved without changing health outcomes for patients, as can be seen with 90% of inhalers in Scandinavian countries now being dry-powder, with no change in respiratory outcomes.

Getting health care to net-zero

These are only a few examples of how health care can reduce its emissions while not compromising patient safety or quality of care – either by moving from high carbon to low carbon alternatives, or by reducing unnecessary testing or treatments.

The Australian Medical Association and Doctors for the Environment have called for Australian healthcare to be net-zero by 2040, with an interim emission target of an 80% reduction by 2030.

This can be achieved, but will require both ongoing education of current and future health-care professionals about low-carbon care, and targeted commitments by individual health-care organisations, and federal and state health departments.

The Conversation, 3 August 2022

https://theconversation.com

Researchers create biosensor by turning spider silk into optical fiber

2022-08-02

Researchers have harnessed the light-guiding properties of spider silk to develop a sensor that can detect and measure small changes in the refractive index of a biological solution, including glucose and other types of sugar solutions. The new light-based sensor might one day be useful for measuring blood sugar and other biochemical analytes.

"Glucose sensors are crucial to people with diabetes, but these devices tend to be invasive, uncomfortable and not cost-efficient," said research team leader Cheng-Yang Liu from National Yang Ming Chiao Tung University in Taiwan. "With spider silk attracting attention for its superior optomechanical properties, we wanted to explore using this biocompatible material to optically detect various sugar concentrations in real-time."

Liu and colleagues from Taiwan Instrument Research Institute and Taipei Medical University describe their new sensor in Biomedical Optics Express. They show that it can be used to determine concentrations of fructose, sucrose and glucose sugars based on changes in a solution's refractive index. Spider silk is ideal for this application because it can not only transmit light like an optical fiber but is also very strong and elastic.

"Our new spider silk-based fiber optic sugar sensor is practical, compact, biocompatible, cost-effective and highly sensitive," said Liu. "With further development, it could lead to better at-home medical monitoring devices and point-of-care diagnostic and testing devices."

From silk to sensor

Researchers used the light-guiding properties of spider silk to develop a sensor that can detect and measure sugar concentrations based on refractive index.

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To make the sensor, the researchers harvested dragline spider silk from the giant wood spider Nephila pilipes, which is native to Taiwan. They enveloped the silk, which is just 10 microns in diameter, with a biocompatible photocurable resin and cured it to form a smooth protective surface. This created an optical fiber structure that was 100 microns in diameter, with the spider silk acting as the core and the resin as the cladding. They then added a biocompatible nano-layer of gold to enhance the fiber's sensing abilities.

This process formed a thread-like structure with two ends. To use the fiber to take measurements, the researchers immersed one end in a liquid sample and connected the other end to a light source and a spectrometer. This allowed the researchers to detect the refractive index of the solution and use it to determine the type of sugar and its concentration.

"The spider silk-based sugar sensor is reusable, cost-effective, easy to use and offers real-time detection," said Liu. "Moreover, because it is compact it could allow access to hard-to-reach areas such as the brain and heart. With further development, it is also hoped that this silk-based fiber optic sugar sensor could be used in implantable medical devices and treatment strategies in biomedical applications."

Consistent, accurate readings

To test the repeatability and stability of the sensor over time, the researchers used it to measure solutions with unknown concentrations of fructose, sucrose or glucose sugars at room temperature. The measurements were each repeated 10 times at 5-minute intervals.

To quantitatively determine the performance of the silk-based fiber optic sensor, the researchers compared the light intensity spectra produced by the sensor with refractive index measurements acquired with a commercial refractometer. The sensor was able to both identify the type of sugar in the solution and provide a readout of the concentration.

"The measurement precision and sensing sensitivity we achieved suggests that the sensor can accurately estimate the concentration of an unknown sugar solution," said Liu. "Moreover, the sensing sensitivity for our proposed sensor completely encompasses the range of sugar concentrations found in human blood."

Before the sensor can be used for real-time measurements in a clinic or home-use device it will be necessary to improve its accuracy and enhance

its stability under environmental changes so that it can be used for longer periods of time.

The researchers are also working on software that would allow the sensor to be used with mobile devices for point-of-care readings. They also want to extend the sensor's functionality so that it could be used to measure different biochemical components in human blood such as lactose and fat.

Phys Org, 2 August 2022

https://phys.org

Your Yard Could Be a Wildlife Sanctuary

2022-07-29

When Donna Corbelli Castro moved to her home in South Florida 25 years ago, her yard was "stark, barren, hot and devoid of any trees," she says. The typical way to tackle this would have been to do what many of her neighbors had done: lay down a tidy, manicured lawn, perhaps with a couple of little bushes or decorative plants.

But as a horticulturist, Castro had a different vision: a yard brimming with native trees and shrubs. She promptly set about creating a "mini forest" in front of her house. Today, there is virtually no lawn space in Castro's yard. Instead, it's a gorgeous homegrown wildlife sanctuary that attracts and nourishes a wide range of local pollinators.

"The trees make a canopy over our patio and yard, the air is fresh and fragrant, and wildlife abounds," she says. "Although I live near a fairly busy street, and have neighbors on every side, you feel like you are in another world. The butterflies are too numerous to count at times. The birds are building nests and feasting off the bounty of the native trees and shrubs, and the bees are always buzzing, happily collecting nectar and pollen."

Nouveaux Voisins — New Neighbors, in English — envisions a world of yards like this, where suburban landscapes teem with life and buzz with planet-nourishing biodiversity. The Montreal-based nonprofit aims to "transform the culture of lawns" by educating people about how they can turn their yards (or balconies, or window ledges) into critical habitats for native plants and pollinators.

A glimpse of this world can be seen in its series of "showcase gardens" in Montreal's Jean Drapeau Park, a sampler of aesthetically pleasing, biodiversity-rich yard types. There's a variety to choose from, as different yards mimic different natural habitats: dry meadow, open woods, lowland garden, shady forest glade. Taken together, they represent a range of gardening aesthetics, from "pretty wild" to "semi-lawn." The idea is to offer visible proof that a native yard can be beautiful, too, and that there are options to match anyone's taste.

What we do with our yards matters, in part because they've become such a dominant part of our world. Residential yards make up more than 16 percent of all land in the contiguous United States, and are rapidly expanding. Most of these are simple turfgrass, which is now the nation's largest irrigated crop. Yet these lawns are ecologically inert — many scientists refer to them as "biodiversity deserts."

Lawns are America's biggest irrigated crop. Converting some of them into natural habitats could do wonders for Earth's biodiversity.

"Simplifying the landscape so that we just have one or two trees and turfgrass takes away plant diversity, it takes away structural diversity, it takes away habitat that wildlife [use to] live, feed and raise their young," says Desirée Narango, an ecologist and researcher at the University of Massachusetts, Amherst. "All of those important resources are lost."

"In many cases," she adds, "we have taken away the native vegetation and replaced it with nonnative or exotic vegetation that — in many to most cases — our wildlife has not adapted to use."

Narango was the lead author of a 2018 Smithsonian Institute study that found that using nonnative trees and shrubs in residential yards can lead to declines in native bird species. She and her colleagues found that suburban Maryland yards with nonnative plants were less likely to have breeding Carolina chickadees, and those chickadees fledged fewer young, because the nonnative plants didn't support insects that the chickadee feeds on. The only yards that were able to sustain a stable population of chickadees were those that contained more than 70 percent native plants, the study found.

"There are a lot of folks who think the only reason they have birds in their backyard is because they have feeders, but in reality it's the amount of insect biodiversity that's supporting the birds," says Narango. "If we can help people make that connection that the more insects you support, the more songbirds you're going to have … that would be a huge step."

A basic principle to stick to in wildlife-friendly gardening is to be inspired by nature, says Emile Forest, chief coordinator and gardener for Nouveaux Voisins. This is the approach Nouveaux Voisins takes with its showcase gardens. Each contains four to eight plant varieties that are found in natural environments like woodlands, meadows or prairies. A garden representing prairie conditions, for example, features airy clusters of tufted hairgrass and clumps of wild thyme, which blooms bright purple. Another garden inspired by meadows and open woodland contains tall pink and purple coneflowers, irresistible to butterflies and bees.

"With cuisine, chefs often say 'If it grows together, it goes together,'" says Forest. "It's the same in natural planting. If it grows together it's going to look good in a garden, but you can rearrange it in a way that is more organized and orderly."

The showcase gardens recognize that the human environment is nearly as diverse as nature itself. For urbanites, for example, Forest and his team have designed gardens well-suited to busy roadsides, featuring native

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plants that can thrive in depleted soil, such as the bright-yellow butterfly flower and the ethereal prairie dropseed. For those whose yards get little sun, they've designed gardens with shade-loving plants like the delicate dwarf-crested iris. Gardeners who are busy (or lazy) are pointed toward easy-to-maintain groundcover varietals like wild strawberry. This removes the guesswork for new converts: Forest says he wants visitors to be able to "copy-paste" these gardens into their own yards if they choose.

But copying and pasting a natural yard requires access to the local flora — which, ironically, is often hard to find locally.

"Native plant availability is not where it should be," says Narango. "It needs to be more widely available, it needs to be more affordable, it needs to be in places like Home Depot and Wal-Mart."

The great majority of plants sold by garden centers and nurseries are nonnative, though smaller, independently-owned nurseries tend to offer a greater selection of native plants than big retailers, says Narango. Even when these stores do carry native plants, they're often not clearly marked as such, making it difficult for consumers to make smarter choices for the environment.

"When people are going to get their plants, they [should] see a sign that says, 'This is good for butterflies,' or, 'Here's a native sunflower,'" says Narango. "I think in most cases when people are armed with the information they'll value wildlife. Especially charismatic wildlife."

Despite this, Forest has seen promising signs of wildlife-friendly gardening in Montreal, from balconies draped with tomatoes to back alleys bright with native perennials. And he says the public has been receptive to Nouveaux Voisins' mission to challenge traditional horticultural practices.

In addition to its showcase gardens, Nouveaux Voisins provides landscaping consulting, or what Forest and his colleagues call "planting design."

"Essentially, rather than trying to control the entire project, as is often the case in horticulture, we [help] citizens to reimagine their yard in a quick co-design session," Forest says. After taking into account the clients' gardening preferences and abilities, Nouveaux Voisins helps them design simple planting beds that feature native plants. This approach allows Nouveaux Voisins to offer landscaping services for about half of what they would normally cost.

"Usually, it is the people who have a little less money, but for whom the mission of rewilding cities is important, who choose this service," says Forest. "Half of our 55 current projects are planting designs."

Nouveaux Voisins is also developing a research partnership with Concordia University to measure the ecological and social impacts of hundreds of experimental gardens in Montreal.

Because one of the nonprofit's goals is to "plant more diverse cities," Forest and his colleagues will start tracking the number of green spaces where they've been able to boost biodiversity.

"Our measure of success isn't to have five perfectly designed ecological gardens by the end of the year," Forest says, "but to change, for example, 100 backyards and say we helped convert so many citizens to a new way of gardening."

Restoring wildlife habitat is a slow process, particularly when it conflicts with entrenched societal attitudes and market supply. But it's one that can be infinitely rewarding — for us and for the planet.

"If everyone who owns a home turned half of their lawn area to trees and shrubs, it could change the world," says Castro, echoing ecologists like Douglas Tallamy, author of Nature's Best Hope: A New Approach to Conservation That Starts in Your Yard. Her decision to let her yard "go" felt drastic at first, but Castro never needs to mow a lawn, and her plants mostly maintain themselves. And when she sits in her garden on a summer evening, with the scent of flowers in the cool air and frogs chorusing in the background, she knows she did the right thing.

Reasons to be Cheerful, 29 July 2022

https://reasonstobecheerful.world

Is everything we think we know about Alzheimer's wrong?

2022-08-01

If you've followed the news about Alzheimer's disease research in the past few months, you might find yourself wondering what else could go wrong.

First, a much-anticipated new drug called Aduhelm got approval from the Food & Drug Administration—but its actual effect on patients was so small that insurance won't cover it for most patients.

The paper at the center of the scandal has to do with a specific form of amyloid, AB*56, that was put forth as an important "toxic oligomer" encouraging plaque formation.

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Then, several other promising drugs in development by pharmaceutical companies got sidelined or showed less-than-impressive results in clinical trials.

And then a scandal broke: New evidence came to light in Science that researchers had faked images in a paper published 16 years ago—a paper that other researchers had trusted and relied on as they did their own work.

And what do all of these developments have to do with one another?

They're all tied to the molecule beta-amyloid, the plaque-forming sludge that gunks up the outside of brain cells. The molecule that decades of research has focused on as an important factor in the disease and potential treatments to reverse it.

But in fact, scientists at the Michigan Alzheimer's Disease Center and elsewhere have spent years looking beyond amyloid for answers to the roots of dementia and ways to prevent or treat it.

"It's true that amyloid plays a role in the brain and dementia, but Alzheimer's disease is complicated and there's much more to it than one molecule," says Henry Paulson, M.D., Ph.D., who directs the center and has devoted his own laboratory's research at Michigan Medicine and his clinical care to dementia and other neurodegenerative diseases for decades.

The paper at the center of the scandal has to do with a specific form of amyloid, AB*56, that was put forth as an important "toxic oligomer" encouraging plaque formation.

But Paulson says he and many of his colleagues have not paid much attention to it for many years, because researchers haven't been so successful at achieving the same results that the original researchers claimed.

"I'm more worried about what this news might do to the public's perception of science than to our ability to make progress against this disease," he says. The long delay in uncovering the alleged fakery isn't ideal, and shows the importance of scientists speaking up and publishing results even when their experiments fail to prove another team's claim."

This kind of publishing of "negative results"—papers that don't give good news about a potentially promising idea—is not always encouraged,

because scientists have more reason to leave those results on the shelf and spend time writing papers about things that do work.

But if no one knows that an effort to reproduce a scientific discovery has failed, then other scientists could spin their wheels driving down a blind alley.

Paulson notes that it is still important to study the protein that gets cut up, or cleaved, in order to make different forms of beta-amyloid, and the consequences of that process.

But he's not necessarily surprised by the failure of Aduhelm, the much-talked-about drug that got approval last year, to produce a sizable effect even in the patients it was tested in.

The drug is not available at the clinics or hospitals of Michigan Medicine, and Medicare will only cover its high cost for people taking part in clinical trials. Other drugs in the pipeline at drug companies that focus on beta-amyloid should be scrutinized carefully before getting any approval, he adds.

"We believe much more attention needs to be paid to other factors and proteins underlying various dementias, ranging from environmental factors, to the immune system, to specific molecules like tau, which is the other hallmark protein of Alzheimer's disease," he explains. "In my view, the Aduhelm story underscores the importance of continuing to look for other therapeutic targets in Alzheimer's disease and related dementia."

Targeting amyloid for treatments may be like trying to saddle up a horse that has already left the barn, he says—too much has happened in the disease process by the time the plaques begin to form for a treatment to make a difference.

Working upstream in the process, and doing more with modern tools to understand the process by studying people in the early stages of memory loss, could prove more important.

That's why the Michigan Alzheimer's Disease Center is always seeking people to take part in studies involving everything from brain scans to surveys. Anyone who wants to get involved can start the process by making an initial inquiry.

Alzheimer's and other forms of dementia are complicated diseases, and likely result from multiple things going wrong in the brain over time, not one rogue molecule, Paulson explains. So it may end up that we need to

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treat patients with multiple treatments at once, targeting several aspects of their disease—just like cancer or HIV-positive patients receive today.

But in the meantime, research has already shown another important upstream effect that many people may not realize, Paulson says.

There's plenty of evidence that middle-aged and older adults who want to reduce their risk of dementia, or slow its onset, should focus on healthy habits like sleep, nutrition, exercise, social engagement, and controlling blood pressure and cholesterol. The role of lifelong education and learning—whether informal or formal—is also clear

"If you're 70 years old, I can't tell you to go back in time and eat healthier or get more years of school, but I can tell you to do more to get a good night's sleep as often as possible, and connect socially with other people," says Paulson, a professor of neurology.

For the millions of families dealing with a loved one's dementia today, the hope of new treatments may seem like a faint light on the horizon that's fading as their loved one gets further into their disease.

That's why it's also important to focus on supporting caregivers and understanding their needs through research that could impact public policy and insurance coverage—another focus of the center's programs and research.

Research takes time, which today's patients may not have a lot of. But with help from patients and families willing to volunteer for research studies, including tests of new drugs, it can move as quickly as possible, with safeguards in place to make sure it's happening safely and honestly.

Medical Xpress, 1 August 2022

https://medicalxpress.com

Three reasons concrete doesn't live up to its environmental claims

2022-08-01

Up to 8% of all global anthropogenic human-made emissions are due to just one material, cement. And our use of it is rising.

The cement and concrete industry is encouraging this use, for example, by claiming that using concrete will reduce the "whole life" carbon emissions from buildings.

Up to 8% of all global anthropogenic human-made emissions are due to just one material, cement. And our use of it is rising.

The absence of regulations to measure this has allowed such claims to play an important role in persuading designers and specifiers to use certain products. However, research conducted by my colleagues and me shows that these claims are often, at the least, exaggerated.

We identified the use of three such claims. First is the claim that because concrete has a high thermal mass, which allows it to act as a heat store, it will reduce the carbon emissions from heating and cooling a building during its life.

The second claim is that concrete is more durable than other materials, and that therefore concrete buildings will last longer, reducing the need to build new. The third is based on the ability of concrete to undergo carbonation, in which carbon dioxide is slowly absorbed from the atmosphere. This means that concrete can be seen as a "carbon sink," and so is a sustainable choice.

These messages, among others, are promoted by the Mineral Products Association (MPA), the UK's trade association, through their technical guidance and their sector roadmap to "beyond net zero." Similar messages have been repeated by the European concrete industry.

Our research reveals a very different picture.

Absorbing heat won't cut heating use

First, while concrete's thermal mass does indeed allow it to act as a store of heat, or "coolth," this is likely to do little to reduce the carbon emissions from heating buildings. Concrete's capacity to absorb heat is instead more likely to necessitate an increase in heating energy use, since the concrete needs to be heated as well as the room space.

This can be illustrated by considering stone-built churches, which give testament to the challenges of heating buildings with high thermal mass. It is true that the use of exposed concrete may reduce the need for cooling, particularly in deep plan office buildings. However, in relatively cool climates such as the U.K., cooling still uses only a fraction of the energy of heating.

What's more, cooling is predominantly powered by the national electricity grid, which is rapidly being decarbonized. Our research shows that the calculations for using construction materials that take lots of carbon to make, in order to save decreasing amounts of future operational carbon, just don't add up.

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Buildings are replaced before they need to be

The second argument, durability, is similarly flawed. Our research found that few buildings are demolished because they have reached structural obsolescence. Instead they are destroyed to make way for "regeneration" in areas which are economically booming.

There is also little evidence to suggest that concrete buildings are more durable than others. The number of exposed concrete buildings and structures which have "concrete cancer," in which the steel reinforcement bars have started to rust and degrade and the concrete to break, suggests rather the opposite.

Meanwhile, millions of ancient buildings around the world constructed of timber, as well as brick and stone, suggest that other building materials can be highly durable.

Concrete buildings don't absorb much carbon

Finally, the ability of concrete to absorb carbon is typically oversold. Only the exposed surface of concrete will carbonate. So concrete situated underground, or hidden under coatings or cladding, will not act as a carbon sink.

Reinforced concrete is also designed to minimize carbonation, as this leaves the steel reinforcement vulnerable to rusting. Carbonation therefore occurs mainly after the end of life of the building, once the concrete is crushed.

If concrete rubble is left exposed to air, it will slowly reabsorb a proportion of the carbon dioxide emissions that were emitted in its original manufacture. This is more correctly understood as "partial re-carbonation" and scarcely represents a good argument for using additional high-carbon concrete in new buildings.

Is the tide changing?

During 2021–22, the U.K. government's Environmental Audit Committee held an inquiry into the sustainability of the U.K.'s built environment. In their response to the inquiry, the MPA again repeated its claims of thermal mass, durability and carbonation.

However, the report on the outcome of the inquiry does not repeat these claims. Instead, it encourages the increased use of lower carbon materials such as timber, and calls for the measurement of the whole life carbon of buildings to be included in regulations.

Alongside the recent introduction of such regulations in several European countries, this should support a move away from high-carbon materials. The accurate measurement and genuine reduction of carbon, both as embodied in the materials and resulting from the operation of a building, are essential to reducing our impact on the environment.

TechXplore, 1 August 2022

https://techxplore.com

New discovery of panda species which may have been Europe's last

2022-08-01

Lumbering through the forested wetlands of Bulgaria around six million years ago, a new species of panda has been uncovered by scientists who state it is currently the last known and "most evolved" European giant panda.

Unearthed from the bowels of the Bulgarian National Museum of Natural History, two fossils of teeth originally found in the eastern European nation in the late 1970s, provide new evidence of a sizable relative of the modern giant panda. Unlike today's iconic black and white bear however, it was not reliant on purely bamboo.

"Although not a direct ancestor of the modern genus of the giant panda, it is its close relative," explains the Museum's Professor Nikolai Spassov, whose findings are today published in the peer-reviewed Journal of Vertebrate Paleontology.

"This discovery shows how little we still know about ancient nature and demonstrates also that historic discoveries in paleontology can lead to unexpected results, even today."

The upper carnassial tooth, and an upper canine, were originally cataloged by paleontologist Ivan Nikolov, who added them to the museum's trove of fossilized treasures when they were unearthed in northwestern Bulgaria. This new species is named Agriarctos nikolovi in his honor.

"They had only one label written vaguely by hand," recalls Professor Spassov. "It took me many years to figure out what the locality was and what its age was. Then it also took me a long time to realize that this was an unknown fossil giant panda."

"Although not a direct ancestor of the modern genus of the giant panda, it is its close relative."

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The coal deposits in which the teeth were found—which have imbued them with a blackened hue—suggest that this ancient panda inhabited forested, swampy regions.

There, during the Miocene epoch, it likely consumed a largely vegetarian diet—but not purely reliant on bamboo!

Fossils of the staple grass that sustains the modern panda are rare in the European—and, especially, in the Bulgarian late Miocene—fossil record and the cusps of the teeth do not appear strong enough to crush the woody stems.

Instead, it likely fed on softer plant materials—aligning with the general trend toward increased reliance on plants in this group's evolutionary history.

Sharing their environment with other large predators likely drove the giant panda lineage toward vegetarianism.

"The likely competition with other species, especially carnivores and presumably other bears, explains the closer food specialization of giant pandas to vegetable food in humid forest conditions," states Professor Spassov.

The paper speculates that A. nikolovi's teeth nonetheless provided ample defense against predators. In addition, the canines are comparable in size to those of the modern panda, suggesting that they belonged to a similarly sized or only slightly smaller animal.

The authors propose that A. nikolovi may have become extinct as a result of climate change, probably because of the 'Messinian salinity crisis'—an event in which the Mediterranean basin dried up, significantly altering the surrounding terrestrial environments.

"Giant pandas are a very specialized group of bears," Professor Spassov adds. "Even if A. niklovi was not as specialized in habitats and food as the modern giant panda, fossil pandas were specialized enough and their evolution was related to humid, wooded habitats. It is likely that climate change at the end of the Miocene in southern Europe, leading to aridification, had an adverse effect on the existence of the last European panda."

Co-author Qigao Jiangzuo, from Peking University, China, was primarily responsible in helping to narrow down the identity of this strange beast to belonging to the Ailuropodini—a tribe within the Ursidae bear family.

While this group of animals is best known by its only living representative, the giant panda, they once ranged across Europe and Asia. Intriguingly, the authors propose two potential pathways for the distribution of this group.

One possible evolutionary trajectory has the Ailuropodini heading out of Asia and concluding in A. nikolovi in Europe.However, Professor Spassov does add caution to this hypothesis, stating that the paleontological data show that "the oldest members of this group of bears were found in Europe".This suggests that the group may have developed in Europe and then headed to Asia, where the ancestors of another genus, Ailurarctos, developed. These early pandas may then have later evolved into Ailuropoda—the modern giant panda.

Phys Org, 1 August 2022

https://phys.org

The tongue: How one of the body's most sensitive organs is helping blind people 'see'

2022-08-02

Ever wondered why kissing feels better than holding hands? The tongue is a pretty incredible piece of kit, though notoriously difficult to study, due to its position inside the mouth. Obviously, it gives us access to the wonderful world of taste, but more than that, it has greater sensitivity to touch than the fingertip. Without it, we aren't able to speak, sing, breathe efficiently or swallow delicious beverages.

So why don't we use it even more? My new study investigates how to make the most of this strange organ—potentially as an interface to help people with visual impairments navigate and even exercise. I realize this may sound mindboggling, but please bear with me.

My research is part of a field known as "sensory substitution," a branch of interdisciplinary science that combines psychology, neuroscience, computer science and engineering to develop "sensory substitution devices" (known as SSDs). SSDs convert sensory information from one sense to another. For example, if the device is designed for a person with a visual impairment, this typically means converting visual information from a video feed into sound or touch.

Drawing pictures on the tongue

The tip of the tongue is more sensitive than our fingertips.

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BrainPort, first developed in 1998, is one such technology. It converts a camera's video feed into moving patterns of electrical stimulation on the surface of the tongue. The "tongue display" (a small device shaped like a lollipop) consists of 400 tiny electrodes, with each electrode corresponding to a pixel from a camera's video feed.

It creates a low-resolution tactile display on the tongue matching the output from the camera. The technology can be used to help stroke victims maintain their sense of balance. And in 2015, the US Food and Drug Administration approved its use as an aid for the visually impaired.

Imagine holding your hand up to a camera and feeling a tiny hand simultaneously appear on the tip of your tongue. It sort of feels a bit like someone is drawing images on your tongue in popping candy.

While the BrainPort has been around for years, it hasn't seen much real-world uptake, despite being ten times cheaper than a retinal implant. I use the BrainPort to test how human attention works on the surface of the tongue, to see if differences in perception might be the cause of this.

In psychology research, there is a famous method to test attention, called the Posner Cueing paradigm, named after the American psychologist Mike Posner who developed it in the 1980s to measure visual attention.

When I say attention, I don't mean "attention span." Attention refers to the set of processes that bring things from the environment into our conscious awareness. Posner found that our attention can be cued by visual stimuli.

If we briefly see something moving out of the corner of our eye, attention focuses on that area. We probably evolved this way to quickly react to dangerous snakes lurking around corners and in the edges of our visual field.

This process also occurs between senses. If you've ever sat in a pub garden in summer and heard the dreaded drone of an incoming wasp to one ear, your attention is very quickly drawn to that side of your body.

The sound of the wasp captures your auditory attention to the general location of the potentially incoming wasp so that the brain can quickly allocate visual attention to identify the exact location of the wasp, and tactile attention to quickly swat or duck away from the wasp.

This is what we call "cross-modal" attention (vision is one mode of sensation, audio another): things that appear in one sense can influence other senses.

Paying attention to the tongue

My colleagues and I developed a variation of the Posner Cueing paradigm to see if the brain can allocate tactile attention on the surface of the tongue in the same way as the hands or other modes of attention. We know loads about visual attention, and tactile attention on the hands and other body parts, but have no idea if this knowledge translates to the tongue.

This is important because BrainPort is designed, built and sold to help people "see" through their tongue. But we need to understand if "seeing" with the tongue is the same as seeing with the eyes.

The answer to these questions, like almost everything in life, is that it's complicated. The tongue does respond to cued information in roughly the same way as the hands or vision, but despite the incredible sensitivity of the tongue, attentional processes are a bit limited compared with the other senses. It is very easy to over-stimulate the tongue—causing sensory overload that can make it hard to feel what's going on.

We also found that attentional processes on the tongue can be influenced by sound. For example, if a BrainPort user hears a sound to the left they can more easily identify information on the left side of their tongue. This could help to guide attention and reduce sensory overload with the BrainPort if paired with an auditory interface.

In terms of real-world use of the BrainPort, this translates to managing the complexity of visual information that gets substituted and, if possible, use another sense to help share some of the sensory load. Using the BrainPort in isolation could be too overstimulating to provide reliable information and could potentially be improved by using other assistive technology alongside, such as the vOICe.

We're using these findings to develop a device to help rock climbers with visual impairments to navigate while climbing. To prevent information overload, we're using machine learning to identify climbing holds and filter out less relevant information. We're also exploring the possibility of using sound to cue where the next hold might be, and then use the feedback on the tongue to precisely locate the hold.

With a few tweaks, this technology may eventually become a more reliable instrument to help blind or deaf or blind people navigate. It may even help

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paraplegic people, unable to use their hands, navigate or communicate more efficiently.

Medical Xpress, 2 August 2022

https://medicalxpress.com

Outsourcing our memory to digital devices may actually be beneficial

2022-08-01

Does anyone remember phone numbers anymore? Or have all these little bits of information you used to memorize moved onto digital devices such as smartphones? Some have argued this outsourcing of our memory is damaging our ability to remember anything properly, but a new study suggests that is not the case. Using a digital device to remember some things may actually be freeing up our brains to remember more things overall. Unless of course, we lose our smartphones …

Around a decade ago German neuroscientist Manfred Spitzer coined the term "digital dementia." Spitzer warned the overuse of digital devices could lead to a novel kind of cognitive decline. By outsourcing many short-term memory demands to devices such as smartphones, he proposed our ability to remember things can be damaged, resulting in a unique kind of amnesia.

But the idea of digital dementia was initially proposed without any real science backing it up and some scientists have suggested using devices to store random bits of information can actually help improve our cognitive abilities by freeing up space to think about other things. Chris Bird, a cognitive neuroscientist from the University of Sussex, recently compared the way we use smartphones to the way we used to jot things down on notepads.

"We have always offloaded things into external devices, like writing down notes, and that's enabled us to have more complex lives," Bird explained to The Guardian. "I don't have a problem with using external devices to augment our thought processes or memory processes. We're doing it more, but that frees up time to concentrate, focus on and remember other things."

A new study, led by researchers from University College London, offers some good evidence to suggest using digital devices to store information

Using a digital device to remember bits of information was found to free up mental space for people to memorize other things.

can actually free up your memory to remember other less important things.

The researchers developed a unique memory game that presented volunteers with a dozen numbered circles on the screen of a tablet. Each circle had to be dragged to either the right or the left side of the screen. If the circle was dragged to the correct side the volunteer would receive a small financial reward.

Half of the circles were classified high-value, meaning they would pay out 10 times more than the regular circles. The volunteers repeated the game a number of times, and had to remember where to drag the circles to receive the greatest reward.

On the first half of the trials, subjects were tasked with using their own memory, while on the second half they were allowed to set a small amount of reminders on a digital device. Unsurprisingly, most subjects used the digital reminders to mark the location of the high-value circles. But not only did their results improve on high-value circle placements when they set digital reminders, most participants also improved on low-value circle placements with no reminders set.

Sam Gilbert, senior author on the new study, says this finding highlights the way using digital devices to store important information can free up mental space to remember lower-order information. So instead of the device impairing people's ability to remember other things, it actually increased their ability to remember more things overall.

"This was because using the device shifted the way that people used their memory to store high-importance versus low-importance information," explained Gilbert. "When people had to remember by themselves, they used their memory capacity to remember the most important information. But when they could use the device, they saved high-importance information into the device and used their own memory for less important information instead."

The findings were not all good news, though. When the subjects using digital devices set with reminders for high-value circles had their devices removed they struggled to remember anything beyond the low-value circle placements. This suggests when information is stored on a digital device a person entrusts that information to the device. And if the device is withheld then that information is likely to be gone.

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This does highlight one major difference between using a digital device to store information and writing it down in a notepad. A large body of research has effectively shown that writing something down on a piece of paper activates a complex neural process that helps strongly encode memory. So writing something down on a piece of paper often means you will remember that thing even without needing to check back over your notes.

But using a digital device to remember information does not work in the same way. And here Gilbert notes the catch. For very important information he suggests we use "back up" storage, such as maybe writing an extra note down somewhere. Maybe it's a valuable password or a crucial phone number. But as long as we have extra backup, there isn't necessarily a problem with offloading information onto digital devices.

"The results show that external memory tools work," Gilbert noted. "Far from causing 'digital dementia,' using an external memory device can even improve our memory for information that we never saved. But we need to be careful that we back up the most important information. Otherwise, if a memory tool fails, we could be left with nothing but lower-importance information in our own memory."

The new study was published in the Journal of Experimental Psychology.

New Atlas, 1 August 2022

https://newatlas.com

Ordinary computers can beat Google's quantum computer after all

2022-08-02

If the quantum computing era dawned 3 years ago, its rising sun may have ducked behind a cloud. In 2019, Google researchers claimed they had passed a milestone known as quantum supremacy when their quantum computer Sycamore performed in 200 seconds an abstruse calculation they said would tie up a supercomputer for 10,000 years. Now, scientists in China have done the computation in a few hours with ordinary processors. A supercomputer, they say, could beat Sycamore outright.

"I think they're right that if they had access to a big enough supercomputer, they could have simulated the … task in a matter of seconds," says Scott Aaronson, a computer scientist at the University of Texas, Austin. The advance takes a bit of the shine off Google's claim, says

Superfast algorithm put crimp in 2019 claim that Google's machine had achieved "quantum supremacy"

Greg Kuperberg, a mathematician at the University of California, Davis. "Getting to 300 feet from the summit is less exciting than getting to the summit."

Still, the promise of quantum computing remains undimmed, Kuperberg and others say. And Sergio Boixo, principal scientist for Google Quantum AI, said in an email the Google team knew its edge might not hold for very long. "In our 2019 paper, we said that classical algorithms would improve," he said. But, "we don't think this classical approach can keep up with quantum circuits in 2022 and beyond."

The "problem" Sycamore solved was designed to be hard for a conventional computer but as easy as possible for a quantum computer, which manipulates qubits that can be set to 0, 1, or—thanks to quantum mechanics—any combination of 0 and 1 at the same time. Together, Sycamore's 53 qubits, tiny resonating electrical circuits made of superconducting metal, can encode any number from 0 to 253 (roughly 9 quadrillion)—or even all of them at once.

Starting with all the qubits set to 0, Google researchers applied to single qubits and pairs a random but fixed set of logical operations, or gates, over 20 cycles, then read out the qubits. Crudely speaking, quantum waves representing all possible outputs sloshed among the qubits, and the gates created interference that reinforced some outputs and canceled others. So some should have appeared with greater probability than others. Over millions of trials, a spiky output pattern emerged.

The Google researchers argued that simulating those interference effects would overwhelm even Summit, a supercomputer at Oak Ridge National Laboratory, which has 9216 central processing units and 27,648 faster graphic processing units (GPUs). Researchers with IBM, which developed Summit, quickly countered that if they exploited every bit of hard drive available to the computer, it could handle the computation in a few days. Now, Pan Zhang, a statistical physicist at the Institute of Theoretical Physics at the Chinese Academy of Sciences, and colleagues have shown how to beat Sycamore in a paper in press at Physical Review Letters.

Following others, Zhang and colleagues recast the problem as a 3D mathematical array called a tensor network. It consisted of 20 layers, one for each cycle of gates, with each layer comprising 53 dots, one for each qubit. Lines connected the dots to represent the gates, with each gate encoded in a tensor—a 2D or 4D grid of complex numbers. Running the simulation then reduced to, essentially, multiplying all the tensors. "The

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advantage of the tensor network method is we can use many GPUs to do the computations in parallel," Zhang says.

Zhang and colleagues also relied on a key insight: Sycamore's computation was far from exact, so theirs didn't need to be either. Sycamore calculated the distribution of outputs with an estimated fidelity of 0.2%—just enough to distinguish the fingerprintlike spikiness from the noise in the circuitry. So Zhang's team traded accuracy for speed by cutting some lines in its network and eliminating the corresponding gates. Losing just eight lines made the computation 256 times faster while maintaining a fidelity of 0.37%.

The researchers calculated the output pattern for 1 million of the 9 quadrillion possible number strings, relying on an innovation of their own to obtain a truly random, representative set. The computation took 15 hours on 512 GPUs and yielded the telltale spiky output. "It's fair to say that the Google experiment has been simulated on a conventional computer," says Dominik Hangleiter, a quantum computer scientist at the University of Maryland, College Park. On a supercomputer, the computation would take a few dozen seconds, Zhang says—10 billion times faster than the Google team estimated.

The advance underscores the pitfalls of racing a quantum computer against a conventional one, researchers say. "There's an urgent need for better quantum supremacy experiments," Aaronson says. Zhang suggests a more practical approach: "We should find some real-world applications to demonstrate the quantum advantage."

Still, the Google demonstration was not just hype, researchers say. Sycamore required far fewer operations and less power than a supercomputer, Zhang notes. And if Sycamore had slightly higher fidelity, he says, his team's simulation couldn't have kept up. As Hangleiter puts it, "The Google experiment did what it was meant to do, start this race."

Science, 2 August 2022

https://science.org

Synthetic embryos grown from stem cells don't need sperm or eggs

2022-08-02

Researchers have created synthetic mouse embryos out of stem cells, removing the need for sperm, eggs and even a womb. They were then

[The embryos were] grown to almost half the entire gestation period, at which point they had all of the organ pro-genitors, including a beating heart.

grown to almost half the entire gestation period, at which point they had all of the organ progenitors, including a beating heart. The tech could eventually be used to grow organs for transplant.

The new study, from researchers at the Weizmann Institute of Science in Israel, built on two branches of the team's previous research. The first involved reprogramming stem cells into a "naive" state that allows them to differentiate into all other cells, including other stem cells. The other work focused on developing a device that could grow embryos more effectively outside of the womb.

By combining the two techniques, the team has now grown some of the most advanced synthetic mouse embryos to date. They started with naive mouse stem cells, which had been cultured in a Petri dish for several years prior. These were separated into three groups that would play key roles in the embryo development.

One group contained cells that would develop into embryonic organs. The other two were treated with master regulator genes of extra-embryonic tissues – the placenta for one group and the yolk sac for the other. The three types of cells were then mixed together in the artificial womb, which carefully controls pressure and oxygen exchange, and gently moves the beakers around to simulate natural nutrient flow.

Once inside, the three types of cells clumped together to form aggregates, which had the potential to develop into embryo-like structures. As might be expected, the vast majority failed at that stage, with only 0.5% – or 50 out of about 10,000 – successfully developing further.

Those lucky few started to form spheres of cells, and eventually elongated structures resembling natural embryos, complete with placentas and yolk sacs. Thy were allowed to develop for over eight days, which is almost half of the mouse gestation period, by which point they had formed all the early progenitors of organs. That includes a beating heart, blood stem cell circulation, a well-shaped brain, an intestinal tract and the beginnings of a spinal column.

On closer inspection, the team found that the shape of internal structures and the gene expression patterns of these synthetic embryos matched natural ones to within 95%. Their organs also seemed to be functional.

The team says that this technique could help reduce the need for live animal testing, and could eventually become a plentiful source of tissues and organs for transplantation.

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"The embryo is the best organ-making machine and the best 3D bioprinter – we tried to emulate what it does," said Professor Jacob Hanna, lead researcher on the study. "Instead of developing a different protocol for growing each cell type – for example, those of the kidney or liver – we may one day be able to create a synthetic embryo-like model and then isolate the cells we need. We won't need to dictate to the emerging organs how they must develop. The embryo itself does this best."

The research was published in the journal Cell.

New Atlas, 2 August 2022

https://newatlas.com

Research reveals the chemical underpinnings of how benign water can transform into harsh hydrogen peroxide

2022-08-02

A new study has put a remarkable and unexpected chemical genesis on more solid footing.

A new study has put a remarkable and unexpected chemical genesis on more solid footing.

Back in 2019, Stanford University researchers and colleagues revealed the surprising discovery that hydrogen peroxide—a caustic substance used for disinfecting surfaces and bleaching hair—spontaneously forms in microscopic droplets of ordinary, benign water. Researchers have since aimed to flesh out how the newfound reaction occurs, as well as exploring potential applications, such as eco-friendlier cleaning methods.

The latest study has revealed that when sprayed microdroplets of water strike a solid surface, a phenomenon known as contact electrification happens. Electric charge jumps between the two materials, liquid and solid, producing unstable molecular fragments called reactive oxygen species. Pairs of these species known as hydroxyl radicals, and which have the chemical formula OH, can then combine to form hydrogen peroxide, H2O2, in minuscule but detectable quantities.

The new study further demonstrated that this process occurs in humid environments when water touches particles of soil as well as fine particles in the atmosphere. Those additional findings suggest that water can transform into small amounts of reactive oxygen species, such as hydrogen peroxide, wherever microdroplets naturally form, including in fogs, mists, and raindrops, bolstering results from a related 2020 study.

"We have a real understanding now that we didn't have before about what is causing this hydrogen peroxide formation to happen," said study senior author Richard Zare, the Marguerite Blake Wilbur Professor in Natural Science and a professor of chemistry in the Stanford School of Humanities and Sciences. "Furthermore, it appears that contact electrification yielding hydrogen peroxide is a universal phenomenon at water-solid interfaces."

Zare led this work, collaborating with researchers from two universities in China, Jianghan University and Wuhan University, as well as the Chinese Academy of Sciences. The study was published Aug. 1 in the Proceedings of the National Academy of Sciences (PNAS).

On the origins of the hydrogen peroxide

For the study, the researchers built a glass apparatus with microscopic channels in it where water could be forcibly injected. The channels formed an airtight water-solid boundary. The researchers perfused the water with a fluorescent dye that glows in the presence of hydrogen peroxide. An experiment showed the presence of the harsh chemical in the glass microfluidic channel, but not in a bulk sample of water also containing the dye. Additional experiments elaborated that the hydrogen peroxide formed quickly, within a matter of seconds, at the boundary between the water and the solid.

To gauge if the extra oxygen atom in the hydrogen peroxide (H2O2) came from a reaction with the glass or within the water (H2O) itself, the researchers treated the glass lining of some microfluidic channels. These treated channels contained a heavier isotope or version of oxygen, dubbed oxygen-18 or 18O. Comparing the post-reaction mix of water and hydrogen peroxide fluid from the treated and untreated channels showed the signal of 18O in the former, implicating the solid as the source of the oxygen in the hydroxyl radicals and ultimately in hydrogen peroxide.

The new findings could help settle some of the debate that has ensued in the scientific community since the Stanford researchers initially announced their novel detection of hydrogen peroxide in water microdroplets three years ago. Other studies have emphasized the major contributions of hydrogen peroxide production via chemical interactions with the gas ozone, O3, and a process called cavitation, when vapor bubbles arise in low-pressure areas within accelerated liquids. Zare pointed out that both of those processes also clearly yield hydrogen peroxide, and in comparatively greater amounts.

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"All of these processes contribute to hydrogen peroxide production, but the present work confirms that this production is also intrinsic to the way microdroplets are made and interact with solid surfaces through contact electrification," said Zare.

Turning the tables on seasonal respiratory viruses

Nailing down how and in what situations water can transform into reactive oxygen species, such as hydrogen peroxide, has a host of real-world insights and applications, Zare explained. Among the most compelling is understanding the formation of hydroxyl radicals and hydrogen peroxide as an overlooked contributor to the well-known seasonality of many viral respiratory diseases, including colds, flus, and likely COVID-19 once the disease eventually becomes fully endemic.

Viral respiratory infections are transmitted in the air as aqueous droplets when people who are sick cough, sneeze, sing, or even just talk. These infections tend to spike in winter and ebb in summer, a trend chalked up in part to people spending more time indoors and in close, transmissible proximity during the cold weather season. However, between work, school, and sleeping at night, people actually end up spending about the same amount of time indoors during the hot weather months as well. Zare said the new study's findings offer a possible explanation for why winter is correlated with more flu cases: The key variable at work is humidity, the amount of water in the air. In the summer, the higher relative levels of indoor humidity—tied to higher humidity in the warm air outside—likely facilitate reactive oxygen species in droplets having enough time to kill viruses. Contrastingly, in winter—when the air inside buildings is heated and its humidity lowered—the droplets evaporate before the reactive oxygen species can act as a disinfectant.

"Contact electrification provides a chemical basis for partly explaining why there is seasonality to viral respiratory diseases," said Zare. Accordingly, Zare added, future research should investigate any links between indoor humidity levels in buildings and the presence and spread of contagions. If links are further borne out, simply adding humidifiers to heating, ventilation, and cooling systems could lessen disease transmission.

"Taking a fresh approach to disinfecting surfaces is just one of the great practical consequences of this work involving the fundamental chemistry of water in the environment," said Zare. "It just goes to show that we think we know so much about water, one of the most commonly encountered substances, but then we're humbled."

Zare is also a member of Stanford Bio-X, the Cardiovascular Institute, the Stanford Cancer Institute, Stanford ChEM-H, the Stanford Woods Institute for the Environment, and the Wu Tsai Neurosciences Institute.

Phys Org, 2 August 2022

https://phys.org

Should we be worried about our pet cats and dogs getting COVID?

2022-08-05

The SARS-CoV-2 virus, which causes COVID, originated from bats and then, probably after passing through an intermediary host, gained the ability to infect humans.

Many new viruses that emerge in this way, like SARS-CoV-2, maintain the ability to infect both animals and humans.

It's well documented the SARS-CoV-2 virus infects a number of different animals. Cases of COVID have been recorded in animals as different as hamsters, ferrets, lions, tigers, mink and non-human primates.

However the question that concerns many of us in our cosy domesticated worlds, is what sort of threat does the virus pose to cats and dogs, the animals we have the closest relationship with?

Can cats and dogs get COVID?

Yes, cats and dogs can get COVID.

Both cats and dogs have been found to have been infected with the virus. A number of studies that involved the testing of domestic pets have confirmed the presence of these infections.

One of the more interesting suggestions from a pre-print study (one that is yet to be reviewed by other scientists), is that cats and dogs were less susceptible to the BA.1 Omicron variant compared to previous variants.

It was speculated the mutations in this variant which we know made it more transmissible in humans may have made it less able to bind to cellular receptors in cats and dogs.

Who gives it to whom?

Although it's theoretically possible for COVID to be transmitted in any direction – that is, from humans to cats and dogs, from cats and dogs to humans, and from these pets to each other – the current belief is the virus is primarily transmitted from humans to these pets.

When a cat or dog gets COVID symptoms, they get pretty much the same symptoms as humans.

There are a number of possible explanations for why transmission generally occurs in this direction.

However, the most likely explanation is that these animals, when infected, generate much lower viral loads than humans and they may shed the virus for only a short time, which makes them less likely to transmit the virus onwards.

How common is it in pets?

The question of how common COVID is in animals generally, and in domestic pets, is one being actively explored.

In terms of how common it is in cats and dogs, there are methodological challenges to answering this question in large studies. Try taking a nasal swab from your cat and see how this works out!

Despite the practical obstacles, a study published in June suggests these infections may be more common than initially thought. The researchers studied the blood samples of 59 dogs and 48 cats in Ontario, Canada, which lived with people who'd tested positive to COVID.

They found 52% of the cats, and 41% of the dogs, had antibodies targeted to SARS-CoV-2, suggesting they'd been previously infected with the coronavirus. Cats were more likely than dogs to have contracted COVID in this study, but the authors note there's a lot of variability in the studies looking into the prevalence of infection in animals.

How severe is it in pets?

When a cat or dog gets COVID symptoms, they get pretty much the same symptoms as humans.

They generally don't feel well and the symptoms they experience include coughing and sneezing, lethargy and loss of appetite.

But the good news is, available data suggests most of the time infection results in either no symptoms or very mild disease. And the duration of their symptoms, if they get them, may be very short.

Although it's possible for a pet to get more severe symptoms, this seems to be uncommon.

So what should we make of this?

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The strong message from what we know so far is that we humans pose much more of a threat to our cats and dogs than they pose to us when it comes to COVID.

Therefore, if you get infected it's probably sensible to limit contact with your pets, particularly while you're at your most infectious. Just like you probably do anyway, you should treat your pet as you would any other member of your family when you're ill and do everything you can to reduce the likelihood of infecting them.

Trying to get your pet to wear a mask, however, is definitely a step too far…

The good news is that even if you were to give your pet COVID, chances are they will either get no symptoms or only mild symptoms. And even if they do experience more severe illness, the evidence suggests they will bounce back quickly.

Of course, if you do suspect your pet has COVID and you are unsure about what to do, you should seek professional advice.

The Conversation, 5 August 2022

https://theconversation.com

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The acute toxicity of bitumen-influenced groundwaters from the oil sands region to aquatic organisms

Association between lead exposure and DNA damage (genotoxicity): systematic review and meta-analysis

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Environmentally realistic concentrations of ibuprofen influence life histories but not population dynamics of Daphnia magna

Legacy and emerging pollutants in Latin America: A critical review of occurrence and levels in environmental and food samples

PHARMACEUTICAL/TOXICOLOGY

The PFAS-Tox Database: A systematic evidence map of health studies on 29 per- and polyfluoroalkyl substances

Positive association between dietary exposure to polybrominated diphenyl ethers and breast cancer risk in the French E3N cohort: The role of vegetable oil consumption

OCCUPATIONAL

Risk assessment and dose-effect of co-exposure to benzene, toluene, ethylbenzene, xylene, and styrene (BTEXS) on pulmonary function: A cross-sectional study

Enrichment and removal of five brominated flame retardants in the presence of co-exposure in a soil-earthworm system

Association between occupational exposure to chemical or physical factors and sleep disturbance: An analysis of the fifth Korean Working Conditions Survey

Acute respiratory distress after exposure to chlorine dioxide-based disinfectant