CHEMWATCH

Bulletin Board

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JUN. 24, 2022

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ASIA PACIFIC

Melbourne e-commerce business fined $13k for unauthorised imports

2022-06-17

Investigators from the Australian Industrial Chemicals Introduction Scheme (AICIS) have fined a Melbourne e-commerce order fulfilment business more than $13,000 for allegedly importing industrial chemicals without the required registration.

Following a joint investigation with Victoria Police, AICIS Compliance issued a 60-penalty-unit infringement notice for $13,320 to the Melbourne business, which imports, stores and ships goods for online sellers.

Under the Industrial Chemicals Act (IC Act), an importer or manufacturer must be registered with AICIS for the registration year before introducing an industrial chemical during that year. Penalties may apply if a person introduces an industrial chemical without being registered.

AICIS reminds all importers, including order fulfilment businesses and similar companies that provide import services to online sellers, that the requirements and offence provisions of the IC Act fall on the introducer of the chemicals as the importer of record.

Read More

AICIS, 17-06-22

https://www.industrialchemicals.gov.au/news-and-notices/melbourne-e-commerce-business-fined-13k-unauthorised-imports

APVMA approves emergency permit for RHDV2 (calicivirus) vaccine for rabbits

2022-06-16

The Australian Pesticides and Veterinary Medicines Authority (APVMA) has approved an emergency permit (PER92219) for a vaccine to protect pet rabbits against the rabbit haemorrhagic disease (calicivirus) virus type 2 strain (RHDV2).

The emergency permit for the Filavac VHD K C+V vaccine is in force until 31 May 2024 and provides for the active immunisation of pet rabbits from 10 weeks of age to reduce mortality rates caused by the RHDV2 and RHDV1 (classical) virus strains.

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The manufacturer of Filavac VHD K C+V, FILAVIE, has submitted an application for registration of the vaccine, which is currently under assessment by the APVMA. The vaccine has a current Marketing Authorisation in Europe with an approved onset of immunity of one week and a duration of immunity of one year. Under the conditions of the emergency permit, the vaccine will be supplied in Australia through Ceva Animal Health Pty Ltd.

What is the rabbit haemorrhagic disease virus?

The rabbit haemorrhagic disease virus (RHDV) typically causes a rapidly fatal disease in wild rabbits. There are 2 strains of RHDV present in Australia – RHDV1 and RHDV2.

What are the RHDV1 and RHDV2 strains?

The RHDV1 strain of RHDV was first released in Australia in 1996 as a biocontrol measure against wild rabbits.

RHDV2 is a new strain of the virus that was first reported in Europe in 2010 and then in Australia in 2015. This RHDV2 strain was not released in Australia by any government department and it is not known how the virus entered the country.

Read More

APVMA, 16-06-22

https://apvma.gov.au/node/101676

Hong Kong to reform workplace health and safety regime

2022-06-14

The Hong Kong Special Administrative Region (SAR) administration has published a bill to amend the existing occupational health and safety regime.

The bill was published with a view to increasing the penalties for occupational safety and health offences and increasing the protections available to workers.

Known as the Occupational Safety and Occupational Health Legislation (Miscellaneous Amendments) Bill 2022 (the bill), it seeks to amend the Factories and Industrial Undertakings Ordinance (Cap. 59) and the

Occupational Safety and Health Ordinance (Cap. 509), and their subsidiary legislation.

The bill follows the release of a consultation paper by the Labour Department in 2020.

The proposed reforms now include increasing the penalties at premises and industrial undertakings; extending the time limits for prosecution, making offences triable by indictment; and, notably, requiring the court to take into account the turnover of the responsible entities when determining the amount of a fine.

The main proposals in the bill include:

- Making offences under general duty provisions for employers, proprietors and occupiers triable as indictable offences, meaning serious offences can be tried at higher levels of courts such as District Court or High Court as opposed to the Magistrates' Courts under the current regime.
- Courts to consider turnover of convicted entities when determining levels of fines.

Read More

PinsentMasons, 14-06-22

https://www.pinsentmasons.com/out-law/analysis/hong-kong-to-reform-workplace-health-and-safety-regime

AMERICA

Colorado bans PFAS, establishes EPR scheme for packaging

2022-06-15

On June 3, 2022, Governor Jared Polis signed two bills into law concerning food packaging within the state of Colorado.

House Bill 22-1345 bans PFAS in eight product categories including food packaging by January 1, 2024. The bill also obligates the state to purchase only PFAS-free products. Colorado is the ninth US state to ban PFAS in food packaging (FPF reported).

House Bill 22-1355 establishes an extended producer responsibility (EPR) scheme for packaging and some printed paper products. All companies

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that sell such materials must design an individual plan or join a producer responsibility organization to support, fund, and manage a statewide recycling system.

According to the bill, by June 2023 the executive director of the Colorado Department of Public Health and Environment must designate a nonprofit organization to create and manage a statewide recycling program. The nonprofit would then hire a third party to run a needs assessment on recycling services within Colorado. An advisory board would use the results of the needs assessment to propose a residential recycling system, provide a list of covered materials, and establish a funding mechanism with the packaging manufacturers. Colorado is the third US state to create an EPR

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Food Packaging Forum, 15-06-22

https://www.foodpackagingforum.org/news/colorado-bans-pfas-establishes-epr-scheme-for-packaging

Washington State regulating chemicals of concern in food packaging

2022-06-15

In early June 2022, the US state of Washington Department of Ecology (DoE) published its final report for the first implementation cycle of the Safer Products for Washington program. The report obligates the state to regulate certain priority chemicals in key consumer products including food packaging by June 2023. Food packaging related changes include a restriction, potentially taking the form of a complete ban, of phenolic compounds including all bisphenols in the lining of drink cans and obligatory reporting of bisphenols in the lining of food cans. Tetramethyl bisphenol F (TMBPF) is excluded from these obligations.

DoE determined that the "vast majority" of bisphenols with enough data to assess safety did not meet the department's criteria for "safer." TMBPF met the minimum criteria to be considered "safer" but DoE could not determine if replacing all bisphenols with TMBPF would completely avoid adverse outcomes, i.e. regrettable substitution. So the chemical is allowed with limits. "This means that in applications where TMBPF is present as a residual monomer at concentrations below 100 ppm, it may be considered a safer alternative."

The Safer Products for Washington program launched in 2019 with a piece of legislation directing the DoE "to identify and take action on products containing harmful chemicals that pose a health threat to sensitive populations, like pregnant women and children, and sensitive species like orcas and salmon" (FPF reported, also here).

Read More

Food Packaging Forum, 15-06-22

https://www.foodpackagingforum.org/news/washington-state-regulating-chemicals-of-concern-in-food-packaging

Health Canada Takes Steps to Secure Biocides in Canada

2022-06-15

Prompted in part by supply chain challenges emerging during the COVID-19 pandemic, Health Canada is proposing a new regulatory framework under the Food and Drugs Act (FDA) specific to biocides. Biocides are products that sanitize or disinfect hard or soft non-living and non-liquid surfaces to prevent disease in humans or animals. After several rounds of consultation, on May 7, 2022, Health Canada published the proposed Biocides Regulations in the Canada Gazette, which attempt to create a regulatory framework that harmonizes the regulation of biocides under one comprehensive framework.

Background

Biocides are currently regulated under separate regulatory frameworks in Canada: disinfectants are regulated under the FDA, surface sanitizers are regulated under the Pest Control Products Act (PCPA), and products with both disinfectant and sanitizer claims are regulated solely under the FDA.1 As such, despite having similar ingredients and risks and benefits, these products and their safety, efficacy and quality are subject to a myriad of requirements, fees and timelines that confuse (and sometimes deter) applicants, burdening the supply chain.

Under the proposed Biocides Regulations, however, disinfectants currently regulated under the Food and Drug Regulations (FDR) and certain surface sanitizers regulated under the PCPA would instead be regulated together under the new regulations. Health Canada's hope is that by reducing the application costs and increasing the predictability of the regulatory process for applicants, the Biocides Regulations will attract more industry to the Canadian market and help secure the Canadian supply chain of biocides for future emergency response preparedness.

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JDSupra, 15-06-22

https://www.jdsupra.com/legalnews/health-canada-takes-steps-to-secure-6890071/

EPA Announces New Drinking Water Health Advisories for PFAS Chemicals, $1 Billion in Bipartisan Infrastructure Law Funding to Strengthen Health Protections

2022-06-15

Today, the U.S. Environmental Protection Agency (EPA) released four drinking water health advisories for per- and polyfluoroalkyl substances (PFAS) in the latest action under President Biden's action plan to deliver clean water and Administrator Regan's PFAS Strategic Roadmap. EPA also announced that it is inviting states and territories to apply for $1 billion – the first of $5 billion in Bipartisan Infrastructure Law grant funding – to address PFAS and other emerging contaminants in drinking water, specifically in small or disadvantaged communities. These actions build on EPA's progress to safeguard communities from PFAS pollution and scientifically inform upcoming efforts, including EPA's forthcoming proposed National Primary Drinking Water Regulation for PFOA and PFOS, which EPA will release in the fall of 2022.

"People on the front-lines of PFAS contamination have suffered for far too long. That's why EPA is taking aggressive action as part of a whole-of-government approach to prevent these chemicals from entering the environment and to help protect concerned families from this pervasive challenge," said EPA Administrator Michael S. Regan. "Thanks to President Biden's Bipartisan Infrastructure Law, we are also investing $1 billion to reduce PFAS and other emerging contaminants in drinking water."

"Today's actions highlight EPA's commitment to use the best available science to tackle PFAS pollution, protect public health, and provide critical information quickly and transparently," said EPA Assistant Administrator for Water Radhika Fox. "EPA is also demonstrating its commitment to harmonize policies that strengthen public health protections with infrastructure funding to help communities—especially disadvantaged communities—deliver safe water."

Assistant Administrator Fox announced these actions at the 3rd National PFAS Conference in Wilmington, North Carolina.

$1 Billion in Bipartisan Infrastructure Law Funding

As part of a government-wide effort to confront PFAS pollution, EPA is making available $1 billion in grant funding through President Biden's Bipartisan Infrastructure Law to help communities that are on the frontlines of PFAS contamination, the first of $5 billion through the Law that can be used to reduce PFAS in drinking water in communities facing disproportionate impacts. These funds can be used in small or disadvantaged communities to address emerging contaminants like PFAS in drinking water through actions such as technical assistance, water quality testing, contractor training, and installation of centralized treatment technologies and systems.

EPA will be reaching out to states and territories with information on how to submit their letter of intent to participate in this new grant program. EPA will also consult with Tribes and Alaskan Native Villages regarding the Tribal set-aside for this grant program. This funding complements $3.4 billion in funding that is going through the Drinking Water State Revolving Funds (SRFs) and $3.2 billion through the Clean Water SRFs that can also be used to address PFAS in water this year.

Read More

EPA, 15-06-22

https://www.epa.gov/newsreleases/epa-announces-new-drinking-water-health-advisories-pfas-chemicals-1-billion-bipartisan

EUROPE

Commission supports the European Clean Hydrogen Alliance to reduce EU dependency on Russian gas

2022-06-16

Today, the Commission is hosting the fourth Forum of the European Clean Hydrogen Alliance. Members of the Alliance will discuss the Commission's REPowerEU Plan, which sets out a series of actions to accelerate hydrogen deployment to spur the green transition and replace Russian fossil fuels.

At today's event, the 'Electrolyser PartnershipSearch for available translations of the preceding linkEN•••' announced in May will also be

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launched. It will support the commitment by industry to increase tenfold its hydrogen electrolyser manufacturing capacity by 2025. Furthermore, today the Alliance will present its report on the permitting of hydrogen installations, which will inform the ongoing Commission work to simplify procedures for renewable energy and hydrogen projects. Finally, the Alliance will collect new hydrogen projects from its members to be included into the project pipeline of the Alliance.

Executive Vice-President for the European Green Deal, Frans Timmermans said: "Hydrogen is an essential part of Europe's future energy sovereignty. The speed of development of the European hydrogen sector shows that we can decarbonise our economy and secure our independence from Russian fossil fuels. The hydrogen accelerator in the RePowerEU plan will steer the necessary investment to scale up European production of clean hydrogen.

Read More

European Commission, 16-06-22

https://ec.europa.eu/growth/news/commission-supports-european-clean-hydrogen-alliance-reduce-eu-dependency-russian-gas-2022-06-16_en

Commission launches infringement proceedings against the UK for breaking international law and provides further details on possible solutions to facilitate the movement of goods between Great Britain and Northern Ireland

2022-06-15

The European Commission has today launched infringement proceedings against the United Kingdom for not complying with significant parts of the Protocol on Ireland / Northern Ireland. Despite repeated calls on the UK government to implement the Protocol, it has failed to do so. This is a clear breach of international law. The aim of these infringement proceedings is to restore compliance with the Protocol in a number of key areas where the UK hasn't been implementing it properly – ultimately with the goal of protecting the health and safety of EU citizens.

At the same time, the Commission is today providing additional details on the possible solutions it put forward in October 2021 to facilitate the movement of goods between Great Britain and Northern Ireland. The position papers published today explain how the movement of goods

between Great Britain and Northern Ireland can be significantly facilitated. The Commission calls on the UK government to engage seriously and constructively with these suggested solutions. As usual, the Commission will proceed in close collaboration and constant dialogue with the European Parliament and Council.

Read More

European Commission, 15-06-22

https://ec.europa.eu/commission/presscorner/detail/en/ip_22_3676

European Commission issues long-awaited update to definition of nanomaterials

2022-06-16

The European Commission has published its long-overdue revised definition of nanomaterials – a set of clarifications it hopes will improve the way nanoparticles are identified for the purposes of regulation and align EU legislation across all sectors.

However, the changes will not "significantly affect" the scope of those identified, the EU executive said. NGOs have cried foul that their concerns were not properly considered, warning of loopholes and worrisome exclusions of many known nanomaterials from the definition.

The Commission's recommendation, published on 10 June, ticks a box for the EU chemicals strategy, bringing to an end a review of the 2011 definition that was due more than seven years ago. Long delays have irked stakeholders, especially as manufacturers have been required to register nano substances under a REACH annex since 2020.

Most of the changes had been on the cards since the Commission's Joint Research Centre (JRC) first proposed them in 2015.

They do not alter the core elements of the 2011 recommendation, which defines nanomaterials as substances with 50% of particles or more between 1nm-100nm. There was no scientific evidence to decrease or increase the default threshold of 50%, the Commission said.

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Chemical Watch, 16-06-22

https://chemicalwatch.com/504600/european-commission-issues-long-awaited-update-to-definition-of-nanomaterials

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INTERNATIONAL

EU and Egypt step up cooperation on climate, energy and the green transition

2022-06-15

Today in Cairo, on the occasion of the visit of Commission President Ursula von der Leyen and her meeting with Egyptian President El Sisi, the EU and Egypt issued a joint statement on climate, energy and the green transition.

President von der Leyen said: "We are starting to tap into the full potential of EU-Egypt relations, by putting the clean energy transition and the fight against climate change at the heart of our partnership. I look forward to working with Egypt as COP27 Presidency to build on the good momentum from last year in Glasgow. Egypt is also a crucial partner in our efforts to move away from Russian fossil fuels and towards more reliable suppliers."

The EU and Egypt will join efforts to implement the Paris Agreement and ensure ambitious outcomes at COP27, which takes place in Sharm El-Sheikh in November. The joint statement commits both parties to work together on a global just energy transition, on improving adaptation capacity, mitigating loss and damage due to climate change, and on increasing climate finance to respond to the needs of developing countries.

The cooperation will have a particular focus on renewable energy sources, hydrogen, and energy efficiency. The EU and Egypt will develop a Mediterranean Hydrogen Partnership to promote investments in renewable electricity generation, strengthening and extension of electricity grids, including trans-Mediterranean interconnectors, the production of renewables and low carbon hydrogen, and the construction of storage, transport and distribution infrastructure.

Read More

European Commission, 15-06-22

https://ec.europa.eu/commission/presscorner/detail/en/ip_22_3662

Time to break up with toxic makeup

2022-06-16

The fact that the EU's cosmetic regulation is terrible is one of Europe's worst-kept secrets. It allows for using several well-known hazardous chemicals in the products we apply to our faces. The good thing is that the Commission has promised to change it. But the current public consultation makes us wonder: Where do the ambitions lie?

As a part of the Commission's Chemical Strategy, it has promised to revise the Cosmetics Regulation. It has been evident for a long time that the current legislation is insufficient as it allows for cosmetic products with harmful substances to the environment and humans, such as PFAS and hormone disruptors. As a result, substitution of the most harmful chemicals has obviously not occurred at the expected pace.

Even though there is an awareness of the problem with the Cosmetics Regulation, the way the question is formulated in the current public consultation makes us wonder how high the ambitions for this revision are set.

The first question, for example, is about whether or not you would be comfortable buying cosmetics if they contained chemicals that could cause cancer or damage your immune system, or your neurological system. The fact that it is not a rhetorical question makes it absurd. No person on this planet would prefer cosmetics that contain chemicals that can cause cancer over one that doesn't (surprise!).

Read More

Chemsec, 16-06-22

https://chemsec.org/time-to-break-up-with-toxic-makeup/

European Commission: Current food contact materials regulation "sub-optimal"

2022-06-14

On June 10, 2022, the European Commission published its staff working document, and regulatory scrutiny board opinion on the evaluation of the EU food contact material (FCM) legislation, (EC) No. 1935/2004. The review found "that EU FCM Regulation is partly effective in fulfilling its two main objectives" – securing a high level of protection of human health and ensuring the functioning of the internal market, but "overall, the efficiency of the FCM legislation appears to be sub-optimal."

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Issues raised in the review include (i) a lack of safety or regulatory specificity for materials other than plastic, (ii) overlooking the nature of some substances intentionally used in plastics and additional risks posed from non-intentionally added substances (NIAS), (iii) a high uncertainty connected with the unknowns around technologies like nanomaterials, bioplastics, and chemical recycling, (iv) a scarcity of safety information being exchanged through the supply chain, and (v) a lack of efficiency and being unable to fully address safety concerns when performing risk assessments.

According to the working document, for materials that are not plastic, the current FCM regulation is not specific enough while the rules that are in place are "technically complex." Specifically, Article 3 of the FCM regulation, which is meant to be the principle legal requirement, "does not define the level of safety or quality expected for many [materials other than plastic], which may differ amongst stakeholders. Further, it does not state how safety should be achieved or how it can be demonstrated." Because there are currently no EU-wide specific rules for many FCMs other than plastics, individual Member States have defined their own substance lists, migration limits, or testing regimes at the national level. Remaining compliant is therefore more time- and resource-intensive, which has made operations especially challenging for small and medium-sized businesses.

The regulation of plastics is considered to be the most developed of any FCM type and includes a positive list of substances to be used in their manufacture (FPF reported). Still, the EC's working document writes that even the plastic regulation "is compromised by derogations for some substances such as colorants and so-called non-intentionally added substances (NIAS)." It is also challenged by new processes or more complicated materials including bioplastics, chemical recycling, and multi-materials.

Read More

Food Packaging Forum, 14-06-22

https://www.foodpackagingforum.org/news/european-commission-current-food-contact-materials-regulation-sub-optimal

Janet's Corner

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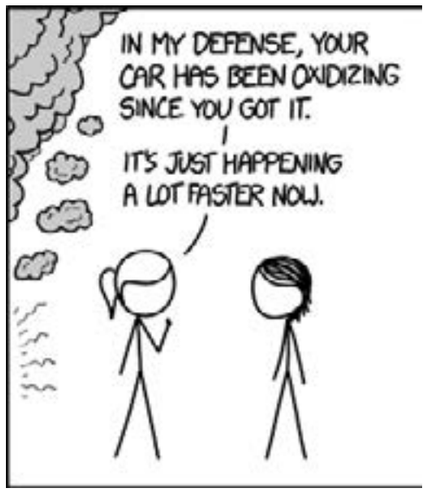
Oxidation

2022-06-24



https://xkcd.com/1693/

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Hazard Alert

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Arsine

2022-06-24

Arsine is an inorganic compound with the formula AsH_3. This flammable, pyrophoric, and highly toxic gas is one of the simplest compounds of arsenic. [1] Arsine has a garlic-like or fishy odour that can be detected at concentrations of 0.5 ppm and above. Because arsine is non-irritating and produces no immediate symptoms, persons exposed to hazardous levels may be unaware of its presence. Arsine is water soluble. [2] Arsine is formed when arsenic comes in contact with an acid. [3]

USES [2,3]

Arsine is used as a doping agent in the semiconductor industry and in the manufacture of crystals for fiberoptics and computer chips. It is used infrequently in galvanizing, soldering, etching, burnishing, and lead plating. It was also investigated as a warfare agent during World War II, but it was never used on the battlefield.

SOURCES & ROUTES OF EXPOSURE

Arsine is an inorganic compound with the formula AsH3.

Sources of Exposure [2]

Arsine gas is formed when arsenic-containing materials react with freshly formed hydrogen in water or acids. Exposure may result when arsenic containing metals (i.e., metal vats) undergo acid washes. Unintentional exposures have also occurred during refining of ores (e.g., lead, copper, zinc, iron, and antimony ores) that contain arsenic.

Routes of Exposure [2]

- Inhalation is the major route of exposure. The odour threshold of arsine is 10-fold greater than the Occupational Safety and Health Administration (OSHA) permissible exposure limit. Odour is not an adequate indicator of arsine's presence and does not provide reliable warning of hazardous concentrations. Arsine is heavier than air and hazardous concentrations may develop quickly in enclosed, poorly ventilated, or low-lying areas.
- Skin/Eye Contact: There is little information about direct toxic effects of arsine on the skin or eyes, or about absorption through the skin. Exposure to liquefied arsine (the compressed gas) can result in frostbite.

- Ingestion of arsine itself is unlikely because it is a gas at room temperature. However, metal arsenides are solids that can react with acidic gastric contents, releasing arsine gas in the stomach.

HEALTH EFFECTS [2]

Acute Exposure

After absorption by the lungs, arsine enters red blood cells (RBC) where different processes may contribute to haemolysis and impairment of oxygen transport. Inhibition of catalase may lead to accumulation of hydrogen peroxide which, as an oxidiser, destroys red cell membranes and may contribute to arsine-induced conversion of Fe+2 to Fe+3, which also impairs oxygen transport. Arsine preferentially binds to haemoglobin, and is oxidised to an arsenic dihydride intermediate and elemental arsenic, both of which are haemolytic agents. Arsine toxicity involves depletion of reduced glutathione. Therefore, people deficient in the enzyme glucose-6-phosphate-dehydrogenase (G6PD) are more susceptible to haemolysis following arsine exposure. Pre-existing cardiopulmonary or renal conditions, iron deficiency, and/or pre-existing anaemia may result in more severe outcomes if haemolysis occurs. Contact with the skin or eyes is not expected to result in systemic toxicity. Ingestion of arsine is unlikely, but ingestion of metallic arsenides can lead to arsine gas production and toxicity.

Haematologic

Acute intravascular haemolysis develops within hours and may be severe during the first 2 or 3 days following exposure. Free haemoglobin levels in plasma rise (levels greater than 2 g/dL have been reported). Anaemia ensues subsequent to haemolysis. Anaemia may develop quickly and be severe. Leukocytosis and signs of intravascular coagulation can be observed during the haemolytic phase. Methemoglobinaemia can be of concern in infants and toddlers. Children may be more vulnerable to loss of effectiveness of haemoglobin because of their relative anaemia compared to adults.

Respiratory

A garlic odour may be present on the breath. Delayed accumulation of fluid in the lungs may occur after massive exposure. Dyspnoea may be due to lack of oxygen secondary to haemolysis. Children may be more vulnerable to gas exposure because of relatively higher minute ventilation

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per kg and failure to recognise the need to promptly evacuate an area when exposed.

Renal

Kidney failure due to acute tubular necrosis is a significant sequela of arsine exposure. Haemoglobin in the urine is thought to be the major cause of damage to the kidneys; however, a direct toxic effect of arsine or deposition of the arsine-haemoglobin-haptoglobin complex may also play a role. Urinalysis shows large amounts of protein and free haemoglobin usually without intact RBCs. Urine may be unusually coloured (e.g., brown, red, orange, or greenish). Decreased urinary output may develop within 24-48 hours.

Gastrointestinal

Nausea, vomiting, and crampy abdominal pain are among the first signs of arsine poisoning. Onset varies from a few minutes to 24 hours after exposure.

Dermal

The characteristic bronze tint of the skin caused by arsine toxicity is induced by haemolysis and may be caused by haemoglobin deposits. The bronze coloration is not jaundice, although jaundice may develop later as a result of significant haemolysis. Contact with liquefied arsine (compressed gas) can cause frostbite.

CNS

Headache is often an early sign of exposure. CNS disorders can develop several days after severe exposure; signs include restlessness, memory loss, disorientation, and agitation. Some exposed persons experience signs of peripheral nerve damage 1-2 weeks after exposure. There are case reports of polyneuropathy developing 1-6 months after arsine exposure.

Hepatic

Right upper quadrant pain, hepatomegaly, elevated serum globulin, elevated liver enzymes and prolonged prothrombin time have been observed.

Musculoskeletal

Skeletal muscle injury or necrosis have been reported. Muscle pain and twitches, myoglobinuria, elevated levels of serum creatine phosphokinase (CPK), and aldolase have been observed.

Cardiovascular

Cardiovascular effects may include moderate and transient sinus tachycardia secondary to haemolysis or anaemia, hypovolemia or acute pulmonary oedema, hypotension and cardiovascular shock due to direct effects on the myocardium and hyperkalaemia, elevation of the T-wave (ECG) and various degrees of heart block, and general vasoconstriction due to peripheral hypoxia.

Ophthalmic/Ocular

Watery eyes, photophobia, blurred vision, and red staining of the conjunctiva may appear early after exposure.

Chronic Exposure

Chronic arsine exposure can result in gastrointestinal upset, anaemia, and damage to lungs, kidneys, liver, nervous system, heart, and blood-forming organs. There is little information regarding health effects of chronic low-level exposures to arsine.

Carcinogenicity

There are no data on the carcinogenicity of arsine in humans or in experimental animals. However, arsine is oxidised to the same trivalent and pentavalent forms of arsenic as those seen after drinking-water or inhalation exposure to arsenic compounds known to present a cancer hazard. The Department of Health and Human Services (DHHS), the International Agency for Research on Cancer (IARC), and the Environmental Protection Agency (EPA) have classified inorganic arsenic as a human carcinogen based on sufficient evidence from human data.

Reproductive and Developmental Effects

Arsine should be treated as a potential teratogenic agent. Although the reproductive effects of acute or chronic exposure to arsine are unknown, some related inorganic arsenicals produce a broad spectrum of adverse developmental effects in animals. Animal studies indicated that in arsine-exposed mothers, arsenic crosses the placenta and reaches the foetus; however, no adverse developmental effects were observed.

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SAFETY [5]

First Aid Measures

- Inhalation: Immediately remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, qualified personnel may give oxygen. Call a physician. Symptoms may be delayed. Consider any exposure as a potentially toxic dose.
- Skin contact: Adverse effects not expected from this product. The liquid may cause frostbite. For exposure to liquid, immediately warm frostbite area with warm water not to exceed 105°F (41°C). Water temperature should be tolerable to normal skin. Maintain skin warming for at least 15 minutes or until normal colouring and sensation have returned to the affected area. In case of massive exposure, remove clothing while showering with warm water. Seek medical evaluation and treatment as soon as possible.
- Eye contact: Immediately flush eyes thoroughly with water for at least 15 minutes. Hold the eyelids open and away from the eyeballs to ensure that all surfaces are flushed thoroughly. Contact an ophthalmologist immediately.
- Ingestion: Ingestion is not considered a potential route of exposure.

Fire Information

- Arsine is a toxic, flammable liquefied gas.
- Vapour forms explosive mixtures with air and oxidising agents.
- If leaking gas catches fire, do not extinguish flames.
- Flammable and toxic vapours may spread from leak and could explode if reignited by sparks or flames.
- Vapours are heavier than air and may collect in low spots. Explosive atmospheres may linger.
- Evacuate all personnel from the danger area. Use self-contained breathing apparatus (SCBA) and protective clothing.
- Immediately cool containers with water from maximum distance.
- Stop flow of gas if safe to do so, while continuing cooling water spray.
- Remove ignition sources if safe to do so.
- Remove containers from area of fire if safe to do so.

Exposure Controls and Personal Protection

Engineering Controls

- Use an explosion-proof local exhaust system.
- Local exhaust and general ventilation must be adequate to meet exposure standards.
- Use explosion proof equipment and lighting.

Personal Protective Equipment

The following personal protective equipment is recommended when handling arsine:

- Hand protection: Neoprene rubber.
- Eye protection: Wear safety glasses when handling cylinders; vapour-proof goggles and a face shield during cylinder change out or whenever contact with product is possible. Select eye protection in accordance with OSHA 29 CFR 1910.133.
- Skin and body protection: Wear metatarsal shoes and work gloves for cylinder handling, and protective clothing where needed. Wear appropriate chemical gloves during cylinder change out or wherever contact with product is possible. Select per OSHA 29 CFR 1910.132, 1910.136, and 1910.138.
- Respiratory protection: When workplace conditions warrant respirator use, follow a respiratory protection program that meets OSHA 29 CFR 1910.134, ANSI Z88.2, or MSHA 30 CFR 72.710 (where applicable). Use an air-supplied or air-purifying cartridge if the action level is exceeded. Ensure that the respirator has the appropriate protection factor for the exposure level. If cartridge type respirators are used, the cartridge must be appropriate for the chemical exposure (e.g., an organic vapour cartridge). For emergencies or instances with unknown exposure levels, use a self-contained breathing apparatus (SCBA).
- Thermal hazard protection: Wear cold insulating gloves when transfilling or breaking transfer connections.

REGULATION [6]

United States

OSHA: The United States Occupational Safety & Health Administration has set the following Permissible Exposure Limits (PEL) for arsine of:

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- General Industry: 29 CFR 1910.1000 Z-1 Table -- 0.05 ppm, 0.2 mg/m3 TWA
- Maritime: 29 CFR 1915.1000 Table Z-Shipyards -- 0.05 ppm, 0.2 mg/m3 TWA

ACGIH: The American Conference of Governmental Industrial Hygienists has set a Threshold Limit Value (TLV) for arsine of 0.005 ppm, 0.016 mg/m3 TWA

NIOSH: The National Institute for Occupational Safety and Health has set a Recommended Exposure Limit (REL) for arsine of 0.002 mg/m3 Ceiling (15 min); Potential Carcinogen

Australia

Safe Work Australia: Safe Work Australia has established a Time Weighted Average Concentration for arsine of 0.05 ppm, 0.16 mg/m3 for a 40-hour work week.

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Electricity and data over-the-air: The simultaneous transmission of 5G and power

2022-06-13

The potential of millimeter-wave wireless power transfer as a solution for the Internet of Things has finally been harnessed by researchers from Tokyo Tech, who have created a device for simultaneous transmission of power and 5G signal. This transceiver for 5G network signal is fully wirelessly powered and has high power conversion efficiency at large distances and angles.

Ever since Nikola Tesla first proposed the idea of wireless transfer of power, there have been multiple efforts to exploit this concept for different applications. A new way to do this is with 5G networks. As 5G networks start coming online, there is an expected associated increase in the scale of the Internet of Things network. With so many devices on the network, there is a growing need to make wirelessly powered devices that can work with 5G signals. The production of such devices has faced the same hurdles that a lot of wirelessly powered devices face—short transmission distances and a fixed direction from which power can be received.

Now, a team of scientists from Tokyo Institute of Technology (Tokyo Tech), led by Associate Professor, have reported the production of a wirelessly powered transmitter-receiver for 5G networks that overcomes both of these problems. Their findings were presented during the 2022 IEEE Symposium on VLSI Technology & Circuits.

Dr. Shirane explains that "the millimeter-wave wireless power transfer system is a promising solution for massive Internet of Things, yet it has been hampered by technical problems. We were thus able to make a breakthrough by producing a 5G transceiver with high efficiency at big angles and distances."

The transmitter-receiver produced by the team is the first of its kind. The device has two modes, a receiving mode, and a transmitting mode. In the receiving mode, the device receives a 5G signal and a millimeter-wave power signal. This power signal activates the device and provides it with power. The device then enters the transmission mode and sends a 5G signal back in the same direction from which it initially received one. Thus, a device like this can easily communicate and be part of the Internet of Things without needing a separate plug point, unlike most current indoor Internet of Things devices. The device can generate power over

The device can generate power over a wide span of angles and distances and, thus, does not suffer from the challenges faced by previous wirelessly powered devices.

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Thus, with smaller devices like this, which require very little maintenance and additional infrastructure, the Internet of Things network can be expanded easily and make our world better connected. Dr. Shirane concludes that "this was the world's first simultaneous reception of power and communication signals with beam steering. We truly believe that technology like this can revolutionize the Internet of Things network and free it from the shackles that bind it today."

Tech Xplore, 13 June 2022

https://techxplore.com

AI identifies cancer cells

2022-06-10

How do cancer cells differ from healthy cells? A new machine learning algorithm called "ikarus" knows the answer, reports a team led by MDC bioinformatician Altuna Akalin in the journal Genome Biology. The AI program has found a gene signature characteristic of tumors.

When it comes to identifying patterns in mountains of data, human beings are no match for artificial intelligence (AI). In particular, a branch of AI called machine learning is often used to find regularities in data sets—be it for stock market analysis, image and speech recognition, or the classification of cells. To reliably distinguish cancer cells from healthy cells, a team led by Dr. Altuna Akalin, head of the Bioinformatics and Omics Data Science Platform at the Max Delbrück Center for Molecular Medicine in the Helmholtz Association (MDC), has now developed a machine learning program called "ikarus."

The program found a pattern in tumor cells that is common to different types of cancer, consisting of a characteristic combination of genes. According to the team's paper in the journal Genome Biology, the algorithm also detected types of genes in the pattern that had never been clearly linked to cancer before.

Machine learning essentially means that an algorithm uses training data to learn how to answer certain questions on its own. It does so by searching for patterns in the data that help it to solve problems. After the training phase, the system can generalize from what it has learned in order to evaluate unknown data. "It was a major challenge to get suitable training

According to the team's paper in the journal Genome Biology, the algorithm also detected types of genes in the pattern that had never been clearly linked to cancer before.

data where experts had already distinguished clearly between 'healthy' and 'cancerous' cells," relates Jan Dohmen, the first author of the paper.

A surprisingly high success rate

In addition, single-cell sequencing data sets are often noisy. That means the information they contain about the molecular characteristics of individual cells is not very precise—perhaps because a different number of genes is detected in each cell, or because the samples are not always processed the same way. As Dohmen and his colleague Dr. Vedran Franke, co-head of the study, reports, they sifted through countless publications and contacted quite a few research groups in order to get adequate data sets. The team ultimately used data from lung and colorectal cancer cells to train the algorithm before applying it to data sets of other kinds of tumors.

In the training phase, ikarus had to find a list of characteristic genes which it then used to categorize the cells. "We tried out and refined various approaches," Dohmen says. It was time-consuming work, as all three scientists relate. "The key was for ikarus to ultimately use two lists: one for cancer genes and one for genes from other cells," Franke explains. After the learning phase, the algorithm was able to reliably distinguish between healthy and tumor cells in other types of cancer as well, such as in tissue samples from liver cancer or neuroblastoma patients. Its success rate tended to be extraordinarily high, which surprised even the research group. "We didn't expect there to be a common signature that so precisely defined the tumor cells of different kinds of cancer," Akalin says. "But we still can't say if the method works for all kinds of cancer," Dohmen adds. To turn ikarus into a reliable tool for cancer diagnosis, the researchers now want to test it on additional kinds of tumors.

AI as a fully automated diagnostic tool

The project aims to go far beyond the classification of "healthy" versus "cancerous" cells. In initial tests, ikarus already demonstrated that the method can also distinguish other types (and certain subtypes) of cells from tumor cells. "We want to make the approach more comprehensive," Akalin says, "developing it further so that it can distinguish between all possible cell types in a biopsy."

In hospitals, pathologists tend only to examine tissue samples of tumors under the microscope in order to identify the various cell types. It is laborious, time-consuming work. With ikarus, this step could one day become a fully automated process. Furthermore, Akalin notes, the

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data could be used to draw conclusions about the tumor's immediate environment. And that could help doctors to choose the best therapy. For the makeup of the cancerous tissue and the microenvironment often indicates whether a certain treatment or medication will be effective or not. Moreover, AI may also be useful in developing new medications. "Ikarus lets us identify genes that are potential drivers of cancer," Akalin says. Novel therapeutic agents could then be used to target these molecular structures.

A remarkable aspect of the publication is that it was prepared entirely during the COVID pandemic. All those involved were not at their usual desks at the Berlin Institute for Medical Systems Biology (BIMSB), which is part of the MDC. Instead, they were in home offices and only communicated with one another digitally. In Franke's view, therefore, "The project shows that a digital structure can be created to facilitate scientific work under these conditions."

Medical Xpress, 10 June 2022

https://medicalxpress.com

MIT's new heat engine has no moving parts --- is as efficient as a steam turbine

2022-06-02

Engineers at MIT and the National Renewable Energy Laboratory (NREL) have designed a heat engine with no moving parts. Their new demonstrations show that it converts heat to electricity with over 40 percent efficiency — a performance better than that of traditional steam turbines.

The heat engine is a thermophotovoltaic (TPV) cell, similar to a solar panel's photovoltaic cells, that passively captures high-energy photons from a white-hot heat source and converts them into electricity. The team's design can generate electricity from a heat source of between 1,900 to 2,400 degrees Celsius, or up to about 4,300 degrees Fahrenheit.

The researchers plan to incorporate the TPV cell into a grid-scale thermal battery. The system would absorb excess energy from renewable sources such as the sun and store that energy in heavily insulated banks of hot graphite. When the energy is needed, such as on overcast days, TPV cells would convert the heat into electricity, and dispatch the energy to a power grid.

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With the new TPV cell, the team has now successfully demonstrated the main parts of the system in separate, small-scale experiments. They are working to integrate the parts to demonstrate a fully operational system. From there, they hope to scale up the system to replace fossil-fuel-driven power plants and enable a fully decarbonized power grid, supplied entirely by renewable energy.

"Thermophotovoltaic cells were the last key step toward demonstrating that thermal batteries are a viable concept," says Asegun Henry, the Robert N. Noyce Career Development Professor in MIT's Department of Mechanical Engineering. "This is an absolutely critical step on the path to proliferate renewable energy and get to a fully decarbonized grid."

Henry and his collaborators have published their results today in the journal Nature. Co-authors at MIT include Alina LaPotin, Kevin Schulte, Kyle Buznitsky, Colin Kelsall, Andrew Rohskopf, and Evelyn Wang, the Ford Professor of Engineering and head of the Department of Mechanical Engineering, along with collaborators at NREL in Golden, Colorado.

Jumping the gap

More than 90 percent of the world's electricity comes from sources of heat such as coal, natural gas, nuclear energy, and concentrated solar energy. For a century, steam turbines have been the industrial standard for converting such heat sources into electricity.

On average, steam turbines reliably convert about 35 percent of a heat source into electricity, with about 60 percent representing the highest efficiency of any heat engine to date. But the machinery depends on moving parts that are temperature- limited. Heat sources higher than 2,000 degrees Celsius, such as Henry's proposed thermal battery system, would be too hot for turbines.

In recent years, scientists have looked into solid-state alternatives — heat engines with no moving parts, that could potentially work efficiently at higher temperatures.

"One of the advantages of solid-state energy converters are that they can operate at higher temperatures with lower maintenance costs because they have no moving parts," Henry says. "They just sit there and reliably generate electricity."

Thermophotovoltaic cells offered one exploratory route toward solid-state heat engines. Much like solar cells, TPV cells could be made from semiconducting materials with a particular bandgap — the gap between

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a material's valence band and its conduction band. If a photon with a high enough energy is absorbed by the material, it can kick an electron across the bandgap, where the electron can then conduct, and thereby generate electricity — doing so without moving rotors or blades.

To date, most TPV cells have only reached efficiencies of around 20 percent, with the record at 32 percent, as they have been made of relatively low-bandgap materials that convert lower-temperature, low-energy photons, and therefore convert energy less efficiently.

Catching light

In their new TPV design, Henry and his colleagues looked to capture higher-energy photons from a higher-temperature heat source, thereby converting energy more efficiently. The team's new cell does so with higher-bandgap materials and multiple junctions, or material layers, compared with existing TPV designs.

The cell is fabricated from three main regions: a high-bandgap alloy, which sits over a slightly lower-bandgap alloy, underneath which is a mirror-like layer of gold. The first layer captures a heat source's highest-energy photons and converts them into electricity, while lower-energy photons that pass through the first layer are captured by the second and converted to add to the generated voltage. Any photons that pass through this second layer are then reflected by the mirror, back to the heat source, rather than being absorbed as wasted heat.

The team tested the cell's efficiency by placing it over a heat flux sensor — a device that directly measures the heat absorbed from the cell. They exposed the cell to a high-temperature lamp and concentrated the light onto the cell. They then varied the bulb's intensity, or temperature, and observed how the cell's power efficiency — the amount of power it produced, compared with the heat it absorbed — changed with temperature. Over a range of 1,900 to 2,400 degrees Celsius, the new TPV cell maintained an efficiency of around 40 percent.

"We can get a high efficiency over a broad range of temperatures relevant for thermal batteries," Henry says.

The cell in the experiments is about a square centimeter. For a grid-scale thermal battery system, Henry envisions the TPV cells would have to scale up to about 10,000 square feet (about a quarter of a football field), and would operate in climate-controlled warehouses to draw power from huge banks of stored solar energy. He points out that an infrastructure exists

for making large-scale photovoltaic cells, which could also be adapted to manufacture TPVs.

"There's definitely a huge net positive here in terms of sustainability," Henry says. "The technology is safe, environmentally benign in its life cycle, and can have a tremendous impact on abating carbon dioxide emissions from electricity production."

The Brighter Side of News, 2 June 2022

https://thebrighterside.news

A weird star produced the fastest nova on record

2022-06-14

Astronomers are buzzing after observing the fastest nova ever recorded. The unusual event drew scientists' attention to an even more unusual star. As they study it, they may find answers to not only the nova's many baffling traits, but to larger questions about the chemistry of our solar system, the death of stars and the evolution of the universe.

The research team, led by Arizona State University Regents Professor Sumner Starrfield, Professor Charles Woodward from University of Minnesota and Research Scientist Mark Wagner from The Ohio State University, co-authored a report published today in the Research Notes of the American Astronomical Society.

A nova is a sudden explosion of bright light from a two-star system. Every nova is created by a white dwarf—the very dense leftover core of a star—and a nearby companion star. Over time, the white dwarf draws matter from its companion, which falls onto the white dwarf. The white dwarf heats this material, causing an uncontrolled reaction that releases a burst of energy. The explosion shoots the matter away at high speeds, which we observe as visible light.

The bright nova usually fades over a couple of weeks or longer. On June 12, 2021, the nova V1674 Hercules burst so bright that it was visible to the naked eye—but in just over one day, it was faint once more. It was like someone flicked a flashlight on and off.

Nova events at this level of speed are rare, making this nova a precious study subject.

"It was only about one day, and the previous fastest nova was one we studied back in 1991, V838 Herculis, which declined in about two or three

Speed wasn't its only unusual trait. The light and energy it sends out is also pulsing like the sound of a reverberating bell.

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days," says Starrfield, an astrophysicist in ASU's School of Earth and Space Exploration.

As the astronomy world watched V1674 Hercules, other researchers found that its speed wasn't its only unusual trait. The light and energy it sends out is also pulsing like the sound of a reverberating bell.

Every 501 seconds, there's a wobble that observers can see in both visible light waves and X-rays. A year after its explosion, the nova is still showing this wobble, and it seems it's been going on for even longer. Starrfield and his colleagues have continued to study this quirk.

"The most unusual thing is that this oscillation was seen before the outburst, but it was also evident when the nova was some 10 magnitudes brighter," says Wagner, who is also the head of science at the Large Binocular Telescope Observatory being used to observe the nova. "A mystery that people are trying to wrestle with is what's driving this periodicity that you would see it over that range of brightness in the system."

The team also noticed something strange as they monitored the matter ejected by the nova explosion—some kind of wind, which may be dependent on the positions of the white dwarf and its companion star, is shaping the flow of material into space surrounding the system.

Though the fastest nova is (literally) flashy, the reason it's worth further study is that novae can tell us important information about our solar system and even the universe as a whole.

A white dwarf collects and alters matter, then seasons the surrounding space with new material during a nova explosion. It's an important part of the cycle of matter in space. The materials ejected by novae will eventually form new stellar systems. Such events helped form our solar system as well, ensuring that Earth is more than a lump of carbon.

"We're always trying to figure out how the solar system formed, where the chemical elements in the solar system came from," Starrfield says. "One of the things that we're going to learn from this nova is, for example, how much lithium was produced by this explosion. We're fairly sure now that a significant fraction of the lithium that we have on the Earth was produced by these kinds of explosions."

Sometimes a white dwarf star doesn't lose all of its collected matter during a nova explosion, so with each cycle, it gains mass. This would eventually make it unstable, and the white dwarf could generate a type 1a

supernova, which is one of the brightest events in the universe. Each type 1a supernova reaches the same level of brightness, so they are known as standard candles.

"Standard candles are so bright that we can see them at great distances across the universe. By looking at how the brightness of light changes, we can ask questions about how the universe is accelerating or about the overall three-dimensional structure of the universe," Woodward says. "This is one of the interesting reasons that we study some of these systems."

Additionally, novae can tell us more about how stars in binary systems evolve to their death, a process that is not well understood. They also act as living laboratories where scientists can see nuclear physics in action and test theoretical concepts.

The nova took the astronomy world by surprise. It wasn't on scientists' radar until an amateur astronomer from Japan, Seidji Ueda, discovered and reported it.

Citizen scientists play an increasingly important role in the field of astronomy, as does modern technology. Even though it is now too faint for other types of telescopes to see, the team is still able to monitor the nova thanks to the Large Binocular Telescope's wide aperture and its observatory's other equipment, including its pair of multi-object double spectrographs and exceptional PEPSI high resolution spectrograph.

They plan to investigate the cause of the outburst and the processes that led to it, the reason for its record-breaking decline, the forces behind the observed wind, and the cause of its pulsing brightness.

Phys Org, 14 June 2022

https://phys.org

Polluted air cuts global life expectancy by two years

2022-06-14

Microscopic air pollution caused mostly by burning fossil fuels shortens lives worldwide by more than two years, researchers reported Tuesday.

Across South Asia, the average person would live five years longer if levels of fine particulate matter met World Health Organization standards, according to a report from the University of Chicago's Energy Policy Institute.

"Permanently reducing global air pollution to meet the WHO's guidelines would add 2.2 years onto average life expectancy."

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In the Indian states of Uttar Pradesh and Bihar, home to 300 million, crippling lung and heart disease caused by so-called PM2.5 pollution reduces life expectancy by eight years, and in the capital city of New Delhi by a decade.

PM2.5 pollution—2.5 microns across or less, roughly the diameter of a human hair—penetrates deep into the lungs and enters the bloodstream.

In 2013, the United Nations classified it as a cancer-causing agent.

The WHO says PM2.5 density in the air should not top 15 microgrammes per cubic meter in any 24-hour period, or 5 mcg/m3 averaged across an entire year.

Faced with mounting evidence of damaging health impacts, the WHO tightened these standards last year, the first change since establishing air quality guidance in 2005.

"Clean air pays back in additional years of life for people across the world," lead research Crista Hasenkopf and colleagues said in the Air Quality Life Index report.

"Permanently reducing global air pollution to meet the WHO's guidelines would add 2.2 years onto average life expectancy."

Major gains in China

Almost all populated regions in the world exceed WHO guidelines, but nowhere more so that in Asia: by 15-fold in Bangladesh, 10-fold in India, and nine-fold in Nepal and Pakistan.

Central and West Africa, along with much of Southeast Asia and parts of central America, also face pollution levels—and shortened lives—well above the global average.

Surprisingly, PM2.5 pollution in 2020, the most recent data available, was virtually unchanged from the year before despite a sharp slow-down in the global economy and a corresponding drop in CO2 emissions due to COVID lockdowns.

"In South Asia, pollution actually rose during the first year of the pandemic," the authors noted.

One country that has seen major improvements is China.

PM2.5 pollution fell in the nation of 1.4 billion people by almost 40 percent between 2013 and 2020, adding two years to life expectancy.

But even with this progress, lives in China are on average cut short today by 2.6 years.

The worst-hit provinces include Henan and Hebei, in north-central China, and the coastal province of Shandong.

Compared to other causes of premature death, the impact of PM2.5 pollution is comparable to smoking tobacco, more than three times that of alcohol use, and six times that of HIV/AIDS, the report said.

Phys Org, 14 June 2022

https://phys.org

EPA: 'Forever chemicals' pose risk even at very low levels

2022-06-15

The Environmental Protection Agency is warning that two nonstick and stain-resistant compounds found in drinking water are more dangerous than previously thought—and pose health risks even at levels so low they cannot currently be detected.

The two compounds, known as PFOA and PFOS, have been voluntarily phased out by U.S. manufacturers, but there are a limited number of ongoing uses and the chemicals remain in the environment because they do not degrade over time. The compounds are part of a larger cluster of "forever chemicals" known as PFAS that have been used in consumer products and industry since the 1940s.

The EPA on Wednesday issued nonbinding health advisories that set health risk thresholds for PFOA and PFOS to near zero, replacing 2016 guidelines that had set them at 70 parts per trillion. The chemicals are found in products including cardboard packaging, carpets and firefighting foam

At the same time, the agency is inviting states and territories to apply for $1 billion under the new bipartisan infrastructure law to address PFAS and other contaminants in drinking water. Money can be used for technical assistance, water quality testing, contractor training and installation of centralized treatment, officials said.

Several states have set their own drinking water limits to address PFAS contamination that are far tougher than the federal guidance. The toxic

The EPA […] issued nonbinding health advisories that set health risk thresholds for PFOA and PFOS to near zero, replacing 2016 guidelines that had set them at 70 parts per trillion.

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industrial compounds are associated with serious health conditions, including cancer and reduced birth weight.

"People on the front-lines of PFAS contamination have suffered for far too long," EPA Administrator Michael Regan said in a statement. "That's why EPA is taking aggressive action as part of a whole-of-government approach to prevent these chemicals from entering the environment and to help protect concerned families from this pervasive challenge."

PFAS is short for per- and polyfluoroalkyl substances, which are used in nonstick frying pans, water-repellent sports gear, stain-resistant rugs, cosmetics and countless other consumer products. The chemical bonds are so strong that they don't degrade or do so only slowly in the environment and remain in a person's bloodstream indefinitely.

The revised health guidelines are based on new science and consider lifetime exposure to the chemicals, the EPA said. Officials are no longer confident that PFAS levels allowed under the 2016 guidelines "do not have adverse health impacts," an EPA spokesman said.

In this still image provided by Ethereal Films, Brenda Hampton is tearful as she observes a man grieving in a children's section of East Lawrence Memorial Gardens, in Lawrence County, Ala., in June 2021. Hampton, a mother and grandmother, who believes tainted water led to her kidney problems, found that PFAS seemed to be in everything, including fast food packaging.

While the new guidelines set acceptable risk below levels that can currently be measured, as a practical matter EPA recommends that utilities take action against the chemicals when they reach levels that can be measured—currently about four parts per trillion, a senior administration official told reporters Tuesday night.

The EPA said it expects to propose national drinking water regulations for PFOA and PFOS later this year, with a final rule expected in 2023.

In a related development, the EPA said that for the first time it is issuing final health advisories for two chemicals that are considered replacements for PFOA and PFOS. One group is known as GenX chemicals, while the other is known as PFBS. Health advisories for GenX chemicals were set at 10 parts per trillion, while PFBS was set at 2,000 parts per trillion.

The agency said the new advisories provide technical information that federal, state and local agencies can use to inform actions to address PFAS in drinking water, including water quality monitoring, use of filters and

other technologies that reduce PFAS and strategies to reduce exposure to the substances.

Environmental and public health groups hailed the announcement as a good first step. Advocates have long urged action on PFAS after thousands of communities detected PFAS chemicals in their water. PFAS chemicals have been confirmed at nearly 400 military installations and at least 200 million Americans are drinking water contaminated with PFAS, according to the Environmental Working Group, a research and advocacy organization.

"EPA had the courage to follow the science. This is a step in the right direction," said Stel Bailey, co-facilitator of National PFAS Contamination Coalition.

"The science is clear: These chemicals are shockingly toxic at extremely low doses," added Erik Olson, senior strategic director for health and food at the Natural Resources Defense Council. He called on the EPA to regulate all PFAS chemicals "with enforceable standards as a single class of chemicals."

Melanie Benesh, legislative attorney for the Environmental Working Group, said the EPA's announcement "should set off alarm bells for consumers and regulators" alike. She urged the EPA to "move much faster to dramatically reduce exposures to these toxic chemicals."

The American Chemistry Council, which represents major chemical companies, said in a statement that while it supports development of drinking water standards for PFAS based on the best available science, the EPA's announcement "reflects a failure of the agency to follow its accepted practice for ensuring the scientific integrity of its process."

While the advisories are non-binding, "they will have sweeping implications for policies at the state and federal levels," the group said. "These new levels cannot be achieved with existing treatment technology and, in fact, are below levels that can be reliably detected using existing EPA methods."

The Chemours Co., a DuPont spinoff that uses so-called GenX chemicals to produce high-performance fluoropolymers used in semiconductors, mobile phones, hospital ventilators and other products, called the EPA's announcement "fundamentally flawed."

EPA "disregarded relevant data and issued a health advisory contrary to the agency's own standards and this administration's commitment to scientific integrity," Chemours said in a statement.

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The company is "already using state-of-the-art technologies at our sites to abate emissions and remediate historical releases" Chemours said, adding that officials are evaluating next steps, "including potential legal action, to address the EPA's scientifically unsound action."

An investigation by the state of North Carolina found that Chemours had discharged GenX from its Fayetteville Works plant into the Cape Fear River for years. EPA chief Regan was the state's top environmental official when the probe began and led negotiations that resulted in cleanup of the river. Gov. Roy Cooper and his current environmental chief unveiled a three-pronged strategy last week address further efforts to reduce and remedy a broad category of PFAS chemicals in water sources.

Legislation passed by the House would set a national drinking water standard for PFAS and direct the EPA to develop discharge limits for a range of industries suspected of releasing PFAS into the water. The bill has stalled in the Senate.

Phys Org, 15 June 2022

https://phys.org

No signs (yet) of life on Venus

2022-06-14

The unusual behavior of sulfur in Venus' atmosphere cannot be explained by an "aerial" form of extra-terrestrial life, according to a new study.

Researchers from the University of Cambridge used a combination of biochemistry and atmospheric chemistry to test the "life in the clouds" hypothesis, which astronomers have speculated about for decades, and found that life cannot explain the composition of the Venusian atmosphere.

Any life form in sufficient abundance is expected to leave chemical fingerprints on a planet's atmosphere as it consumes food and expels waste. However, the Cambridge researchers found no evidence of these fingerprints on Venus.

Even if Venus is devoid of life, the researchers say their results, reported in the journal Nature Communications, could be useful for studying the atmospheres of similar planets throughout the galaxy, and the eventual detection of life outside our solar system.

"To understand why some planets are alive, we need to understand why other planets are dead."

"We've spent the past two years trying to explain the weird sulfur chemistry we see in the clouds of Venus," said co-author Dr. Paul Rimmer from Cambridge's Department of Earth Sciences. "Life is pretty good at weird chemistry, so we've been studying whether there's a way to make life a potential explanation for what we see."

The researchers used a combination of atmospheric and biochemical models to study the chemical reactions that are expected to occur, given the known sources of chemical energy in Venus's atmosphere.

"We looked at the sulfur-based 'food' available in the Venusian atmosphere—it's not anything you or I would want to eat, but it is the main available energy source," said Sean Jordan from Cambridge's Institute of Astronomy, the paper's first author. "If that food is being consumed by life, we should see evidence of that through specific chemicals being lost and gained in the atmosphere."

The models looked at a particular feature of the Venusian atmosphere—the abundance of sulfur dioxide (SO_2). On Earth, most SO_2 in the atmosphere comes from volcanic emissions. On Venus, there are high levels of SO_2 lower in the clouds, but it somehow gets "sucked out" of the atmosphere at higher altitudes.

"If life is present, it must be affecting the atmospheric chemistry," said co-author Dr. Oliver Shorttle from Cambridge's Department of Earth Sciences and Institute of Astronomy. "Could life be the reason that SO_2 levels on Venus get reduced so much?"

The models, developed by Jordan, include a list of metabolic reactions that the life forms would carry out in order to get their "food," and the waste by-products. The researchers ran the model to see if the reduction in SO_2 levels could be explained by these metabolic reactions.

They found that the metabolic reactions can result in a drop in SO_2 levels, but only by producing other molecules in very large amounts that aren't seen. The results set a hard limit on how much life could exist on Venus without blowing apart our understanding of how chemical reactions work in planetary atmospheres.

"If life was responsible for the SO_2 levels we see on Venus, it would also break everything we know about Venus's atmospheric chemistry," said Jordan. "We wanted life to be a potential explanation, but when we ran the models, it isn't a viable solution. But if life isn't responsible for what we see

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on Venus, it's still a problem to be solved—there's lots of strange chemistry to follow up on."

Although there's no evidence of sulfur-eating life hiding in the clouds of Venus, the researchers say their method of analyzing atmospheric signatures will be valuable when JWST, the successor to the Hubble Telescope, begins returning images of other planetary systems later this year. Some of the sulfur molecules in the current study are easy to see with JWST, so learning more about the chemical behavior of our next-door neighbor could help scientists figure out similar planets across the galaxy.

"To understand why some planets are alive, we need to understand why other planets are dead," said Shorttle. "If life somehow managed to sneak into the Venusian clouds, it would totally change how we search for chemical signs of life on other planets."

"Even if 'our' Venus is dead, it's possible that Venus-like planets in other systems could host life," said Rimmer, who is also affiliated with Cambridge's Cavendish Laboratory. "We can take what we've learned here and apply it to exoplanetary systems—this is just the beginning."

Phys Org, 14 June 2022

https://phys.org

The signals that make cells self-destruct

2022-06-15

Most human hearts look nearly identical—muscle cells in the same places, blood vessel structures in the same orientations. Organs such as hearts or stomachs look alike and function the same across individual organisms in a species because cells follow rigorous processes during development that get them precisely where they need to go.

The process of development involves countless steps that must occur in an exact order and fashion. Studying these intricate steps is the focus of the laboratory of Caltech's Angela Stathopoulos, professor of biology. The lab uses fruit flies, which have a 24-hour developmental cycle with significant changes observable almost every minute, as a model system.

A new paper from the Stathopoulos laboratory examines caudal visceral mesoderm (CVM) cells, which will ultimately become muscle fibers in the fruit fly gut. These cells migrate from the back of the developing embryo to the front over the course of six hours—the longest migration distance in all of fruit fly embryogenesis.

Cells have an internal "clock," known as the cell cycle, which controls the timing of growth, DNA replication, and cell division (mitosis).

The new research identifies the mechanisms that ensure that any wayward, wandering cells will self-destruct through a specific form of cell death called anoikis. Interestingly, resistance to anoikis is a precursor to many types of metastatic cancers. Understanding the pathways that guide healthy anoikis may ultimately provide insight into how cancers metastasize and why they invade certain parts of the body.

"Cell death is a normal, healthy part of development," Stathopoulos says. "The migrating cell has to constantly be making decisions and figuring out if it is in the in the right place in the body. If it's not in the right place, it needs to self-destruct. We have now determined the pathways through which the cell can do this."

CVM cells (white) migrating around a bend in the embryo. When they make this turn, they begin to proliferate and multiply. Credit: F. Macabenta

The paper appears online in the journal Developmental Cell on June 15. Frank Macabenta, senior postdoctoral scholar research associate in biology and biological engineering at Caltech, is the study's first author.

The CVM cells do not make their long journey through the fruit fly embryo alone. These 40 to 50 cells follow a kind of track that is made up of a different cell type called trunk visceral mesoderm (TVM). TVM cells emit a chemical signal called fibroblast growth factor (FGF), which lets a CVM cell know that it is in the right place.

At the midpoint of their migration, the CVM cells must navigate around a sharp bend in the embryo, which is roughly U-shaped. At this juncture, CVM cells start proliferating in anticipation of soon being at the end of their journey, when it will be time to start building muscle. The problem is, when cells start multiplying, some begin to drift off of the TVM track. Researchers have previously observed that this is the point where these lost cells will undergo anoikis and self-destruct.

A gene called hid (short for head involution defective) is responsible for anoikis. When hid is expressed in a cell, the cell will die. In the new work, Macabenta found that CVM cells begin to express hid as they make the turn around the bend in the embryo, but they do not die—unless they fall off of the TVM track.

The team found that this is possible thanks to the FGF signals, which act as the antidote to hid: If a cell falls off of the track and therefore stops receiving FGF signals, it will die; it can stay alive despite hid being expressed as long as it stays on track. In this way, the embryo can make

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sure that any wayward cells will self-destruct, while properly functioning cells are spared.

Finally, the team also discovered that a particular pathway, called the bone morphogenetic protein (BMP) pathway, controls the timing of when the cells begin to proliferate. BMP signaling initiates just as cells navigate the U-shaped turn, roughly at the midpoint of their migration. It is this signal that allows cells to divide and grow in number.

Cells have an internal "clock," known as the cell cycle, which controls the timing of growth, DNA replication, and cell division (mitosis). The team found that the timing of hid expression is linked to progression of the cell cycle, and when this is disrupted, hid is no longer expressed at the right point during cell migration. BMP signaling is necessary to allow the cell cycle to move forward through mitosis and is therefore also necessary for timing the precise expression of hid, as cells that fail to divide are not able to express hid in a timely manner to eliminate lost cells.

It is crucial that cells are able to have these programmed quality control mechanisms because wayward cells can be damaging to the proper development of the rest of the organism.

"When we removed the hid gene, the cells that came off the track would survive and ultimately invade and disrupt the central nervous system, where they really shouldn't be," Macabenta says. "They aren't on the correct path anymore, so they revert to a kind of 'plan B' where they find some location they have some affinity for. If you look at autopsies of people who have had metastatic cancer, typically the metastasizing cells will go colonize specific places. Our research serves as a system to hopefully understand how this works, how cells go awry and figure out the 'second-best' signals to follow. In future work, we would like to see what other signals or cues the CVM cells are following that lead them to the central nervous system. This could explain why certain types of metastases preferentially colonize other tissues."

Phys Org, 15 June 2022

https://phys.org

Inside Clean Energy: Solid-State Batteries for EVs Make a Leap Toward Mass Production

2022-06-09

At some point, the development of solid-state batteries—in which electrons flow through a solid material instead of a liquid or gel—is going to lead to electric vehicles that can go much farther on a charge and battery-storage systems that can hold more energy while taking up less space. We just don't know when that is going to be.

But in the last 10 days, two announcements offer reasons to think the answer is "sooner rather than later."

First, Solid Power, a Colorado-based company developing solid-state EV batteries for partners including Ford and BMW, said it has completed installation of a "pilot production line" that is capable of making about 300 battery cells per week. This signals that the technology is now moving from the lab to the factory.

Second, University of Houston researchers published a paper showing how they have developed a glasslike material that is highly effective as an electrolyte—the part of a battery that electrons pass through during cycles of charging and discharging—for use in a sodium-sulfur battery for energy storage. The research is notable because this is a solid-state battery, and because it shows the promise of sodium-sulfur batteries as an alternative to lithium-ion batteries for long-duration energy storage.

Let's step back for some solid-state battery 101. I reached out to George Crabtree, director of the Joint Center for Energy Storage Research, which is based at Argonne National Laboratory near Chicago, to help explain why these batteries are special.

"I would say, first of all, that solid-state batteries are very likely to be the next big thing at the commercial level," he said.

They would be the biggest step forward in battery technology since 1991, he said. That was when Sony released the first commercial lithium-ion battery.

Solid-state batteries are capable of holding much more energy per unit of mass than today's lithium-ion batteries, which means an EV could go for much longer before needing to be recharged, he said. Even though the electrolyte is solid, it is porous on a microscopic level, allowing electrons to pass through it.

The development of solid-state batteries […] is going to lead to electric vehicles that can go much farther on a charge and battery-storage systems that can hold more energy while taking up less space.

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Researchers have long known that a solid-state design has advantages over batteries that use a liquid or gel, including lithium-ion batteries. One of the big advantages is that solid electrolytes can be made to weigh less and take up less space than liquids or gels. But there are some big engineering challenges that have slowed this technology from reaching consumers.

Solid-State Batteries

One issue is dendrites, the spiky fibers that can accumulate in a battery during recharging, diminishing the battery's performance. Dendrites aren't alive, even though they sometimes resemble branches of a tree, or even clumps of wild mushrooms. They are a problem for many kinds of batteries, including lithium-ion, and have been especially vexing for researchers designing solid-state batteries. The new solid-state designs have a variety of approaches to dealing with the problem, including the use of an electrolyte that resists or otherwise limits the growth of dendrites.

Researchers have developed solid electrolytes made of ceramics, glass and mixes of ceramics and glass.

Solid Power, based in Louisville, Colorado, is a spinoff from research begun at the University of Colorado Boulder. It was founded in 2011 and is now publicly traded with a market capitalization of $1.3 billion. The company's battery uses a ceramic-glass electrolyte.

With its partners Ford and BMW, Solid Power is one of the leading players in the race to develop a mass-market electric vehicle that runs on a solid-state battery system.

Among the major competitors is QuantumScape of San Jose, California, which has a market capitalization of $5.1 billion and is working with Volkswagen.

Just about every automaker is developing solid-state batteries, either with an external partner like Solid Power or QuantumScape, or through internal research and development.

By announcing its new production line, Solid Power is indicating that it is on track to produce its systems on a much larger scale by the mid-2020s.

"With the EV cell pilot line now installed, our next big challenge is commencing production at scale and building cells that meet the requirements necessary for us to enter into automotive qualification later

this year," Derek Johnson, chief operating officer at Solid Power, said in a statement.

He is referring to the years-long process of working with automakers to validate the safety and effectiveness of the systems before the batteries can be sold to the public.

In addition to improving the performance of EVs, solid-state batteries could be part of a new generation of energy-storage systems.

The University of Houston research results, published in the journal Nature Communications, show the results of a project to develop a solid-state battery for use in grid-scale energy storage.

Researchers say their battery is low cost, easy to build, has a high degree of mechanical stability and is chemically stable—four important factors for viability in the market.

"To date, no single sodium solid electrolyte has been able to achieve all four of these requirements at the same time," Yan Yao, an electrical and computer engineering professor and co-author of the paper, said in a statement.

The key component is the glasslike electrolyte that uniquely combines the properties of oxygen and sulfur, Yao said in an email. It also resists dendrite formation.

His team is trying to develop a battery that has the potential to combine low costs and an ability to discharge for up to 12 hours on a single charge. The key to the low costs is that one of its main materials, sodium, is widely available and affordable, in contrast to lithium.

I asked Crabtree how these recent developments in research and manufacturing fit into the bigger picture of the transition to clean energy.

"Lithium-ion is the best battery we've ever had," he said. "However, it can't do everything."

Lithium-ion batteries have been highly effective for the current generation of EVs but are not well-suited for long-haul ground vehicles, rail, ships or aircraft. Lithium-ion batteries also are not well-suited for grid-scale energy storage of more than four hours.

Much of current battery research is looking at what materials and designs are going to be most effective for these other applications, he said. The development of solid-state batteries is a small part of this larger picture.

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So solid-state batteries can make EVs and energy storage systems capable of holding more energy than today's batteries, but that's just the beginning of something bigger and transformative for the energy economy.

Inside Climate News, 9 June 2022

https://insideclimatenews.com

Newly identified population of polar bears survives on glacier slush, not sea ice

2022-06-16

Polar bears typically depend on solid sea ice to hunt and keep their bellies full. To breathe, seals pop up in holes in the frozen seawater, and there the bears ambush and eat them. Now, however, scientists have discovered a group of polar bears in southeastern Greenland that does things differently, using a slushy mix of freshwater snow and ice as a platform to ambush seals. This new population may offer clues to how polar bears will fare as the Arctic warms at an alarming rate and sea ice shrinks, threatening many polar bears with starvation.

The southeastern Greenland polar bears are genetically distinct from polar bears elsewhere in the country, researchers report today in Science. That makes this small group of a few hundred polar bears its own subpopulation, one of just 20 in the world. "This southeast Greenland group of bears is the most genetically distinctive population of polar bears that has ever been documented," says Elizabeth Peacock, a polar bear biologist at Emory University who was not involved with the work.

Westerners first spotted polar bears in southeastern Greenland's fjords—a region characterized by mountainous topography and craggy icebergs—in 1830. The animals live just a couple degrees south of their closest relatives, which reside in more typical polar bear environments. The southeastern bears aren't well-studied because of the unpredictable weather and heavy snowfall at the rugged southern tip of Greenland.

But Kristin Laidre, an ecologist at the University of Washington's Polar Science Center, and her colleagues were able to access the unforgiving region with heavy-duty helicopters. To ensure they made it back to their research base at a Greenlandic coastal community 4 hours away, the scientists stashed fuel in the snow at strategic spots in the bears' habitat years in advance.

"This southeast Greenland group of bears is the most genetically distinctive population of polar bears that has ever been documented."

Over the course of 7 years, the team gained unprecedented access to the region's resourceful bears. They tracked 27 local bears with satellite tags to see where they went, comparing that with more than 30 years of polar bear tracking data from throughout Greenland's eastern coast. They bolstered these data with observations from traditional subsistence hunters in nearby communities, who provided genetic samples from slain bears for the scientists to test.

Most likely, the bears are genetically distinctive because they have been isolated by their habitat. Polar bears in southeastern Greenland are hemmed in by the mountainous expanse of the Greenland Ice Sheet to the west and rapid currents to the east. Moving overland is difficult as the southeastern tip of Greenland is gashed with fjords and flanked by steep cliffs.

With little sea ice for more than 250 days of the year, the animals utilize blocks of floating glacial ice breaking off of the Greenland Ice Sheet to ambush unsuspecting seals—the first time polar bears have been observed utilizing frozen freshwater for most of the year. As the area's sea ice continues to dwindle, Laidre and her colleagues think this slushy glacial mélange offers these bears an alternative hunting ground in a warming Arctic.

In their rugged environment, these isolated polar bears are homebodies, sticking mostly to the glacial ice floating in their local fjords. The researchers observed that the median distance covered by female polar bears over 4 days in this area of Greenland was just 10 kilometers, compared with the nearly 40 kilometers female bears in northeastern Greenland cover in the same amount of time. But these bears are not lazy: Roughly half of the animals the team tracked covered an average distance of 190 kilometers to return to their home fjords after their hunk of glacial ice drifted southward on one of the coast's swift currents.

These environments are relatively rare outside of southeastern Greenland and the Norwegian archipelago of Svalbard. "This isn't a lifeboat for all polar bears," Laidre says. Peacock agrees. "This is a very small corner of the world," she says. "It does not change the status of polar bears in the Arctic." In fact, because they live toward the southern edge of their species' range, these few hundred polar bears are more susceptible to climate change.

Still, southeastern Greenland's resourceful bears can teach scientists vital lessons about how melting sea ice may impact these creatures, Laidre says. Compared with bears farther north on Greenland's coast, female southeastern Greenland polar bears are smaller and produce fewer

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cubs. She thinks future research on these animals can help scientists predict how polar bears will fare as disappearing sea ice isolates other subpopulations of polar bears. "They're an important group because they can help us look into the future."

Science, 16 June 2022

https://science.org

New designer cells could advance treatments for illness and disease

2022-06-13

Artificial cells have been engineered to mimic the natural characteristics of biological cells in a new study from Imperial College London.

Scientists from the Departments of Chemical Engineering and Chemistry have developed a way to engineer artificial cells that mimic how biological cells behave in response to environmental changes. This could have significant implications for our understanding of biology, in treating illness and in drug delivery.

Producing such cellular architectures has been one of the ultimate goals of synthetic biology, as it would enable scientists to create designer cells with specific functions that are easier to control and predict than biological ones.

The research has been published today in ACS Nano.

Fundamental biological features

A fundamental feature of biological cells across all forms of life is the compartmentalization of cells, which can change in response to environmental stimuli. For example, when certain immune cells sense a virus, they release sub-compartments to their environment, which act as signal for other types of cells to destroy that virus.

Previous efforts at replicating this dynamic feature of cells have only resulted in static compartmentalization, which has hindered the biomimetic and technological potential of synthetic cells.

Now a team of synthetic biologists have developed a method of mimicking the dynamic features of natural sub-compartments in artificial cells, which can exist either inside the cell or externally on its surface.

This could pave the way for developments in treating illness and disease, and in targeted drug delivery.

Sophisticated cells

The team at Imperial used a "bottom-up assembly" approach to develop artificial cells with sub-compartments, which can respond to chemical stimuli in their environment by changing their internal organization.

Scientists […] have developed a way to engineer artificial cells that mimic how biological cells behave in response to environmental changes.

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They can be engineered to disperse from the cell surface in response to chemical cues in the environment, or switch to a dispersed state within the cell lumen after sensing mechanical triggers. These structural rearrangements can be reversible and do not require complex biological machinery.

Dr. Yuval Elani, academic lead of this study, says that "biological cells are highly dynamic and responsive, which is why they are so sophisticated. They constantly shift how materials inside are arranged, in response to their environment. Taking inspiration from biology and building this feature into synthetic systems has great potential in biotechnology and therapeutics, something which we are now looking to exploit."

Next steps

The understanding of how to build dynamic sub-compartments within cells in an essential first step in utilizing this technology. Now researchers will need to focus on increasing its biological and technological relevance. For example, by engineering these synthetic cells to deliver medicines encapsulated in sub-compartments.

Lead author Greta Zubaite added that "if a target of interest, for example a tumor, has a microenvironment that is different to that of healthy cells, the artificial cells could sense this and use it as cue to release drug-loaded sub-compartments. Drug carrying artificial cells could also be engineered to allow on site non-invasive treatment of disease or illness. The research we have carried out paves the way to this type of treatment."

Phys Org, 13 June 2022

https://phys.org

Tin in Permanent Contraception Implants Causes Toxicity

2022-05-31

Essure implants arrived on the market in 2002 as permanent contraception for women older than age 45 years with children. They were recalled in 2017. Presented as an alternative to laparoscopic tubal ligation, this medical device resulted in rare side effects affecting thousands of women, most notably the nervous system, cardiovascular system, endocrine system, and musculoskeletal system.

Implant Analysis Protocol

"When tin binds to a carbon atom, it becomes organotin, a neurotoxin."

A team from Lyon studied the wear debris from these medical devices and their possible toxic health effects. They discovered that tin could be the cause of the implant's toxicity. "My research focuses on a variety of medical devices, mostly joint replacements, and more specifically, hip replacements. I look at how these materials behave in humans and how the wear debris affects the body," explained Ana Maria Trunfio-Sfarghiu, bioengineering expert and research associate with the French National Center for Scientific Research at the Lyon National Institute of Applied Sciences' Contact and Structure Mechanics Laboratory.

"The problems with Essure implants started with a woman who had been using one for about 10 years and was experiencing side effects such as trouble concentrating and focusing, significant vaginal bleeding, extreme tiredness, hair loss, etc. She had the implant removed, and we retrieved it from her gynecologist and analyzed it alongside other implants," said Trunfio-Sfarghiu.

"Together with the hospital, we set up an implant analysis protocol. We visited hospital teams to demonstrate how to prepare the biopsies, embedded in paraffin blocks, before sending them to us for analysis. We gave the same specimen preparation instructions for all subjects," Trunfio-Sfarghiu explained.

After a year of clinical analysis, the Journal of Trace Elements in Medicine and Biology published an article about 18 cases.

Implant Weld Corrosion

The Essure implant measures a few centimeters long and resembles a small spring. Once released inside the fallopian tube, its goal is to create inflammation and block the tube. It triggers fibrosis, which prevents the sperm from reaching the egg. Premarketing tests had shown that the fibrosis surrounding the implant would keep it from moving. However, the pharmaceutical company hadn't assessed the mechanical integrity of the spring weld, which was made of silver-tin.

During their analysis in collaboration with the Minapath laboratory, Trunfio-Sfarghiu's team found that the weld had corroded and that tin particles had been released into the subjects' bodies. "The study included about 40 women, and we found tin in all of them," said Trunfio-Sfarghiu.

This weld corrosion has several possible consequences. "When the implant degrades, it can travel anywhere in the pelvis, like a needle moving through the body with no apparent destination. The surgeons who

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operate to remove it describe similar surgeries in military medicine when the patient has been hit by a bullet!"

Organotin Toxicity

Although tin is not especially toxic for the body when ingested, it can bind to organic compounds if it passes through to the blood. "When tin binds to a carbon atom, it becomes organotin, a neurotoxin," said Trunfio-Sfarghiu.

She believes that this organotin can travel to the brain and trigger symptoms like those found in patients with Essure implants. "For the time being, there is insufficient data to assert that we found organotin in all subjects. Another more in-depth study would be needed to assess migration to the brain. For the past 2 years, we have tried to obtain academic funding to continue our research, so far without success. Academic and political authorities seem to be a bit scared of what we've found," said Trunfio-Sfarghiu.

For her, "it's how the implant was marketed that is problematic. The implant was designed to create local inflammation, inflammation in itself being difficult to control. Some women need to have their entire uterus and ovaries removed to resolve problems caused by the implant."

Harm in the United States

Trunfio-Sfarghiu's research has helped American victims obtain acknowledgment of their suffering in the United States. "But the harm caused to women by defective implants has yet to be acknowledged in France," she added.

She explained that Essure was recalled in 2017 because sales were poor, not because it was deemed dangerous. Her conclusion? "No implant that creates inflammation should be authorized, especially if there is a surgical alternative, which there is here: tubal ligation."

Medscape, 31 May 2022

https://medscape.com

New work upends understanding of how blood is formed

2022-06-15

The origins of our blood may not be quite what we thought. Using cellular "barcoding" in mice, a groundbreaking study finds that blood

cells originate not from one type of mother cell, but two, with potential implications for blood cancers, bone marrow transplant, and immunology. Fernando Camargo, Ph.D., of the Stem Cell Program at Boston Children's Hospital led the study, published in Nature on June 15.

"Historically, people have believed that most of our blood comes from a very small number of cells that eventually become blood stem cells, also known as hematopoietic stem cells," says Camargo, who is also a member of the Harvard Stem Cell Institute and a professor at Harvard University. "We were surprised to find another group of progenitor cells that do not come from stem cells. They make most of the blood in fetal life until young adulthood, and then gradually start decreasing."

The researchers are now following up to see if the findings also apply to humans. If so, these cells, known as embryonic multipotent progenitor cells (eMPPs), could potentially inform new treatments for boosting aging people's immune systems. They could also shed new light on blood cancers, especially those in children, and help make bone marrow transplants more effective.

Cellular 'barcodes'

Camargo's team applied a barcoding technique they developed several years ago and documented in Cell. Using either an enzyme known as transposase or CRISPR gene editing, they inserted unique genetic sequences into embryonic mouse cells in such a way that all the cells descended from them also carried those sequences. This enabled the team to track the emergence of all the different types of blood cells and where they came from, all the way to adulthood.

"Previously, people didn't have these tools," says Camargo. "Also, the idea that stem cells give rise to all the blood cells was so embedded in the field that no one attempted to question it. By tracking what happened in mice over time, we were able to see new biology."

Understanding the aging immune system

Through barcoding, the researchers found that eMPPs, as compared with blood stem cells, are a more abundant source of most lymphoid cells important to the immune responses, such as B cells and T cells. Camargo believes the decrease in eMPPs that they observed with age may explain why people's immunity weakens as they get older.

"We were surprised to find another group of progenitor cells that do not come from stem cells."

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"We're now trying to understand why these cells peter out in middle age, which could potentially allow us to manipulate them with the goal of rejuvenating the immune system," says Camargo.

In theory, there could be two approaches: extending the life of eMPP cells, perhaps through growth factors or immune signaling molecules, or treating blood stem cells with gene therapy or other approaches to make them more like eMPPs.

Unpacking blood cancers

Camargo is also excited about the potential implications for better understanding and treatment of blood cancers. For example, myeloid leukemias, striking mostly older people, affect myeloid blood cells such as granulocytes and monocytes. Camargo thinks these leukemias may originate from blood stem cells, and that leukemias in children, which are mostly lymphoid leukemias, may originate from eMPPs.

"We are following up to try to understand the consequences of mutations that lead to leukemia by looking at their effects in both blood stem cells and eMPPs in mice," he says. "We want to see if the leukemias that arise from these different cells of origin are different—lymphoid-like or myeloid-like."

Improving bone marrow transplant?

Finally, the recognition that there are two types of mother cells in the blood could revolutionize bone marrow transplant.

"When we tried to do bone marrow transplants in mice, we found that the eMPPs didn't engraft well; they only lasted a few weeks," says Camargo. "If we could add a few genes to get eMPPs to engraft long term, they could potentially be a better source for a bone marrow transplant. They are more common in younger marrow donors than blood stem cells, and they are primed to produce lymphoid cells, which could lead to better reconstitution of the immune system and fewer infection complications after the graft."

Phys Org, 15 June 2022

https://phys.org

Mistletoe berries may hold the secret for creating a biological super glue

2022-06-14

Each mistletoe berry can produce up to two meters of a gluey thread called viscin. It allows the seeds of this parasitic plant to stick to and infect host plants. Since ancient times, mistletoe berries have been explored as treatments for everything from infertility and epilepsy to cancer. But, until now, no one has fully investigated the potential medical or technical uses of the glue itself. A recent paper from McGill University and the Max Planck Institute of Colloids and Interfaces, published in PNAS Nexus, suggests that through simple processing, viscin's ultra-stiff flexible fibers, which adhere to both skin and cartilage as well as to various synthetic materials, could have a range of applications—both biomedical and beyond.

It is a discovery that came about almost by chance—sparked by the actions of a young girl. "I had never seen mistletoe before living in Germany," said Matthew Harrington, a senior author on the paper, and an associate professor in the Department of Chemistry at McGill University, and the Tier 2 Canada Research Chair in Green Chemistry. "So, when my daughter was playing with a berry from a mistletoe we bought from a local Christmas market, and it started sticking to everything, I was intrigued." This is understandable since Harrington's research focuses on exploring materials and adhesives found in nature and adapting the underlying principles for the development of advanced bio-inspired materials.

A plant with very unusual qualities

The researchers discovered that through simple processing when wet, viscin fibers, which stick to themselves as well as to other materials, could be stretched into thin films or assembled into 3D structures. They believe that this means viscin could potentially be used as a wound sealant or skin covering. What makes the flexible viscin fibers so interesting as a material is that their ability to stick to things is fully reversible under humid conditions.

"I wore a thin film of viscin on my skin for three days to observe its adhesive qualities and was able to remove it from my fingers afterwards by simply rubbing them together," said Nils Horbelt, a recently graduated Ph.D. student at the Max Planck Institute, and the first author on the paper, who, according to Harrington, brought the creativity and patience of a carpenter (his former profession) to the research. "But there still remain many questions about this very unusual material."

Each mistletoe berry can produce up to two meters of a gluey thread called viscin. It allows the seeds of this parasitic plant to stick to and infect host plants.

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The researchers' next goals are to gain a better understanding of the chemistry behind this swellable, extremely sticky material so that they can then replicate the process.

"The fact that viscin can adhere to both wood and skin or feathers may be relevant evolutionarily speaking," adds Harrington. "But it's harder to explain adherence to various synthetic surfaces, such as plastics, glass and metal alloys, from an adaptive point of view. So viscin may simply represent a highly versatile adhesion chemistry, which is what makes it so interesting to explore what is going on chemically."

Given the excellent properties of mistletoe viscin and the fact that mistletoe plants are abundant, and both biodegradable and biorenewable, these findings suggest that this remarkable plant might provide more than holiday ornamentation in the future.

Phys Org, 14 June 2022

https://phys.org

Ten years after the Higgs, physicists face the nightmare of finding nothing else

2022-06-13

A decade ago, particle physicists thrilled the world. On 4 July 2012, 6000 researchers working with the world's biggest atom smasher, the Large Hadron Collider (LHC) at the European particle physics laboratory, CERN, announced they had discovered the Higgs boson, a massive, fleeting particle key to their abstruse explanation of how other fundamental particles get their mass. The discovery fulfilled a 45-year-old prediction, completed a theory called the standard model, and thrust physicists into the spotlight.

Then came a long hangover. Before the 27-kilometer-long ring-shaped LHC started to take data in 2010, physicists fretted that it might produce the Higgs and nothing else, leaving no clue to what lies beyond the standard model. So far, that nightmare scenario is coming true. "It's a bit disappointing," allows Barry Barish, a physicist at the California Institute of Technology. "I thought we would discover supersymmetry," the leading extension of the standard model.

It's too early to despair, many physicists say. After 3 years of upgrades, the LHC is now powering up for the third of five planned runs, and some new particle could emerge in the billions of proton-proton collisions it will

Unless Europe's Large Hadron Collider coughs up a surprise, the field of particle physics may wheeze to its end

produce every second. In fact, the LHC should run for another 16 years, and with further upgrades should collect 16 times as much data as it already has. All those data could reveal subtle signs of novel particles and phenomena.

Still, some researchers say the writing is on the wall for collider physics. "If they don't find anything, this field is dead," says Juan Collar, a physicist at the University of Chicago who hunts dark matter in smaller experiments. John Ellis, a theorist at King's College London, says hopes of a sudden breakthrough have given way to the prospect of a long, uncertain grind toward discovery. "It's going to be like pulling teeth, not like teeth falling out."

Since the 1970s, physicists have been locked in a wrestling match with the standard model. It holds that ordinary matter consists of lightweight particles called up quarks and down quarks—which bond in trios to make protons and neutrons—along with electrons and featherweight particles called electron neutrinos. Two sets of heavier particles lurk in the vacuum and can be blasted into fleeting existence in particle collisions. All interact by exchanging other particles: The photon conveys the electromagnetic force, the gluon carries the strong force that binds quarks, and the massive W and Z bosons carry the weak force.

The standard model describes everything scientists have seen at particle colliders so far. Yet it cannot be the ultimate theory of nature. It leaves out the force of gravity, and it doesn't include mysterious, invisible dark matter, which appears to outweigh ordinary matter in the universe six to one.

The LHC was supposed to break that impasse. In its ring, protons circulating in opposite directions crash together at energies nearly seven times as high as at any previous collider, enabling the LHC to produce particles too massive to be made elsewhere. A decade ago many physicists envisioned quickly spotting marvels including new force-carrying particles or even mini–black holes. "One would drown in supersymmetric particles," recalls Beate Heinemann, director of particle physics at the German laboratory DESY. Finding the Higgs would take longer, physicists predicted.

Instead, the Higgs appeared in a relatively speedy 3 years—in part because it is somewhat less massive than many physicists expected, about 133 times as heavy as a proton, which made it easier to produce. And 10 years after that monumental discovery, no other new particle has emerged.

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That dearth has undermined two of physicists' cherished ideas. A notion called naturalness suggested the low mass of the Higgs more or less guaranteed the existence of new particles within the LHC's grasp. According to quantum mechanics, any particles lurking "virtually" in the vacuum will interact with real ones and affect their properties. That's exactly how virtual Higgs bosons give other particles their mass.

That physics cuts both ways, however. The Higgs boson's mass ought to be pulled dramatically upward by other standard model particles in the vacuum—especially the top quark, a heavier version of the up quark that weighs 184 times as much as the proton. That doesn't happen, so theorists have reasoned that at least one other new particle with a similar mass and just the right properties—in particular, a different spin—must exist in the vacuum to "naturally" counter the effects of the top quark.

The theoretical concept known as supersymmetry would supply such particles. For every known standard model particle, it posits a heavier partner with a different spin. Lurking in the vacuum, those partners would not only keep the Higgs's mass from running away, but would also help explain how the Higgs field, which pervades the vacuum like an unextinguishable electric field, came into being. Supersymmetric particles might even account for dark matter.

But instead of those hoped-for particles, what have emerged in the past decade are tantalizing anomalies—small discrepancies between observations and standard model predictions—that physicists will explore in the LHC's next 3-year run. For example, in 2017, physicists working with LHCb, one of four large particle detectors fed by the LHC, found that B mesons, particles that contain a heavy bottom quark, decay more often to an electron and a positron than to a particle called a muon and an antimuon. The standard model says the two rates should be the same, and the difference might be a hint of supersymmetric partners, Ellis says.

Similarly, experiments elsewhere suggest the muon might be very slightly more magnetic than the standard model predicts (Science, 9 April 2021, p. 113). That anomaly can be explained by the existence of exotic particles called leptoquarks, which might already be hiding undetected in the LHC's output, Ellis says.

The Higgs itself provides other avenues of exploration, as any difference between its observed and predicted properties would signal new physics. For example, in August 2020, teams of physicists working with the LHC's two biggest detectors, ATLAS and CMS, announced that both had spotted the Higgs decaying to a muon and an antimuon. If the rate of that hard-

to-see decay varies from predictions, the deviation could point to new particles hiding in the vacuum, says Marcela Carena, a theorist at Fermi National Accelerator Laboratory.

Those searches likely won't yield dramatic "Eureka!" moments, however. "There's a shift towards very precise measurements of subtle effects," Heinemann says. Still, Carena says, "I very much doubt that in 20 years, I will say, 'Oh, boy, after the Higgs discovery we learned nothing new.'"

Others are less sanguine about LHC experimenters' chances. "They're facing the desert and they don't know how wide it is," says Marvin Marshak, a physicist at the University of Minnesota, Twin Cities, who studies neutrinos using other facilities. Even optimists say that if the LHC finds nothing new, it will be harder to convince the governments of the world to build the next bigger, more expensive collider to keep the field going.

For now, many physicists at the LHC are just excited to get back to smashing protons. During the past 3 years, scientists have upgraded the detectors and reworked the lower energy accelerators that feed the collider. The LHC should now run at a more constant collision rate, effectively increasing the flow of data by as much as 50%, says Mike Lamont, director of accelerators and beams at CERN.

Accelerator physicists have been slowly tuning up the LHC's beams for months, Lamont says. Only when the beams are sufficiently stable will they turn on the detectors and resume taking data. Those switches should flip on 5 July, 10 years and 1 day after the announcement of the Higgs discovery, Lamont says. "It's good to be going into some sustained running."

Science, 13 June 2022

https://science.org

Has COVID affected your sleep? Here's how viruses can change our sleeping patterns

2022-06-15

During the early phases of the pandemic, and especially during lockdowns and stay-at-home orders, many people reported disruptions to sleep and their sleeping patterns. As COVID infections have increased, we're again seeing reports of people experiencing poor sleep during and following COVID infection.

Like many things, sleep and immunity are bidirectional. This means sleep, in particular poor sleep, can impact immune function, and im-mune function can impact sleep.

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Some people report insomnia symptoms, where they struggle to fall or stay asleep, with this commonly being referred to as "coronasomnia" or "COVID insomnia". Others report feeling constantly fatigued, and seemingly can't get enough sleep, with this sometimes being referred to as "long COVID".

So why is our sleep impacted by COVID infections, and why do the impacts differ so much between individuals?

Sleep and immunity

When our body is infected with a virus this causes an immune, or inflammatory response. As part of this response, our cells produce proteins such as cytokines in order to help fight the infection. Some of these cytokines are also involved in promoting sleep and are known as "sleep regulatory substances". In this way, when there are more of these cytokines in our bodies this tends to make us sleepier.

It gets a little more complicated though, because like many things, sleep and immunity are bidirectional. This means sleep, in particular poor sleep, can impact immune function, and immune function can impact sleep. During sleep, especially during the non-rapid eye movement stage slow wave sleep (a deep stage of sleep), there is an increase in the production of some cytokines. As such, sleep increases the immune response which may increase our chance of survival from the infection.

Sleep and COVID

While we are still learning about the specific effects of COVID on sleep, we do know about what happens to sleep with other viral infections.

One study that looked at rhinovirus infections, or the "common cold", in healthy adults, found individuals who are symptomatic had a reduced sleep duration, less consolidated sleep, and poorer cognitive performance than asymptomatic individuals.

Another study that looked at people with respiratory infections showed that while symptomatic, people spent more time in bed and had increased sleep time, yet had more awakenings during sleep. People also reported increased difficulties falling asleep, poorer sleep quality, more restless sleep and more "lighter" sleep.

A more recent study found patients with COVID reported more trouble sleeping compared to patients without COVID.

COVID insomnia and long COVID

While the changes in sleep with viral infections such as COVID are likely to be due to our bodies' immune response, it's possible the sleep disturbances, such as the fragmented sleep and waking frequently, may lead to poor sleep habits, such as using phones or electronic devices at night.

Poorer night time sleep may also lead to some people having more frequent daytime naps, which could further impact night time sleep. And taking longer to fall asleep, or waking up at night and struggling to fall back asleep can lead to frustrations around not being able to sleep.

All of these factors, either independently or in combination with each other, may lead to the insomnia symptoms people with COVID are experiencing. In the short-term, these insomnia symptoms are not really a big issue. However, if poor sleep habits persist this can lead to chronic insomnia.

On the other side, there are people who experience long COVID, where they are constantly fatigued even though they may be getting sufficient sleep well after their COVID infection has passed. Unfortunately, more research is needed to determine why some people experience lingering fatigue after viral infections, but it may be due to an excessive immune response.

Factors such as genetics, other health concerns and mood disorders such as anxiety are the likely culprits as to why some people experience "COVID insomnia", whereas others are more likely to develop "long COVID". Much more research is needed to fully understand the causes of poorer sleep with COVID.

How to deal with sleep disruptions caused by COVID

During the acute phase of infections, it's important to accept we may experience some sleep disturbances. Try not to get too frustrated about sleeping poorly or taking longer to fall asleep.

When you start to feel better, aim to go back to your regular, pre-COVID, sleep-wake pattern, and avoid daytime napping, or at least too much daytime napping. Try to avoid looking at the clock when in bed, and go to bed when you feel sleepy. Reduce light exposure at night, and aim to get some bright light in the morning, ideally outdoors. This will help you get back to a normal routine faster.

For more tips on how to improve sleep and to avoid chronic insomnia, the Sleep Health Foundation has some resources specifically dedicated

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to COVID and sleep. If you're still struggling with insomnia or excessive sleepiness following a COVID infection, especially if it's been a few months, it's always good to see your GP, who can offer you more specific advice and work out if more testing is required.

The Conversation, 15 June 2022

https://theconversation.com

The benefits of exercise in a pill? Science is closer to that goal

2022-06-15

Researchers at Baylor College of Medicine, Stanford School of Medicine and collaborating institutions report today in the journal Nature that they have identified a molecule in the blood that is produced during exercise and can effectively reduce food intake and obesity in mice. The findings improve our understanding of the physiological processes that underlie the interplay between exercise and hunger.

"Regular exercise has been proven to help weight loss, regulate appetite and improve the metabolic profile, especially for people who are overweight and obese," said co-corresponding author Dr. Yong Xu, professor of pediatrics—nutrition and molecular and cellular biology at Baylor. "If we can understand the mechanism by which exercise triggers these benefits, then we are closer to helping many people improve their health."

"We wanted to understand how exercise works at the molecular level to be able to capture some of its benefits," said co-corresponding author Jonathan Long, MD, assistant professor of pathology at Stanford Medicine and an Institute Scholar of Stanford ChEM-H (Chemistry, Engineering & Medicine for Human Health). "For example, older or frail people who cannot exercise enough, may one day benefit from taking a medication that can help slow down osteoporosis, heart disease or other conditions."

Xu, Long and their colleagues conducted comprehensive analyses of blood plasma compounds from mice following intense treadmill running. The most significantly induced molecule was a modified amino acid called Lac-Phe. It is synthesized from lactate (a byproduct of strenuous exercise that is responsible for the burning sensation in muscles) and phenylalanine (an amino acid that is one of the building blocks of proteins).

"If we can understand the mechanism by which exercise triggers these benefits, then we are closer to helping many people improve their health."

In mice with diet-induced obesity (fed a high-fat diet), a high dose of Lac-Phe suppressed food intake by about 50% compared to control mice over a period of 12 hours without affecting their movement or energy expenditure. When administered to the mice for 10 days, Lac-Phe reduced cumulative food intake and body weight (owing to loss of body fat) and improved glucose tolerance.

The researchers also identified an enzyme called CNDP2 that is involved in the production of Lac-Phe and showed that mice lacking this enzyme did not lose as much weight on an exercise regime as a control group on the same exercise plan.

Interestingly, the team also found robust elevations in plasma Lac-Phe levels following physical activity in racehorses and humans. Data from a human exercise cohort showed that sprint exercise induced the most dramatic increase in plasma Lac-Phe, followed by resistance training and then endurance training. "This suggests that Lac-Phe is an ancient and conserved system that regulates feeding and is associated with physical activity in many animal species," Long said.

"Our next steps include finding more details about how Lac-Phe mediates its effects in the body, including the brain," Xu said. "Our goal is to learn to modulate this exercise pathway for therapeutic interventions."

Medical Xpress, 15 June 2022

https://medicalxpress.com

Dead star's cannibalism of its planetary system is most far-reaching ever witnessed

2022-06-16

The violent death throes of a nearby star so thoroughly disrupted its planetary system that the dead star left behind—known as a white dwarf—is sucking in debris from both the system's inner and outer reaches, UCLA astronomers and colleagues report today.

This is the first case of cosmic cannibalism in which astronomers have observed a white dwarf consuming both rocky-metallic material, likely from a nearby asteroid, and icy material, presumed to be from a body similar to those found in the Kuiper belt at the fringe of our own solar system.

"We have never seen both of these kinds of objects accreting onto a white dwarf at the same time," said lead researcher Ted Johnson, a physics

This is the first case of cosmic cannibalism in which astronomers have observed a white dwarf consuming both rocky-metallic material […] and icy material.

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and astronomy major at UCLA who graduated last week. "By studying these white dwarfs, we hope to gain a better understanding of planetary systems that are still intact."

The findings are based on an analysis of materials captured by the atmosphere of G238-44, a white dwarf some 86 light-years from Earth, using archival data from the Hubble Space Telescope and additional NASA satellites and observatories. A white dwarf is the burned-out core that remains after a star like our sun sheds its outer layers and stops burning fuel through nuclear fusion.

As surprising as the white dwarf's wide-ranging diet is, the findings are also intriguing because astronomers believe icy objects crashed into and irrigated dry, rocky planets in our solar system—including Earth. Billions of years ago, comets and asteroids are thought to have delivered water to our planet, sparking the conditions necessary for life. The makeup of the material detected raining onto G238-44 implies that icy reservoirs might be common among planetary systems, said research co-author Benjamin Zuckerman, a UCLA professor of physics and astronomy.

"Life as we know it requires a rocky planet covered with a variety of volatile elements like carbon, nitrogen and oxygen," Zuckerman said. "The abundances of the elements we see on this white dwarf appear to have come from both a rocky parent body and a volatile-rich parent body—the first example we've found among studies of hundreds of white dwarfs."

Chaos and destruction: From living star to red giant to white dwarf

Theories of planetary-system evolution describe the demise of a star as a turbulent, chaotic event, one that begins when it first balloons exponentially into what is known as a red giant and then quickly loses its outer layers, collapsing into a white dwarf—a super-dense star about the size of Earth, with a mass of our sun. The process dramatically disrupts the remaining planets' orbits, and smaller objects—asteroids, comets, moons—that venture too close to them can be scattered like pinballs and sent hurtling toward the white dwarf.

This study confirms the true scale of the chaos, showing that within 100 million years after the beginning of its white dwarf phase, the star is able to simultaneously capture and consume material from its nearby asteroid belt and its far-flung Kuiper belt–like regions.

Though astronomers have cataloged more than 5,000 planets outside our solar system, the only planet whose interior makeup we have some direct

knowledge of is Earth. Because the materials accreting onto G238-44 are representative of the building blocks of major planets, this white dwarf cannibalism provides a unique opportunity to take planets apart and see what they were made of when they first formed around the star, said UCLA astronomy researcher Beth Klein, a member of the team.

The team measured the presence of nitrogen, oxygen, magnesium, silicon and iron, among other elements, in the white dwarf's atmosphere. Their detection of iron in very high abundance is evidence for metallic cores of terrestrial planets, like Earth, Venus, Mars and Mercury, Johnson said. Unexpectedly high nitrogen abundances led them to conclude that icy bodies were also present.

"The best fit for our data was a nearly two-to-one mix of Mercury-like material and comet-like material, which is made up of ice and dust," Johnson said. "Iron metal and nitrogen ice each suggest wildly different conditions of planetary formation. There is no known solar system object with so much of both."

The researchers say the ultimate scenario for our own sun some 5 billion years from now will likely be quite similar to what has been seen with G238-44. During the sun's red giant phase, the Earth might be completely vaporized along with the inner planets, they predict.

The orbits of many of the asteroids in our solar system's main asteroid belt will be gravitationally perturbed by Jupiter and will also fall onto the white dwarf remnant that the sun will become, he said.

For more than two years, the research group at UCLA, along with colleagues at UC San Diego and the University of Kiel in Germany, has worked to unravel the mystery of G238-44 by analyzing the elements detected on the white dwarf star.

Their analysis included data from NASA's retired Far Ultraviolet Spectroscopic Explorer, the Keck Observatory's High Resolution Echelle Spectrometer in Hawaii and the Hubble Space Telescope's Cosmic Origins Spectrograph and Space Telescope Imaging Spectrograph. The Hubble Space Telescope is a project of international cooperation between NASA and the European Space Agency.

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The team's results were presented at an American Astronomical Society press conference on June 15.

Phys Org, 16 June 2022

https://phys.org

Study suggests a beer a day can increase diversity of gut bacteria

2022-06-15

The state of our gut microbiome continues to be linked to a range of health outcomes, with the diversity of these microbial populations believed to play an important role in our vulnerability to disease. A small pilot study suggests that moderate consumption of lager beer may influence this diversity in a positive way, whether it's a traditional brew or one of the increasingly popular non-alcoholic variety.

Led by scientists in Portugal, the study sought to build on previous research hinting that moderate beer consumption might increase the diversity of gut bacteria. The researchers tested this idea through double-blind, randomized study with 19 healthy males, who were divided into two groups that drank 11 oz (325 ml) of either alcoholic or non-alcoholic beer with dinner each day.

This took place over a four-week period, with blood and fecal samples collected both before and after, and gut microbiota analyzed through a form of RNA gene sequencing. Interestingly, the scientists found that drinking this amount of beer led to no increase in body weight or body fat mass, and didn't alter serum markers for heart health and metabolism.

While the findings suggest that one bottle of beer a day may be beneficial to gut health, the scientists do emphasize that the safest level of alcohol consumption is none.

What did change, however, was the diversity of the gut bacteria in both groups, along with higher levels of fecal alkaline phosphatase, a measure of intestinal health. The scientists suggest they could be induced through compounds in the beer such as polyphenols and microorganisms that facilitate its fermentation.

While the findings suggest that one bottle of beer a day may be beneficial to gut health, the scientists do emphasize that the safest level of alcohol consumption is none. In addition to established health risks such as liver disease, high blood pressure and heart disease, recent research has

While the findings suggest that one bottle of beer a day may be beneficial to gut health, the scientists do emphasize that the safest level of alcohol consumption is none.

uncovered direct causal links with cancer. Given that beer's potential benefits for gut health appear to be independent of alcohol, the study provides yet another reason to opt for a non-alcoholic version.

The research was published in Journal of Agricultural and Food Chemistry.

New Atlas, 15 June 2022

https://newatlas.com

Spilling the Tea: Insect DNA Shows Up in World's Top Beverage

2022-06-14

How do you monitor which species live in an area? In addition to traditional ecological tools such as camera traps, researchers have reported new methods in recent years that allow them to detect minute traces of DNA known as environmental DNA, or eDNA, that animals leave behind in water and even air. In a study published June 15 in Biology Letters, a group reports picking up eDNA from a new source: dried plant material. The team purchased tea from grocery stores, and were able to detect hundreds of species of arthropods in just one bag.

We asked study coauthor Henrick Krehenwinkel, an ecological geneticist at Trier University in Germany who focuses on the ways in which arthropod communities have changed over time due to human influence, to spill the tea about why his group decided to use eDNA to investigate which critters have been munching on plants.

TS: Why did you decide in this case to focus on tea?

Henrik Krehenwinkel: We need [a] time series to understand how insects have changed. When insect decline studies were first published, a lot of people complained [that] there is no real long-term data.

We have a specimen bank here in Trier. They're collecting leaves from different trees in Germany. They've been doing this for 35 years; they go to all kinds of different ecosystems … And what I asked myself is, 'Couldn't you also monitor the DNA of the insects which have lived on this leaf?' … We basically did a test experiment where we took these samples, which are frozen in liquid nitrogen, so they're perfectly stored for DNA preservation … and isolated DNA from them, and reconstructed arthropod communities. This is actually another study which is currently in review, where we have basically reconstructed insect community change in German forest ecosystems over the past 35 years.

If an insect bites into a leaf, it will leave a DNA trace; a little bit of saliva is enough. It's basically like [how] the criminal breaking into your house, touching your window, will leave their DNA.

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So we can extract eDNA from a perfectly frozen leaf … What I asked myself is, "Can you also use other substrates to basically extract the DNA from arthropods?" And is the DNA still stable in other types of substrates? … Plant collections in museums, could they actually be useful to understand how insect communities have changed? … There are studies saying that … if an insect bites into a leaf, it will leave a DNA trace; a little bit of saliva is enough. It's basically like [how] the criminal breaking into your house, touching your window, will leave their DNA; the insect will leave its DNA when it bites into the leaf. And there are studies saying that this DNA is not very stable, it will be quickly degraded by UV light or washed away by rain. But I was thinking in an herbarium record, the DNA is stored dry and dark, which [are] actually ideal conditions to maintain it.

Before we started working on herbaria records, we thought we should try something which is kind of comparable to herbarium records … Structure-wise, [tea is] very similar to herbarium record. It's basically a dried plant which is stored dark and dry … And the DNA should be very stable.

It's all driven by our hope to understand insect community change and being able to find new substrates which allow us to travel back in time … You can collect a plant in the field, basically a flower. And you can dry this flower just using silica gel … It's a substance which is completely harmless, but it's extremely hydrophilic … If you, for example, put a flower into a little envelope, and then you put it in a Ziploc freezer bag together with a little bit of silica gel, within one day approximately, the flower will be completely dry … And we could in theory even store them at room temperature, we wouldn't have to worry to put it all in liquid nitrogen or to wash the plant right away … you don't have to carry water in the field, all you need is a little bit of silica gel, an envelope, and a Ziploc bag.

Another attractive side effect is that what's very interesting for us ecologists is not only who is at a site, so how many insect species are at a site, … but we also want to know how do these insects interact and what do they eat. For example, we know that many insect species are very specific, only living on a certain plant, and when this plant disappears, the insect disappears … Surprisingly, we know very little about these interactions, we know very little about what insect is limited to a certain plant species. We know this pretty well for pest species, but we do not know this pretty well for many other species of insects … And this is a way of very quickly finding this out by basically sampling plant material and being able to associate the insects living on the plant.

TS: Was there anything about the results of this study that surprised you?

HK: What really surprised me was the high diversity we detected … We took one tea bag, and … I think it was from 100 [or] 150 milligrams of dried plant material, we extracted DNA. And we found in green tea up to 400 species of insects in a single tea bag … That really surprised me. And the reason probably is that this tea, it's ground to a relatively fine powder. So the eDNA [from all parts of the tea field] gets distributed.

TS: As far as applying this to herbaria samples, would you need just a relatively small piece of that sample, or could it be an issue that these are rare and very old samples, and you don't want to be grinding up a big chunk of them.

HK: We've been thinking about this, and there's two options. One is to just very carefully treat the herbarium sample. We're now testing if you can also just carefully wash the sample, for example, and kind of wash off the traces which are stuck to the sample.

Then of course, there's herbaria where they're actually happy if you do something with them. [H]ere at this university, we have a retired botany professor, and she has very large herbaria she has collected during her tenure … They don't have a huge scientific value for her, and she would be fine if I grind them up … We're just testing this, so I cannot give you any results on this yet, but it looks like we are actually able to extract insect DNA out of this as well … And then move back to that same place—she has exact collection sites—I just drive back there, collect the same plant again, and then I can compare how was the insect community 50 years ago when she collected it or 30 years ago when she collected again, and then compare it to how is the insect community on that plant today.

But of course, generally these collections are very precious and we are developing methods to carefully extract DNA from this without damaging the specimen. This is something we're just starting now. Seeing how well it worked with tea, I'm now confident that we could also move into other samples like these herbaria.

TS: Are you a tea drinker yourself?

HK: I drink coffee actually … And I fear coffee probably is not well suited for it because coffee is roasted. And what DNA really doesn't like is being heated up to a very high temperature for a long time … We have not

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tried it yet, but I fear coffee is probably not the best choice for this kind of experiment.

The Scientist, 14 June 2022

https://the-scientist.com

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What Dermatologists Should Know About Thiazides

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Drinking water sources and water quality in a prospective agricultural cohort

PHARMACEUTICAL/TOXICOLOGY

Elastin Degradation and Lung Function Deterioration with Remote Secondhand Tobacco Smoke Exposure in Never-smokers

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Current status and high-risk factors of blood-borne occupational exposure among midwives in China: A cross-sectional survey

Integrated approaches to testing and assessment for grouping nanomaterials following dermal exposure

Exposure patterns among Coast Guard responders to the Deepwater Horizon Oil Spill: A latent class analysis

Microbial diversity and metaproteomic analysis of activated sludge responses to naphthalene and anthracene exposure