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Contents

JUN. 17, 2022

(click on page numbers for links)

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CHEMWATCH

Bulletin Board

Contents

JUN. 17, 2022

CHEMWATCH

Bulletin Board

Contents

JUN. 17, 2022

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ASIA PACIFIC

FSANZ Work Plan

2022-04-30

This plan has two parts:

- PART 1 – Applications received and proposals prepared from 1 October 2007 onwards
- PART 2 – Applications received and proposals prepared before 1 October 2007

If you have any questions about items on the Work Plan please contact the Standards Management Officer by email or by phone: +61 2 6271 2280.

Applications and proposals are placed on the plan in the order they are received and are generally worked on in that order. Sometimes those that have expected timelines later than applications and proposals maybe progressed earlier than those with later expected timelines. This can happen for a number of reasons including differences in complexity, availability of specialist expertise, withdrawal of applications or delays in completion such as requests for further information.

Under the FSANZ Act, applicants can choose to pay fees to bring forward the start of the assessment of their application. The anticipated start date of an unpaid application or proposal cannot be displaced by work on paid applications.

Read More

Food Standards Australia New Zealand, 30-04-22

https://www.foodstandards.gov.au/code/changes/workplan/Pages/default.aspx

Notice of completed evaluations - 30 May 2022

2022-05-30

We have published 9 evaluations about the human health and environmental risks associated with the use of certain chemicals on the Australian Inventory of Industrial Chemicals (Inventory).

These evaluations are issued by the AICIS Executive Director under section 78 of the Industrial Chemicals Act 2019 and are listed below. The draft versions of these evaluation statements were open for public consultation that closed on 28 March 2022. The evaluation for Compounds of

CHEMWATCH
Bulletin Board
Regulatory Update
JUN. 17, 2022

dimethyltin (EVA00076) has not been finalised at this time to allow further consideration of information submitted as part of public consultation process.

Read More

Australian Industrial Chemicals Introduction Scheme, 30-05-22

https://www.industrialchemicals.gov.au/news-and-notices/notice-completed-evaluations-30-may-2022

Do universities and not-for-profit organisations need to register?

2022-05-30

If you are a university or not-for-profit organisation introducing industrial chemicals in Australia, you may need to register with us.

Who should read this?

Universities, colleges, tertiary and research institutes, charities and not-for-profit organisations that import or manufacture industrial chemicals (and products designed to release industrial chemicals) and are working out if they need to register with us – including organisations that:

- buy industrial chemicals from overseas for teaching or research – even if another university already imports the same or similar chemicals from overseas
- manufacture industrial chemicals in a lab or classroom for teaching or research – even if another university manufactures the same or similar chemicals
- import or manufacture a low volume of chemicals – there is no threshold limit on volume
- import or manufacture industrial chemicals solely for not-for-profit research
- import or manufacture industrial chemicals solely for a charitable purpose

Do you need to register?

The process of working out if you need to register is the same as for any other business.

Start by working out if you import or manufacture industrial chemicals (we call this 'introducing' industrial chemicals). If you introduce industrial chemicals in Australia, then you may need to register with us.

Note that some chemical introductions don't require you to register your business with us – for example:

- Blending or mixing ingredients that you only bought in Australia. Blending is commonly described as the process of mixing two or more industrial chemicals together without producing a chemical reaction.
- Articles and products that are not designed to intentionally release chemicals
- Non-industrial chemicals

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Australian Industrial Chemicals Introduction Scheme, 30-05-22

https://www.industrialchemicals.gov.au/business/getting-started-registration-importing-and-manufacturing/what-registration-and-who-must-register/do-universities-and-not-profit-organisations-need-register

AMERICA

Colorado is the first state to ban PFAS in oil and gas extraction

2022-06-08

This month Colorado became the first state to ban the use of PFAS in the extraction of oil and gas.

While there has been widespread outcry about PFAS (per- and polyfluoroalkyl substances) in consumer goods — such as stain- and water-resistant clothing, nonstick pots and pans, firefighting foam, carpets and furniture — the oil and gas industry could be a major and under-appreciated source of soil and groundwater contamination.

Last summer an investigation by the advocacy group Physicians for Social Responsibility revealed that the chemicals are often used in the fluids used to extract oil and gas from deep in the ground during fracking. The chemicals, which are extremely water-repellent, are used in fracking fluid to make the chemical mixture more stable and more efficiently flush oil and gas out of the ground at high pressure.

CHEMWATCH
Bulletin Board
Regulatory Update
JUN. 17, 2022

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Environmental Health News, 8-06-22

https://www.ehn.org/pfas-fracking-2657471451.html

It's now illegal in Illinois to incinerate toxic chemicals known to cause cancer

2022-06-08

A new Illinois law signed Wednesday made it illegal to incinerate a class of toxic chemicals known to cause cancer and other health problems.

Metro-east lawmakers and environmental advocates raised concerns last year about burning PFAS, or per- and polyfluoroalkyl substances, after the U.S. Department of Defense authorized a Sauget incinerator to dispose of the man-made chemicals.

The Defense Department has an interest in figuring out how to dispose of PFAS because they are a main ingredient in firefighting foam, which is used in particular at military installments such as Scott Air Force Base. The chemicals are more effective in putting out aviation and fuel fires than water. They're also common in consumer products such as nonstick pans, waterproof clothes, microwave popcorn bags, fast food wrappers and stain-resistant carpets.

Read More

Bellevue Herald Leader, 8-06-22

https://www.bellevueheraldleader.com/news/state/its-now-illegal-in-illinois-to-incinerate-toxic-chemicals-known-to-cause-cancer

Minnesota Department of Health releases online dashboard for PFAS levels in drinking water

2022-06-08

The Minnesota Department of Health (MDH) developed and released an interactive online dashboard to show Minnesota residents who receive drinking water from a community public water system if their system's water has any level of per- and polyfluoroalkyl substances (PFAS).

According to the MDH news release, the results of statewide testing shows the majority of community water systems in the state have either no detections of PFAS or levels below the current state levels.

The testing and dashboard aims to help "communities manage any changes in PFAS occurrence or health risk understanding in the future," according to the news release.

MDH began a project in 2021 to test for PFAS in community water systems, and this testing and monitoring will be ongoing through 2022, according to the MDH.

Sampling in systems most vulnerable to PFAS contamination is the priority.

"With this new tool, Minnesotans will be able to see for themselves whether PFAS is a concern for the health of their communities and their families," said Minnesota Commissioner of Health Jan Malcolm in the news release. "Our statewide testing and dashboard are just two examples of how Minnesota continues to be a national leader in providing safe drinking water."

Read More

WQP, 8-06-22

https://www.wqpmag.com/pfas/minnesota-department-health-releases-online-dashboard-pfas-levels-drinking-water

The EPA Plans to Rein in Truck Pollution to Ease Asthma, but It May Not Go Far Enough

2022-06-08

Every Saturday, 13-year-old Caia Farrell goes running with her classmates. When the group passes a giant, idling truck, they cross the street to get away from the exhaust fumes. But it rarely helps.

"Outside my house right now, there are trucks moving back and forth to various construction sites, spewing pollution, idling on corners and polluting our air," the Philadelphia-based seventh grader recently told EPA administrators during a public hearing.

That exhaust could be hurting Farrell and her classmates more than scientists previously understood. Researchers increasingly are finding a causal relationship between heavy-duty truck emissions and respiratory ailments such as asthma.

CHEMWATCH
Bulletin Board
Regulatory Update
JUN. 17, 2022

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E&E News, 8-06-22

https://www.scientificamerican.com/article/the-epa-plans-to-rein-in-truck-pollution-to-ease-asthma-but-it-may-not-go-far-enough/

Nova Scotia Marking Clean Air Day With Action

2022-06-08

The Province is making regulatory changes to help ensure the air Nova Scotians breathe is clean and healthy and that industrial noise does not impact people's well-being.

Consultation on provincial Air Quality Regulations begins today, June 8, Clean Air Day. The focus is on the standards that are used to ensure industrial emissions have minimal impact on air quality.

"Our industries provide valuable jobs and economic opportunities throughout our province – we want to work with them to update these regulations to ensure ongoing sustainable development that protects our environment while helping both our economy and our people to thrive," said Timothy Halman, Minister of Environment and Climate Change. "Updated, clear, modern environmental standards that are based on the latest science will help ensure Nova Scotia is a clean, healthy place to live, work and do business."

The Department will have targeted consultation with the following stakeholders:

- industries and businesses that produce air emissions
- businesses that have an industrial approval to operate in Nova Scotia
- industry professional associations and consultants
- the Nova Scotia College of Respiratory Therapists
- lung healthcare specialists
- the Lung Association of Nova Scotia
- Cystic Fibrosis Canada – Atlantic Office
- environmental stewardship organizations
- municipalities
- the Halifax Chamber of Commerce
- the Mi'kmaq of Nova Scotia.

Other interested Nova Scotians can offer input by sending an email to air@novascotia.ca or filling in the general feedback form at: https://novascotia.ca/ambient-air-quality-standards-public-engagement/

The regulatory update will also take into account new World Health Organization Global Air Quality Guidelines and the most current science.

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Nova Scotia, 8-06-22

https://novascotia.ca/news/release/?id=20220608001

EUROPE

EUON Publishes Nanopinion on Urinary MicroRNA-based Early Cancer Detection Using Nanowire-based Devices

2022-06-08

On May 31, 2022, the European Union (EU) Observatory for Nanomaterials (EUON) published a Nanopinion entitled "Urinary MicroRNA-based Early Cancer Detection Using Nanowire-based Devices" by Dr. Yasui Takao on using nanowire devices to extract microRNAs (miRNA) from urine to distinguish cancer patients from healthy individuals and improve the early detection of cancer. According to Yasui, researchers designed a device equipped with 100 million zinc oxide nanowires that can extract a significantly greater variety and quantity of miRNAs from only a milliliter of urine compared to conventional methods. Using the device, they revealed that miRNAs in urine could be a promising biomarker to diagnose brain tumors, finding that many miRNAs derived from brain tumors exist in urine in a stable condition. Yasui states that the results showed that the model can distinguish the patients from non-cancer individuals at a sensitivity of 100 percent and a specificity of 97 percent, regardless of the malignancy and size of tumors.

Read More

Nano and Other Emerging Chemical Technologies Blog, 8-06-22

https://nanotech.lawbc.com/2022/06/euon-publishes-nanopinion-on-urinary-microrna-based-early-cancer-detection-using-nanowire-based-devices/

CHEMWATCH
Bulletin Board
Regulatory Update
JUN. 17, 2022

The universal PFAS ban is coming – are you ready?

2022-06-09

An EU restriction targeting all PFAS for all uses is underway. Is your company ready for this universal PFAS ban and its repercussions? Here are the current and upcoming PFAS restrictions, along with safe alternatives to these harmful "forever chemicals".

Up until recently, the approach to regulating the chemical "family" of PFAS has been to restrict the substances one at a time, or impose group restrictions based on the number of carbon atoms in the molecular structure: C6 (PFHxA, PFHxS, and related substances), C8 (PFOA, PFOS, and related substances), C9, and so on.

Although reasonably clear and structured, this approach has often resulted in so called regrettable substitution: switching from the restricted PFAS chemical to an equally, or even more hazardous, unregulated "cousin".

Since all of these approximately 5,000 man-made chemicals share similar characteristics – carcinogenic, endocrine-disrupting, immunosuppressive, mobile or bioaccumulative, and extremely persistent – regulating them one by one or in small groups is clearly not an efficient way forward.

Read More

Chemsec, 9-06-22

https://marketplace.chemsec.org/articles/news/2022/06/09/the-universal-pfas-ban-is-coming-are-you-ready/

EU lawmakers to vote on banning combustion-engine cars

2022-06-08

The future of car transport in Europe may become clearer — and cleaner —on Wednesday when the European Parliament decides whether to ban vehicles with a combustion engine starting in the middle of the next decade.

The European Union assembly's scheduled vote later in Strasbourg, France, is part of EU draft legislation to step up the fight against global warming. Cars account for around 12% of European emissions of the greenhouse gases blamed for climate change.

Regulatory Update

JUN. 17, 2022

The spotlight is on a provision that would force automakers to lower carbon-dioxide emissions by 100% in 2035, a step that would amount to an EU prohibition that year on the sale of new cars powered by gasoline or diesel.

The car industry and some political voices are urging a more gradual transition to fully electric fleets, with a 90% CO2 reduction in 2035 as a possible compromise.

Read More

El Paso Inc, 8-06-22

https://www.elpasoinc.com/eu-lawmakers-to-vote-on-banning-combustion-engine-cars/article_39d90bfc-2d14-5a91-a369-7ffffe6a28e6.html

CHEMWATCH
Bulletin Board

REACH Update

JUN. 17, 2022

REACH revision: Better chemical safety for a Toxic-free environment

2022-06-08

Marking the 15th anniversary of the introduction of the EU's REACH Regulation on chemical safety, EU policy makers and experts warn the current regulation is falling short of protecting consumers from the harmful effects of chemicals.

The 1st of June 2022, marked the 15th anniversary of introduction of the REACH Regulation on the Registration, Evaluation, Authorisation and Restriction of Chemicals. In a webinar event last week, policy makers and experts came together to discuss its revision, as part of the Commission's European Chemical Strategy for Sustainability, which aims to achieve the zero-pollution by 2050.

Host of the event Swedish S&D deputy Jytte Guteland, and experts in the field of precision toxicology discussed both the regulatory and scientific progress made up to now, to protect human health and the environment from the adverse effects of chemicals.

However more needed to be done. "Despite what is probably the most stringent chemical regulation in the world and the tremendous work of the various EU regulatory agencies, over the last 15 years, only a small fraction of chemicals has adequately been tested for safety in the EU," said Guteland.

Read More

The Parliament Magazine, 8-06-22

https://www.theparliamentmagazine.eu/news/article/supporting-innovation-key-to-effective-management-of-chemicals-and-a-healthier-environment

Irish checks led to removal of 87 products for REACH, CLP non-compliance last year

2022-06-09

Market surveillance activities in Ireland resulted in the removal of 87 chemical products from the market last year, according to an annual report by the country's Health and Safety Authority (HSA).

REACH Update

JUN. 17, 2022

Published on 7 June, the report says the HSA checked 970 chemical products for compliance with requirements under REACH, CLP and the detergents Regulation during 2021.

The checks focused on construction-related products, motor factor products, detergents and products sold online.

In addition, inspectors screened jewellery, metal and leather articles for the presence of lead, nickel, cadmium or chromium VI as restricted under REACH.

The authority removed 87 products from the market and banned a further 61 products from sale to the general public. Some of these did not comply with CLP requirements, while others contained restricted substances or substances subject to authorisation under REACH.

The HSA also carried out 1,383 chemical-related workplace inspections that addressed, for instance, the control of chemical agents and asbestos. The authority processed 336 asbestos notifications.

And it assessed 99 alerts submitted under the EU's Safety Gate rapid alert system (Rapex) related to restricted chemicals. Checks found 78 (79%) of the products were not present on the Irish market. Of the remaining alerts, the HSA identified and contacted suppliers to remove non-compliant products from sale, it said.

Read More

Chemical Watch, 9-06-22

https://chemicalwatch.com/499925/irish-checks-led-to-removal-of-87-products-for-reach-clp-non-compliance-last-year

CHEMWATCH
Bulletin Board

Janet's Corner

JUN. 17, 2022

Clean your glassware

2022-06-17

https://twitter.com/ErrantScience/status/1533441177780887552

Acetonitrile

2022-06-17

Acetonitrile is the chemical compound with the formula CH_3CN. This colourless liquid is the simplest organic nitrile. It is produced mainly as a by-product of acrylonitrile manufacture. [1] Acetonitrile is very soluble in water and mixes with most organic solvents, e.g. alcohols, esters, acetone, ether, benzene, chloroform, carbon tetrachloride and many unsaturated hydrocarbons. It does not mix with petroleum ether and many saturated hydrocarbons. Acetonitrile is incompatible with water, acids, bases, oleum, perchlorates, nitrating agents, reducing agents and alkali metals. Acetonitrile decomposes on contact with acids, water and steam, producing toxic fumes and flammable vapour. It reacts with strong oxidants such as nitric acid, chromic acid and sodium peroxide, causing fire and explosion hazards. Acetonitrile forms toxic fumes of hydrogen cyanide and nitrogen oxides on combustion. It attacks some forms of plastics, rubber and coatings. [2]

USES [3]

Acetonitrile is predominantly used as a solvent in the manufacture of pharmaceuticals, for spinning fibres and for casting and moulding of plastic materials, in lithium batteries, for the extraction of fatty acids from animal and vegetable oils, and in chemical laboratories for the detection of materials such as pesticide residues. In addition, acetonitrile is used in dyeing textiles and in coating compositions as a stabiliser for chlorinated solvents and in perfume production as a chemical intermediate.

Acetonitrile is the chemical compound with the formula CH3CN.

SOURCES & ROUTES OF EXPOSURE [2,3]

Sources & Potential Exposure

Sources of acetonitrile emissions into the air include:

- Manufacturing and industrial facilities;
- Automobile exhaust; and
- Volatilisation from aquatic environments.
- Individuals may be exposed to acetonitrile through breathing contaminated air, from smoking tobacco or proximity to someone who is smoking; or
- Through skin contact in the workplace.

CHEMWATCH
Bulletin Board
Hazard Alert
JUN. 17, 2022

Routes of Exposure

The main routes of exposure to acetonitrile are via the inhalation of vapours and contact with the skin and eyes. Absorption through intact skin occurs rapidly. Ingestion is an unlikely route of exposure.

HEALTH EFFECTS [3]

Acute Effects

- Concentrations up to 500 parts per million (ppm) acetonitrile through inhalation exposure cause irritation of mucous membranes in humans, and higher concentrations can produce weakness, nausea, and convulsions.
- Tests involving acute exposure of rats, mice, rabbits, cats, and guinea pigs have shown acetonitrile to have moderate to high acute toxicity from oral exposure and moderate acute toxicity from inhalation exposure.

Chronic Effects

- Chronic inhalation exposure of humans to acetonitrile results in cyanide poisoning from metabolic release of cyanide after absorption. The major effects consist of those on the central nervous system (CNS), such as headaches, numbness, and tremor.
- Cyanide poisoning can also be produced through the ingestion of acetonitrile or from contact with the skin.
- Application of acetonitrile to the skin may produce dermatitis in humans.
- Animal studies have shown that different species vary widely in susceptibility to acetonitrile by various routes.
- EPA has not established a Reference Dose (RfD) for acetonitrile.
- The Reference Concentration (RfC) for acetonitrile is 0.06 milligrams per cubic metre (mg/m^3) based on mortality in mice.

Reproductive/Developmental Effects

- No information is available on the reproductive or developmental effects of acetonitrile in humans.
- Animal studies appear to suggest that acetonitrile may cause developmental and reproductive effects such as a decrease in average foetal body weight and a significant increase in the number of malformed offspring.

Cancer Risk

- No pertinent data concerning the carcinogenicity of acetonitrile in humans were located.
- The National Toxicology Program (NTP) completed a 2-year carcinogenesis inhalation study on acetonitrile and concluded that there was equivocal evidence of carcinogenicity in male rats, and no evidence in male or female mice or in female rats.
- EPA has classified acetonitrile as a Group D, not classifiable as to human carcinogenicity.

SAFETY [4]

First Aid Measures

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

CHEMWATCH
Bulletin Board
Hazard Alert
JUN. 17, 2022

Fire Hazards

Acetonitrile is highly flammable in presence of open flames, sparks of heat and oxidising materials. In the case of a small fire dry chemical powder should be used to extinguish. For large fires, use alcohol foam, water spray or fog.

Exposure Controls & Personal Protection

Engineering Controls

- When using acetonitrile, exhaust ventilation or other engineering controls should be used to keep the airborne concentrations of vapours below their respective threshold limit value.
- Eyewash stations and safety showers should be located proximal to the work-station.

Personal Protective Equipment

When handling acetonitrile the following personal protective equipment is recommended:

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

Personal Protection in Case of a Large Spill:

- Splash goggles;
- Full suit;
- Vapour respirator;
- Boots;
- Gloves;
- A self contained breathing apparatus should be used to avoid inhalation of the product.
- Suggested protective clothing might not be sufficient; consult a specialist BEFORE handling this product.

REGULATION

Exposure Limits [2,5]

United States

- OSHA: The Occupational Safety & Health Administration has established a Permissible Exposure Limit (PEL) for acetonitrile of 40 ppm, 70 mg/m^3 TWA
- ACGIH: The American Conference of Governmental Industrial Hygienists (ACGIH) Threshold Limit Value (TLV) is 20 ppm, 34 mg/m^3 TWA; Skin; Appendix A4 - Not Classifiable as a Human Carcinogen
- NIOSH: The National Institute for Occupational Safety and Health (NIOSH) Recommended Exposure Limit (REL)is 20 ppm, 34 mg/m^3 TWA

Australia

- Safe Work Australia: Safe Work Australia has established an exposure standard for acetonitrile of 40 ppm (equivalent to 67 milligram/m^3) (TWA). The short-term exposure level (STEL) is 60 ppm (equivalent to 101 milligram/m^3). Safe Work Australia also issued a skin absorption notice, which indicates that absorption through the skin may be a significant source of exposure.

REFERENCES

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2. http://www.npi.gov.au/substances/acetonitrile/index.html
3. http://www.epa.gov/ttn/atw/hlthef/acetonit.html
4. http://www.sciencelab.com/msds.php?msdsId=9927335
5. http://www.osha.gov/dts/chemicalsampling/data/CH_216700.html

New, extremely reactive chemical discovered in the atmosphere

2022-06-03

Millions of tons of a class of extremely reactive chemicals called hydrotrioxides can linger in the atmosphere for several hours, a new study suggests — which could have implications for human health and the global climate.

The chemicals interact with other compounds extremely quickly, and their presence means that chemists will have to rethink just how processes in Earth's atmosphere occur.

It's long been thought that hydrotrioxides — chemical compounds that contain a hydrogen atom and three oxygen atoms — were too unstable to last long under atmospheric conditions.

But the new research shows instead that hydrotrioxides are a regular product of many common chemical reactions, and that they can stay stable enough to react with other compounds in the atmosphere.

Researchers discovered a highly reactive chemical that they had long thought was too unstable to last under atmospheric conditions.

"We showed that the lifetime of one of them was at least 20 minutes," Henrik Grum Kjærgaard, a chemist at the University of Copenhagen, told Live Science. "So that's long enough for them to do stuff in the atmosphere."

Kjærgaard is one of the authors of a new study on hydrotrioxide formation in the atmosphere published online May 26 in the journal Science.

The discovery doesn't mean that something new is happening in the atmosphere; rather, it seems that hydrotrioxides have always formed there. But the new study is the first time that the existence of these ultra-reactive chemicals in the atmosphere has been verified.

"We can now show, through direct observation, that these compounds actually form in the atmosphere, that they are surprisingly stable and that they are formed from almost all chemical compounds," University of Copenhagen doctoral student Jing Chen, the second author of the study, said in a statement. "All speculation must now be put to rest."

Powerful oxidants

Hydrotrioxides are a type of hydrogen polyoxide. Water is the simplest and most common hydrogen polyoxide, with two hydrogen atoms and one oxygen atom, or H2O.

Another hydrogen polyoxide is hydrogen peroxide, which has two oxygen atoms — H2O2 — and is commonly used as a bleach or disinfectant. The extra oxygen atom also makes many peroxides extremely flammable, and they are sometimes used as a component of rocket fuels.

Hydrotrioxides are a stage further, as they have three oxygen atoms attached to each other, which makes them even more reactive than peroxides. They're written chemically as ROOOH, where R is any bonded group, such as a carbon group.

But while it's known that peroxides can form from chemical reactions in the atmosphere, it wasn't known before now that hydrotrioxides can also form there, albeit for a relatively short time before they decompose into less reactive chemicals.

In the new study, the researchers estimate that about 11 million tons (10 million metric tons) of hydrotrioxides form in the atmosphere each year as a product of one of the most common reactions: the oxidation of isoprene, a substance produced by many plants and animals and which is the main component of natural rubber.

The researchers estimate around 1% of isoprene released into the atmosphere forms hydrotrioxides, and that they are produced from these reactions in very low concentrations — about 10 million hydrotrioxide molecules in a cubic centimeter of the atmosphere, which is only a very faint trace.

"We are super-happy that we were able to show that [hydrotrioxides] are there and that they are living long enough to be — most likely — important in the atmosphere," study lead author Torsten Berndt, an atmospheric chemist at the Leibniz Institute for Tropospheric Research (TROPOS) in Leipzig, Germany, told Live Science in an email.

The free-jet flow set-up at TROPOS allowed the study of oxidation reactions under atmospheric conditions, revealing the presence of highly-reactive hydrotrioxides.

Atmospheric experiments

Berndt led the research laboratory experiments at TROPOS to discover if hydrotrioxides were in fact produced by chemical reactions in the atmosphere, while the University of Copenhagen team studied the theoretical aspects of how hydrotrioxides form.

CHEMWATCH
Bulletin Board
Gossip
JUN. 17, 2022

Berndt and his colleagues used very sensitive mass spectrometry to detect the ultra-reactive hydrotrioxides — a technique that can determine the molecular weight of chemicals to find out what atoms they consist of.

The reactions to make the hydrotrioxides took place in the TROPOS free-jet flow system which creates a flow of air unobstructed by solid boundaries.

And the study also used the results of experiments in an atmospheric chamber at the California Institute of Technology at Pasadena.

Now that their research has confirmed that hydrotrioxides are formed by common chemical reactions in the atmosphere, the scientists will next investigate how the compounds might affect human health and the environment during the minutes or hours of activity before the compounds decompose, Berndt said.

"From the knowledge of organic chemistry, we can expect that [hydrotrioxides] will act as an oxidant in the atmosphere," he said. It's also possible that hydrotrioxides could have an effect when our lungs breathe in air that contains them in very low concentrations, "but this is all very speculative at the moment."

Berndt said hydrotrioxides could also penetrate atmospheric aerosols — very fine solid particles or liquid droplets suspended in the atmosphere, such as the ash from volcanic eruptions or the soot from large fires — and they might initiate chemical reactions there. But "experimental investigations on that are very challenging," he said. "It's a lot to do."

Space, 3 June 2022

https://space.com

Watchdogs Tackle the Murky World of Greenwash

2022-05-30

From dubious claims about bamboo-based products to climate funds that are not quite what they seem, regulators have been increasing their scrutiny of corporate claims to be green.

Financial watchdogs worldwide have been taking aim at so-called "greenwashing" as investing in line with environmental, social and governance (ESG) principles surges in popularity.

During a punishing first three months of the year for markets, assets held in sustainable funds fell by 4 percent, according to research agency

Government enforcers are on the hunt for companies making misleading claims about their so-called 'eco-friendly' products.

Morningstar. They still proved more resilient than the wider U.S. market, though, where assets fell by 6 percent during the quarter.

But investors might not be getting what they think they are paying for. While some markets have long had unambiguous rules about which eco-claims are acceptable—"organic" food, for example, must meet very strict labeling criteria—the situation with ESG funds is less clear cut.

That has enabled some fund managers, eager for investor cash, to overstate their ESG credentials. Now, however, financial regulators are fighting back.

In March, Joe Longo, the chair of the Australian Securities and Investments Commission (Asic), said his agency was looking closely at fund managers that offer green products to check that they actually do what they claim.

Company boards, he said, also had to assess whether their businesses' environmental disclosures and green product promotions accurately reflected corporate practices. Greenwashing, he added, was "very much in our sights."

Singapore, too, is probing the overlap between practice and promotion. It is developing ESG requirements covering investment funds' names, prospectuses and disclosures.

"We expect asset managers to 'walk the talk' and ensure that their sustainability commitments reflect actual capabilities and practices on the ground," said Tan Keng Heng, executive director of the country's Monetary Authority, in January. "Greenwashing poses a real and present danger to our collective efforts to date and ambitions in the long run."

Other regulators are using rules already in place to target companies over greenwashing.

A draft recommendation from the U.K.'s Advertising Standards Authority, for example, recently proposed a warning for HSBC about advertisements touting its green accomplishments.

These ads—which were displayed at bus stops last year—said the bank was financing clients' net zero initiatives and planting lots of trees to capture carbon. The ASA draft said that people seeing them would conclude that HSBC was making "a positive overall environmental contribution as a company"—whereas, in fact, it also finances companies with big carbon footprints.

Some watchdogs have already taken action.

CHEMWATCH
Bulletin Board
Gossip
JUN. 17, 2022

Last month, the Securities and Exchange Commission sued Brazilian miner Vale for allegedly making false and misleading claims before the fatal collapse of the Brumadinho dam in 2019. Vale, it said, had misled investors and the public through its ESG disclosures. The company is fighting the SEC's complaint in court.

The Vale case may be a harbinger of more to come. The SEC has set up a task force in its enforcement division to hunt for material gaps or misstatements in climate risk disclosures.

According to Christina Thomas, a former SEC staffer who is now a partner at law firm Mayer Brown, the task force is "not only focused on public companies but also looking at investment advisers as well." Following the Vale complaint, it is "certainly looking for more cases," she added.

Separately, SEC chair Gary Gensler has said the regulator is working on a rule that will require funds with names containing terms such as "green" or "sustainable" to disclose how their investments satisfy those descriptions.

For ESG, "there's currently a wide range of what asset managers might mean by certain terms and what criteria they might use," noted Gensler. "It's easy to tell if milk is fat-free, it might be time to make it easier to tell whether a fund is really what they say they are."

And the SEC is not the only Washington agency targeting greenwashing this year.

Last month, the Federal Trade Commission fined retailers Walmart and Kohl's for allegedly marketing dozens of rayon textile products as being made of bamboo. Both companies were charged over claims that these "bamboo" textiles were produced using eco-friendly processes.

Across the Atlantic, meanwhile, the EU is working on standards for green bonds, both to encourage investment in sustainable projects and reduce the risk of greenwashing. In February, the European Securities and Markets Authority (Esma)—which will play a key role in supervising the bonds—said tackling greenwashing would be a priority for 2022-2024.

Since then, the International Organization of Securities Commissions—a Madrid-based coalition of stock market enforcers including the U.K.'s Financial Conduct Authority—has also promised to combat greenwashing.

"We need everyone in the securities sector to work with us now to promote good practices and call out greenwashing," says Rodrigo Buenaventura, the head of Spain's securities regulator, CNMV. "Building

trust through high standards of behavior is critical so that investment products described as sustainable actually are."

Inside Climate News, 30 May 2022

https://insideclimatenews.org

Low-cost, high volume distiller removes salt from seawater using solar energy

2022-05-30

Ural Federal University (UrFU) power engineers have developed a new desalination technology. It will significantly reduce the cost of desalination and quadruple the volume of production. The results of the research are published in the journal Case Studies in Thermal Engineering.

Today one of the most popular and simple ways of desalination is the distillation of water with the help of solar energy. UrFU scientists, together with colleagues from Iraq, have developed a hybrid technology to increase the efficiency of evaporation inside a solar distiller by means of a rotating hollow cylinder and a solar collector.

"We created a desalination technology by using a rotating hollow cylinder inside the solar distiller to accelerate water evaporation in the vessel by forming a thin film of water on the outer and inner surface of the cylinder, which is constantly renewed with each turn. To increase the temperature of water under the cylinder we use a solar collector," said the head of the department Nuclear power plants and renewable energy sources UrFU Sergei Shcheklein.

As part of the experiment, the rotation speed of the cylinder inside the solar distiller was 0.5 rpm. This intensity and time are enough to evaporate a thin film of water from the surface of the cylinder. Experimental tests were held in Ekaterinburg, Russia for several months (June-October, 2019) and showed high efficiency and reliability of the developed device. In addition, the researchers noted that the relatively high intensity of solar radiation and low ambient air temperature also contributed to the performance of water distillation.

"The performance improvement factor of the created solar distiller, compared to traditional devices, was at least 280% in the relatively hot months (June, July, and August) and at least 300% and 400% in the cooler months (September and October). At the same time, the cumulative water distillation capacity reached 12.5 l/m2 per day in summer and 3.5 l/m2 per day in winter," said Alharbawi Naseer Tawfik Alwan, a research engineer at UrFU and an employee of Northern Technical University (Iraq).

UrFU scientists, together with colleagues from Iraq, have developed a hybrid technology to increase the efficiency of evaporation inside a solar distiller

The developed desalination technology with its simple design and low cost could be of interest in the Middle East and Africa — in countries with high solar energy potential and a shortage of fresh water, believe researchers.

In the future, scientists plan to improve the technology and increase the performance of the solar distiller at the lowest possible capital and operating costs for different climatic conditions.

Note:

According to the UN, more than 40% of the world's population suffers from water shortages: more than 700 million people on the planet have no access to clean water, and more than 1.7 billion people living in river basins need additional sources of fresh water.

The Brighter Side of News, 30 May 2022

https://www.thebrighterside.news

Floating solar power could help fight climate change — let's get it right

2022-06-07

Solar panels need to be deployed over vast areas worldwide to decarbonize electricity. By 2050, the United States might need up to 61,000 square kilometres of solar panels — an area larger than the Netherlands. Land-scarce nations such as Japan and South Korea might have to devote 5% of their land to solar farms.

The question of where to put these panels isn't trivial. There is fierce competition for land that is also needed for food production and biodiversity conservation. One emerging solution is to deploy floating solar panels ('floatovoltaics') on reservoirs.

The idea of floatovoltaics holds much promise, and there has been a rapid rise in installation and investments. But there are still many unknowns about the technology's environmental impacts, along with its social, technical and economic dimensions.

Covering 10% of the world's hydropower reservoirs with 'floatovoltaics' would install as much electrical capacity as is currently available for fossil-fuel power plants.

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These knowledge gaps need to be filled as soon as possible to avoid overpromising on the benefits of this approach, or having its roll-out derailed by unforeseen roadblocks.

Location, location

Solar power is space-intensive, requiring at least 20 times more area than conventional fossil-fuel plants to produce one gigawatt (GW) of electricity. Several environments have been proposed as locations for extensive installations, each with pros and cons.

Deserts have ample sunshine and don't have much competition for land use. But even here, there are trade-offs. For example, modelling indicates that in the Sahara, the dark colour of large swathes of solar panels would alter local temperatures and global airflow patterns in ways that could cause droughts in the Amazon, sea-ice loss in the Arctic and more. Solar-energy developments in the Mojave Desert in the US southwest have reduced the cover of cacti that are culturally important to resident Native Americans. And logistically, it can be hard to get energy from remote desert regions to where it is needed.

Agricultural fields are another promising possibility, but researchers are only starting to understand how pairing solar panels with crops in 'agrivoltaic' systems will affect food production. Rooftops, car parks and highways are also good options, but are limited in scale.

Placing solar arrays on reservoirs could have many advantages. The arrays are simply conventional solar panels installed on floats that are anchored through mooring lines. Proximity to water tends to keep them cool, making floating panels about 5% more efficient than land-based ones. Arrays shield the surface from the sun and might reduce evaporation, retaining water for hydropower, drinking and irrigation. Hydropower reservoirs already have the grid infrastructure for conveying electricity to consumers, reducing transmission costs. Pairing solar with pumped-storage hydropower could address the twin challenges of providing energy when sunlight is weak and storing it as potential energy in reservoirs when solar-power production is high.

Floatovoltaics might also reduce the carbon intensity — emissions per unit of energy produced — of some hydropower operations. Many hydropower plants are as low-carbon as other renewables. But for some projects, so much methane — a potent greenhouse gas — is released from decaying submerged plant matter that they can emit as much carbon per unit energy as do fossil-fuel power plants. For some of those sites, putting solar

CHEMWATCH
Bulletin Board
Gossip
JUN. 17, 2022

panels over just 2% of the reservoir's surface could double the electricity production, thereby halving the carbon intensity — which is an important metric in climate policy (see Supplementary information).

For now, floatovoltaics make up a tiny part of the electricity picture. As of 2020, the global installed capacity of floating solar panels was just 3 GW, compared with more than 700 GW for land-based solar systems. But the potential for expansion is considerable, given the vast number of reservoirs worldwide — with a total area roughly equivalent to that of France. Covering 10% of the world's hydropower reservoirs with floating solar panels would install nearly 4,000 GW of solar capacity — equivalent to the electricity-generation capacity of all fossil-fuel plants in operation worldwide.

Floatovoltaics are currently more expensive than land-based ones, but not by much: despite the immaturity of this new market, the break-even cost of floating solar projects is only 4–8% higher than that of ground-mounted solar power. The market is growing fast, with dozens of projects under way. One, scheduled to be completed by 2024 in Batam, Indonesia, plans to produce 2.2 GW by deploying solar panels over 16 km2 of water, nearly doubling global floatovoltaic energy production.

Rapid scaling-up of any new energy technology can have unforeseen consequences. Wind turbines, for example, have harmed birds and bats, and their installation offshore can create noise pollution for marine life, interfere with whale migrations and pose complications for commercial fisheries.

Trade-offs between the expansion of floatovoltaics and environmental, social and economic goals remain largely unexplored in both concept and practice. Reservoirs are artificial ecosystems that have been critiqued for a wide range of undesirable socioenvironmental impacts. Yet, in many places, they also provide habitats for wildlife, and have an important role in fisheries and recreation. Reservoir management often serves many needs besides water supply, such as flood control and hydropower. Pressure on multiple uses of reservoirs will intensify under climate change.

Neglecting these trade-offs could increase public opposition to floatovoltaics, lengthen the environmental-impact approval process and deter private investors, thus hampering the decarbonization shift.

National potential

To explore the potential of floatovoltaics, we compared the solar-power potential of large reservoirs with projected national demand for extra solar energy by 2050 (see 'Floatovoltaic potential' and Supplementary information).

We found that countries in the Americas and Africa could benefit most: even low coverage of reservoirs by floatovoltaics should generate all the solar energy needed to decarbonize their electricity sector. Brazil and Canada could be hotspots, each requiring only about 5% coverage of their plentiful reservoirs to satisfy their massive solar-energy needs. Last year, Brazil implemented regulatory changes to help the industry to develop (see 'Brazil's photovoltaic boom').

By contrast, island nations and much of Europe and the Middle East will find it harder to use floatovoltaics to meet their needs, owing to limited reservoir areas in small or arid nations and weaker sunlight at high latitudes. In some industrial nations, including China, mid-century demand for solar power will be so high that even covering all their reservoirs with floatovoltaics would not suffice; they will also require solar on land.

In places where floatovoltaics make sense, the question becomes one of how much of any given reservoir could be covered before downsides outweigh the advantages. More coverage could amplify logistical difficulties, social disruption and environmental side effects. Even 2% coverage of a mid-sized, 300 km2 reservoir would still be a massive footprint — amounting to about one-tenth of the area of the world's largest land-based solar farm, India's 2,245-megawatt Bhadla Solar Park.

Environmental impacts

Climate change is warming water bodies around the world, with impacts such as harmful algal blooms. Modellers have looked at whether floatovoltaics might counter these effects in lakes and other reservoirs, and found that they can, but only when more than half of the water surface is covered. More needs to be learnt about the consequences for physical, chemical and biological processes, drinking-water quality, aquatic biota, terrestrial wildlife and downstream ecosystems.

Shading a large proportion of a reservoir could trigger cascading effects. Reduced light makes it harder for photosynthetic organisms such as aquatic plants and phytoplankton to flourish, and this might be beneficial in nutrient-polluted reservoirs where harmful algae proliferate. However, the reduced production of oxygen could harm fish and other animals. Extreme oxygen depletion would favour methane-producing bacteria,

CHEMWATCH
Bulletin Board
Gossip
JUN. 17, 2022

which could offset decarbonization benefits. If solar-panel coverage is low, these effects will probably be minor. But it's not known exactly how severe any particular type of impact will be, or how the impacts will vary with latitude, water quality and other factors.

Large-scale field studies are needed to evaluate the response of ecosystems to floatovoltaic coverage. Although several test sites have been deployed, such as the Tengeh Reservoir testbed in Singapore, most research efforts focus more on engineering feasibility than ecology.

Use conflicts

Societal uses of reservoirs might also be compromised by floatovoltaics. If a project interferes with a fishery, it could undermine the livelihoods of populations already affected by reservoir construction. For example, Lake Kariba, on the border between Zambia and Zimbabwe, is home to the world's most productive reservoir fishery, and the artisanal fishing gear used to harvest sardines there would be hard to deploy near or under large floatovoltaic arrays. It is also hard to predict how the food webs that support fisheries would respond to shading.

Floating solar arrays might mar the scenery and curb the recreational use of reservoirs, leading to falls in local property prices; floatovoltaic developers will thus probably face resistance from nearby landowners. Social scientists should catalogue such concerns and work out the conditions that would make floatovoltaic projects acceptable to the public.

Operational challenges

Technical challenges could increase costs for developers. Biofouling of panels by bird faeces and microbial biofilms is likely to be more problematic over water than land, and could reduce photovoltaic output. Frequent cleaning might be necessary, requiring easy and safe access to the panels.

Inclement weather is another factor. At high latitudes, the formation and break-up of ice cover creates large, unpredictable forces, leading to operational and maintenance challenges — as is the case with a floatovoltaic system built in northeast China's Heilongjiang province. In regions hit by tropical cyclones, high winds can create waves and cause damage. In 2019, for example, a typhoon hit a floatovoltaic project on the Yamakura Dam in Japan; the panels piled up in the wind and ignited a fire.

Variable water levels can also be a challenge. For example, lakes Mead and Powell are more than 40 metres below their full levels following persistent droughts in the southwestern United States. Such fluctuations could be exacerbated by climate change. Drinking-water supply and irrigation needs would probably override the desire to maintain stable water levels for floatovoltaics. Engineering solutions need to be developed and factored into project costs.

Plans to address these issues must be made public so that industry and society can move rapidly towards mutually acceptable practices and a realistic assessment of floatovoltaic potential. Transparency would also boost investor confidence. Researchers need to model costs given the conditions at each site, and document the outcomes after large projects go live.

Moving forwards

Beyond modelling, empirical field-based studies are needed. It is unrealistic to suppose that power companies would do all of this work themselves. Licensing agreements should require access for independent researchers and long-term monitoring. The sharing of lessons will be paramount as the industry and regulators refine guidance on best practices.

The floatovoltaic industry is poised to expand rapidly. Science and policy must move equally fast to ensure that this use of the world's reservoirs is sustainable and equitable.

Nature, 7 June 2022

https://nature.com

'Food sequencing' really can help your glucose levels. Here's what science says about eating salad before carbs

2022-06-09

Biochemist and author of the Glucose Revolution Jessie Inchauspé says tweaking your diet can change your life.

Among her recommendations in the mainstream media and on Instagram, the founder of the "Glucose Goddess movement" says eating your food in a particular order is the key.

Does eating different food types before carbs affect glucose spikes? Turns out, yes. This isn't new evidence either.

CHEMWATCH
Bulletin Board
Gossip
JUN. 17, 2022

By eating salads first, before proteins, and finishing the meal with starchy carbohydrates, she says blood glucose spikes will be flattened, which is better for you.

Scientifically speaking, does this make sense? It turns out, yes, partially.

What is a glucose spike?

A glucose spike occurs in your bloodstream about 30-60 minutes after you eat carbohydrate. Many things determine how high and how long the peak lasts. These include what you ate with or before the carbohydrate, how much fibre is in the carbohydrate, and your body's ability to secrete, and use, the hormone insulin.

For people with certain medical conditions, any tactic to flatten the glucose peak is incredibly important. These conditions include:

- diabetes
- reactive hypoglycaemia (a particular type of recurring sugar crash)
- postprandial hypotension (low blood pressure after eating) or
- if you've had bariatric surgery.

That's because high and prolonged glucose spikes have lasting and detrimental impacts on many hormones and proteins, including those that trigger inflammation. Inflammation is linked with a range of conditions including diabetes and heart disease.

Different foods, different spikes

Does eating different food types before carbs affect glucose spikes? Turns out, yes. This isn't new evidence either.

Scientists have known for a long time that high-fibre foods, such as salads, slow gastric emptying (the rate at which food exits the stomach). So high-fibre foods slow the delivery of glucose and other nutrients to the small intestine for absorption into the blood.

Proteins and fats also slow gastric emptying. Protein has the extra advantage of stimulating a hormone called glucagon-like-peptide 1 (or GLP1). When protein from your food hits the cells in your intestines, this hormone is secreted, slowing gastric emptying even further. The hormone also affects the pancreas where it helps secretion of the hormone insulin that mops up the glucose in your blood.

In fact, drugs that mimic how GLP1 works (known as GLP1 receptor agonists) are a new and very effective class of medication for people with

type 2 diabetes. They're making a real difference to improve their blood sugar control.

What about eating food in sequence?

Most of the scientific research on whether eating food in a particular order makes a difference to glucose spikes involves giving a fibre, fat or protein "preload" before the meal. Typically, the preload is a liquid and given around 30 minutes before the carbohydrate.

In one study, drinking a whey protein shake 30 minutes before (rather than with) a mashed potato meal was better at slowing gastric emptying. Either option was better at reducing the glucose spike than drinking water before the meal.

While this evidence shows eating protein before carbohydrates helps reduce glucose spikes, the evidence for eating other food groups separately, and in sequence, during an average meal is not so strong.

Inchauspé says fibre, fats, and proteins don't mix in the stomach – they do. But nutrients don't exit the stomach until they have been churned into a fine particle size.

Steak takes longer than mash to be churned into a fine particle. Given the additional fact that liquids empty faster than solids, and people tend to complete their entire dinner in around 15 minutes, is there any real evidence that eating a meal within a particular sequence will be more beneficial than eating the foods, as you like, and all mixed up on the plate?

Yes, but it is not very strong.

One small study tested five different meal sequences in 16 people without diabetes. Participants had to eat their meal within 15 minutes.

There was no overall difference in glucose spikes between groups that ate their vegetables before meat and rice versus the other sequences.

What's the take-home message?

Watching those glucose spikes is particularly important if you have diabetes or a handful of other medical conditions. If that's the case, your treating doctor or dietitian will advise how to modify your meals or food intake to avoid glucose spikes. Food ordering may be part of that advice.

For the rest of us, don't tie yourself up in knots trying to eat your meal in a particular order. But do consider removing sugary beverages, and adding

CHEMWATCH
Bulletin Board
Gossip
JUN. 17, 2022

fibre, proteins or fats to carbohydrates to slow gastric emptying and flatten glucose spikes.

The Conversation, 9 June 2022

https://theconversation.com

Photosynthesis-inspired process makes commodity chemicals

2022-06-09

Northwestern University chemists have taken inspiration from plants to revolutionize the way an important industrial chemical is made.

In a first for the field, the Northwestern team used light and water to convert acetylene into ethylene, a widely used, highly valuable chemical that is a key ingredient in plastics.

While this conversion typically requires high temperatures and pressures, flammable hydrogen and expensive metals to drive the reaction, Northwestern's photosynthesis-like process is much less expensive and less energy intensive. Not only is the new process environmentally friendly, it also works incredibly well—successfully converting nearly 100% of acetylene into ethylene.

Catalysis driven by light and water produces polymer-grade ethylene.

"In industry, this method requires energy-intensive processes that need high temperatures, an external feed of flammable hydrogen gas and materials containing noble metals, which are expensive and difficult to obtain," said Northwestern's Francesca Arcudi, co-first author of the study. "Our new strategy solves all these issues at once. It operates using light and water in place of high temperatures and hydrogen. And instead of expensive metals, we use naturally abundant, inexpensive materials."

The resulting strategy worked shockingly well. Whereas the current industrial process results in 90% selectivity for ethylene, the Northwestern approach has 99% selectivity for ethylene.

"This is important because it's a commodity chemical with high economic value," said Northwestern's Luka Đorđević, co-first author of the study. "The more you can produce without waste, the better."

The study will be published on Thursday (June 9) in the journal Nature Chemistry. It is the first report of researchers using light to convert acetylene to ethylene.

This paper is a result of a collaboration between Emily Weiss and Samuel I. Stupp and their joint effort as part of the Center for Bio-Inspired Energy Science (CBES) at Northwestern. Weiss, a professor of chemistry in Northwestern's Weinberg College of Arts and Sciences, is the paper's corresponding author. Arcudi is a postdoctoral researcher in Weiss' laboratory. Đorđević is a postdoctoral fellow in Stupp's laboratory. Stupp is the Board of Trustees Professor of Materials Science and Engineering, Chemistry, Medicine and Biomedical Engineering at Northwestern, with appointments in Weinberg College, the McCormick School of Engineering and Northwestern University Feinberg School of Medicine.

"At CBES we strive to address fundamental challenges by taking inspiration from nature," said Stupp, the director of CBES. "Vitamin B12, one of a few naturally occurring organometallic co-factors, was used in this paper as a source of inspiration to design our catalyst."

As the precursor to 50-60% of all the world's plastics, ethylene is a hot commodity. In order to meet the ever-increasing demand for the valuable chemical, industry produces more than 200 million tons of ethylene per year.

To generate ethylene, chemists use steam cracking, an industrial method that employs hot steam to break down ethane into smaller molecules, which are then distilled into ethylene. But the resulting chemical contains a small amount of acetylene, a contaminant that deactivates catalysts to prevent ethylene from properly converting into plastic. Before the ethylene can be turned into plastic, the acetylene must be removed or converted into ethylene.

"The removal or conversion of acetylene in order to get pure ethylene is a process that's well known in the industry," Weiss said. "The process has many problems, which is why the scientific community has been trying to propose an alternative to this process. Producing polymer-grade ethylene from carbon dioxide feedstock is a desirable alternative, but this route is not developed enough yet. Our strategy is a first and major step toward producing this important commodity chemical with the lowest energy footprint possible."

In particular, an incredible amount of energy is needed to reach the high temperatures and pressures required for a successful chemical reaction. It also requires expensive catalysts made from noble metals, such as palladium. And because the process relies on protons from hydrogen, which is produced from fossil fuels, it generates vast amounts of carbon dioxide.

CHEMWATCH
Bulletin Board
Gossip
JUN. 17, 2022

Northwestern's strategy bypasses all these issues. To convert acetylene to ethylene, Northwestern's chemists replaced the palladium catalyst with cobalt, a less expensive, more abundant alternative. They also used room temperature and ambient pressure. In place of heat, they used visible light. And, finally, they replaced hydrogen with plain water as a source for protons.

The study is titled "Selective visible-light photocatalysis of acetylene to ethylene using a cobalt molecular catalyst and water as a proton source."

Phys Org, 9 June 2022

https://phys.org

Scientists craft living human skin for robots

2022-06-09

From action heroes to villainous assassins, biohybrid robots made of both living and artificial materials have been at the center of many sci-fi fantasies, inspiring today's robotic innovations. It's still a long way until human-like robots walk among us in our daily lives, but scientists from Japan are bringing us one step closer by crafting living human skin on robots. The method developed, presented June 9 in the journal Matter, not only gave a robotic finger skin-like texture, but also water-repellent and self-healing functions.

When wounded, the crafted skin could even self-heal like humans' with the help of a collagen bandage.

"The finger looks slightly 'sweaty' straight out of the culture medium," says first author Shoji Takeuchi, a professor at the University of Tokyo, Japan. "Since the finger is driven by an electric motor, it is also interesting to hear the clicking sounds of the motor in harmony with a finger that looks just like a real one."

Looking "real" like a human is one of the top priorities for humanoid robots that are often tasked to interact with humans in healthcare and service industries. A human-like appearance can improve communication efficiency and evoke likability. While current silicone skin made for robots can mimic human appearance, it falls short when it comes to delicate textures like wrinkles and lacks skin-specific functions. Attempts at fabricating living skin sheets to cover robots have also had limited success, since it's challenging to conform them to dynamic objects with uneven surfaces.

"With that method, you have to have the hands of a skilled artisan who can cut and tailor the skin sheets," says Takeuchi. "To efficiently cover surfaces with skin cells, we established a tissue molding method to directly mold

skin tissue around the robot, which resulted in a seamless skin coverage on a robotic finger."

To craft the skin, the team first submerged the robotic finger in a cylinder filled with a solution of collagen and human dermal fibroblasts, the two main components that make up the skin's connective tissues. Takeuchi says the study's success lies within the natural shrinking tendency of this collagen and fibroblast mixture, which shrank and tightly conformed to the finger. Like paint primers, this layer provided a uniform foundation for the next coat of cells—human epidermal keratinocytes—to stick to. These cells make up 90% of the outermost layer of skin, giving the robot a skin-like texture and moisture-retaining barrier properties.

The crafted skin had enough strength and elasticity to bear the dynamic movements as the robotic finger curled and stretched. The outermost layer was thick enough to be lifted with tweezers and repelled water, which provides various advantages in performing specific tasks like handling electrostatically charged tiny polystyrene foam, a material often used in packaging. When wounded, the crafted skin could even self-heal like humans' with the help of a collagen bandage, which gradually morphed into the skin and withstood repeated joint movements.

"We are surprised by how well the skin tissue conforms to the robot's surface," says Takeuchi. "But this work is just the first step toward creating robots covered with living skin." The developed skin is much weaker than natural skin and can't survive long without constant nutrient supply and waste removal. Next, Takeuchi and his team plan to address those issues and incorporate more sophisticated functional structures within the skin, such as sensory neurons, hair follicles, nails, and sweat glands.

"I think living skin is the ultimate solution to give robots the look and touch of living creatures since it is exactly the same material that covers animal bodies," says Takeuchi.

Tech Xplore, 9 June 2022

https://techxplore.com

Most 'silent' genetic mutations are harmful, not neutral, a finding with broad implications

2022-06-08

In the early 1960s, University of Michigan alumnus Marshall Nirenberg and a few other scientists deciphered the genetic code of life, determining the

Researchers found that 75.9% of synonymous mutations were significantly deleterious, while 1.3% were significantly beneficial.

CHEMWATCH
Bulletin Board
Gossip
JUN. 17, 2022

rules by which information in DNA molecules is translated into proteins, the working parts of living cells.

They identified three-letter units in DNA sequences, known as codons, that specify each of the 20 amino acids that make up proteins, work for which Nirenberg later shared a Nobel Prize with two others.

Occasionally, single-letter misspellings in the genetic code, known as point mutations, occur. Point mutations that alter the resulting protein sequences are called nonsynonymous mutations, while those that do not alter protein sequences are called silent or synonymous mutations.

Between one-quarter and one-third of point mutations in protein-coding DNA sequences are synonymous. Ever since the genetic code was cracked, those mutations have generally been assumed to be neutral, or nearly so.

But in a study scheduled for online publication June 8 in the journal Nature that involved the genetic manipulation of yeast cells in the laboratory, University of Michigan biologists show that most synonymous mutations are strongly harmful.

The strong non-neutrality of most synonymous mutations—if found to be true for other genes and in other organisms—would have major implications for the study of human disease mechanisms, population and conservation biology, and evolutionary biology, according to the study authors.

"Since the genetic code was solved in the 1960s, synonymous mutations have been generally thought to be benign. We now show that this belief is false," said study senior author Jianzhi "George" Zhang, the Marshall W. Nirenberg Collegiate Professor in the U-M Department of Ecology and Evolutionary Biology.

"Because many biological conclusions rely on the presumption that synonymous mutations are neutral, its invalidation has broad implications. For example, synonymous mutations are generally ignored in the study of disease-causing mutations, but they might be an underappreciated and common mechanism."

In the past decade, anecdotal evidence has suggested that some synonymous mutations are nonneutral. Zhang and his colleagues wanted to know if such cases are the exception or the rule.

They chose to address this question in budding yeast (Saccharomyces cerevisiae) because the organism's short generation time (about 80

minutes) and small size allowed them to measure the effects of a large number of synonymous mutations relatively quickly, precisely and conveniently.

They used CRISPR/Cas9 genome editing to construct more than 8,000 mutant yeast strains, each carrying a synonymous, nonsynonymous or nonsense mutation in one of 21 genes the researchers targeted.

Then they quantified the "fitness" of each mutant strain by measuring how quickly it reproduced relative to the nonmutant strain. Darwinian fitness, simply put, refers to the number of offspring an individual has. In this case, measuring the reproductive rates of the yeast strains showed whether the mutations were beneficial, harmful or neutral.

To their surprise, the researchers found that 75.9% of synonymous mutations were significantly deleterious, while 1.3% were significantly beneficial.

"The previous anecdotes of nonneutral synonymous mutations turned out to be the tip of the iceberg," said study lead author Xukang Shen, a graduate student research assistant in Zhang's lab.

"We also studied the mechanisms through which synonymous mutations affect fitness and found that at least one reason is that both synonymous and nonsynonymous mutations alter the gene-expression level, and the extent of this expression effect predicts the fitness effect."

Zhang said the researchers knew beforehand, based on the anecdotal reports, that some synonymous mutations would likely turn out to be nonneutral.

"But we were shocked by the large number of such mutations," he said. "Our results imply that synonymous mutations are nearly as important as nonsynonymous mutations in causing disease and call for strengthened effort in predicting and identifying pathogenic synonymous mutations."

The U-M-led team said that while there is no particular reason why their results would be restricted to yeast, confirmations in diverse organisms are required to verify the generality of their findings.

CHEMWATCH
Bulletin Board
Gossip
JUN. 17, 2022

The other authors of the Nature study are Siliang Song of the U-M Department of Ecology and Evolutionary Biology and Chuan Li of Stanford University.

Phys Org, 8 June 2022

https://phys.org

Researchers unveil particle accelerator region inside a solar flare

2022-06-08

Solar flares are among the most violent explosions in our solar system, but despite their immense energy—equivalent to a hundred billion atomic bombs detonating at once—physicists still haven't been able to answer exactly how these sudden eruptions on the sun are able to launch particles to Earth, nearly 93 million miles away, in under an hour.

Now, in a study published June 8 in Nature, researchers at New Jersey Institute of Technology (NJIT) have pinpointed the precise location where solar flare charged particles are accelerated to near-light speed.

The new findings, made possible through observations of an X-class solar flare in 2017 by NJIT's Expanded Owens Valley Solar Array (EOVSA) radio telescope, have revealed a highly efficient particle accelerator located at the tip of the brightest point of the eruption in the sun's outer atmosphere, called the flare's "cusp region", where the explosion's ambient plasma is converted to high-energy electrons.

Researchers say the discovery of the region, measured at almost twice the volume of Earth, could open new doors for investigating fundamental processes of particle acceleration ubiquitous in the universe.

"The findings in this study help explain the long-standing mystery of how solar flares can produce so much energy in mere seconds," said Gregory Fleishman, corresponding author of the paper and distinguished research professor of physics at NJIT's Center for Solar-Terrestrial Research. "The flare unleashes its power in a much vaster region of the sun than expected by the classic model of solar flares. Although others have postulated this must happen, this is the first time the specific size, shape, and location of this key region has been identified, and the efficiency of the energy conversion to particle acceleration inside the flare has been measured."

The discovery follows separate studies from 2020 published in Science and Nature Astronomy, where EOVSA's detailed snapshots of the flare

"The findings in this study help explain the long-standing mystery of how solar flares can produce so much energy in mere seconds."

and changes in the sun's magnetic field—taken at hundreds of radio frequencies at once—initially gave the NJIT team a lead on the location.

"Our recent studies suggested the flare cusp could be the location where such high-energy electrons are produced, but we weren't certain," explained Bin Chen, NJIT associate professor and a co-author of the paper. "We had originally uncovered a magnetic bottle-like structure at the site that contained an overwhelmingly large number of electrons compared to anywhere else in the flare, but now with the new measurements of this study, we can more confidently say this is the flare's particle accelerator."

Using the unique microwave imaging capabilities of EOVSA, the team was able to measure the energy spectrum of electrons at hundreds of locations of an X-class solar flare triggered by a reconfiguration of magnetic field lines along the sun's surface on September 10, 2017.

"EOVSA's spectral imaging gave us a comprehensive map of the flare's thermal plasma as it evolved second-by-second. But to our surprise, what we found was a mysterious hole in the thermal plasma map that began developing at the flare's cusp," said Gelu Nita, NJIT research professor and co-author of the paper. "More than that, as thermal particles in the region disappeared, the hole was then densely filled with non-thermal, high-energy particles."

The team's analysis brought to light an incredibly efficient energy conversion process within the solar flare's particle accelerator, where intense energy from the sun's magnetic fields is rapidly released and transferred to kinetic energy inside the region.

"We wondered how efficient this energy conversion process would be … how many particles in this area would be accelerated beyond the explosion's thermal energy?" added Sijie Yu, study co-author and NJIT assistant research professor. "Using extreme ultraviolet data of the sun, we confirmed that virtually no particles remained inside the region at thermal energies below a few million Kelvin, consistent with the EOVSA measurement that the particles had all been accelerated to non-thermal energies greater than 20 keV, or nearly 100 million Kelvin."

The team now says these latest findings could help scientists study fundamental questions in particle physics not possible on Earth, as well as offer fresh insights into how such high-energy particles from the sun may impact Earth during future space weather events.

CHEMWATCH
Bulletin Board
Gossip
JUN. 17, 2022

"An important aspect of this study is that it directs the attention of theorists to the precise location where most of the energy release and particle acceleration occurs, and provides quantitative measurements to guide numerical models," says Dale Gary, NJIT distinguished professor and director of EOVSA. "However, to extend our measurements to much broader flare regions and weaker but more frequent flare events, we are developing a next-generation, solar-dedicated radio array called the Frequency Agile Solar Radiotelescope, which will be at least 10 times larger and orders of magnitude more powerful."

"We still want to investigate the physical mechanism driving particle acceleration in solar flares. But future studies must account for what we now know about these enormous explosions—both the main energy release at the cusp region and the 100% efficiency at which charged particle acceleration occurs," said Fleishman. "These findings call for a major revision to the models we use to study solar flares and their impact on Earth."

Phys Org, 8 June 2022

https://phys.org

Liquid platinum at room temperature: The 'cool' catalyst for a sustainable revolution in industrial chemistry

2022-06-06

Researchers in Australia have been able to use trace amounts of liquid platinum to create cheap and highly efficient chemical reactions at low temperatures, opening a pathway to dramatic emissions reductions in crucial industries.

When combined with liquid gallium, the amounts of platinum required are small enough to significantly extend the earth's reserves of this valuable metal, while potentially offering more sustainable solutions for CO_2 reduction, ammonia synthesis in fertilizer production, and green fuel cell creation, together with many other possible applications in chemical industries.

These findings, which focus on platinum, are just a drop in the liquid metal ocean when it comes to the potential of these catalysis systems. By expanding on this method, there could be more than 1,000 possible combinations of elements for over 1,000 different reactions.

Platinum is very effective as a catalyst (the trigger for chemical reactions) but is not widely used at industrial scale because it's expensive.

The results will be published in the journal Nature Chemistry on Monday 6 June.

Platinum is very effective as a catalyst (the trigger for chemical reactions) but is not widely used at industrial scale because it's expensive. Most catalysis systems involving platinum also have high ongoing energy costs to operate.

Normally, the melting point for platinum is 1,700°C. And when it's used in a solid state for industrial purposes, there needs to be around 10% platinum in a carbon-based catalytic system.

It's not an affordable ratio when trying to manufacture components and products for commercial sale.

That could be set to change in the future, though, after scientists at UNSW Sydney and RMIT University found a way to use tiny amounts of platinum to create powerful reactions, and without expensive energy costs.

The team, including members of the ARC Center of Excellence in Exciton Science and the ARC Center of Excellence in Future Low Energy Technologies, combined the platinum with liquid gallium, which has a melting point of just 29.8°C—that's room temperature on a hot day. When combined with gallium, the platinum becomes soluble. In other words, it melts, and without firing up a hugely powerful industrial furnace.

For this mechanism, processing at an elevated temperature is only required at the initial stage, when platinum is dissolved in gallium to create the catalysis system. And even then, it's only around 300°C for an hour or two, nowhere near the continuous high temperatures often required in industrial-scale chemical engineering.

Contributing author Dr. Jianbo Tang of UNSW likened it to a blacksmith using a hot forge to make equipment that will last for years.

"If you're working with iron and steel, you have to heat it up to make a tool, but you have the tool and you never have to heat it up again," he said.

"Other people have tried this approach but they have to run their catalysis systems at very high temperatures all the time."

To create an effective catalyst, the researchers needed to use a ratio of less than 0.0001 platinum to gallium. And most remarkably of all, the resulting system proved to be over 1,000 times more efficient than its solid-state rival (the one that needed to be around 10% expensive platinum to work)

CHEMWATCH
Bulletin Board
Gossip
JUN. 17, 2022

The advantages don't stop there—because it's a liquid-based system, it's also more reliable. Solid-state catalytic systems eventually clog up and stop working. That's not a problem here. Like a water feature with a built-in fountain, the liquid mechanism constantly refreshes itself, self-regulating its effectiveness over a long period of time and avoiding the catalytic equivalent of pond scum building up on the surface.

Dr. Md. Arifur Rahim, the lead author from UNSW Sydney, said: "From 2011, scientists were able to miniaturize catalyst systems down to the atomic level of the active metals. To keep the single atoms separated from each other, the conventional systems require solid matrices (such as graphene or metal oxide) to stabilize them. I thought, why not using a liquid matrix instead and see what happens.

"The catalytic atoms anchored onto a solid matrix are immobile. We have added mobility to the catalytic atoms at low temperature by using a liquid gallium matrix."

The mechanism is also versatile enough to perform both oxidation and reduction reactions, in which oxygen is provided to or taken away from a substance respectively.

The UNSW experimentalists had to solve some mysteries to understand these impressive results. Using advanced computational chemistry and modeling, their colleagues at RMIT, led by Professor Salvy Russo, were able to identify that the platinum never becomes solid, right down to the level of individual atoms.

Exciton Science Research Fellow Dr. Nastaran Meftahi revealed the significance of her RMIT team's modeling work.

"What we found is the two platinum atoms never came into contact with each other," she said.

"They were always separated by gallium atoms. There is no solid platinum forming in this system. It's always atomically dispersed within the gallium. That's really cool and it's what we found with the modeling, which is very difficult to observe directly through experiments."

Surprisingly, it's actually the gallium that does the work of driving the desired chemical reaction, acting under the influence of platinum atoms in close proximity.

Exciton Science Associate Investigator Dr. Andrew Christofferson of RMIT explained how novel these results are: "The platinum is actually a little bit

below the surface and it's activating the gallium atoms around it. So the magic is happening on the gallium under the influence of platinum.

"But without the platinum there, it doesn't happen. This is completely different from any other catalysis anyone has shown, that I'm aware of. And this is something that can only have been shown through the modeling."

Phys Org, 6 June 2022

https://phys.org

Coffee Drinkers — Even Those With a Sweet Tooth — Live Longer

2022-05-31

Moderate consumption of coffee, with or without sugar, is associated with a reduced risk of death, according to prospective cohort study.

Among more than 170,000 people in the United Kingdom, those who drank about two to four cups of coffee a day, with or without sugar, had a lower rate of death than those who didn't drink coffee, reported lead author Dan Liu, MD, of the department of epidemiology at Southern Medical University, Guangzhou, China.

"Previous observational studies have suggested an association between coffee intake and reduced risk for death, but they did not distinguish between coffee consumed with sugar or artificial sweeteners and coffee consumed without," Liu, who is also of the department of public health and preventive medicine, Jinan University, Guangzhou, China, and colleagues wrote in Annals of Internal Medicine.

To learn more, the investigators turned to the UK Biobank, which recruited approximately half a million participants in the United Kingdom between 2006 and 2010 to undergo a variety of questionnaires, interviews, physical measurements, and medical tests. Out of this group, 171,616 participants completed at least one dietary questionnaire and met the criteria for the present study, including lack of cancer or cardiovascular disease upon enrollment.

Results from these questionnaires showed that 55.4% of participants drank coffee without any sweetener, 14.3% drank coffee with sugar, 6.1% drank coffee with artificial sweetener, and 24.2% did not drink coffee at all. Coffee drinkers were further sorted into groups based on how many cups of coffee they drank per day.

Over the course of about 7 years, 3,177 of the participants died, including 1,725 who died from cancer and 628 who died from cardiovascular disease.

After accounting for other factors that might impact risk of death, like lifestyle choices, the investigators found that coffee drinkers were significantly less likely to die from any cause, cardiovascular disease, or cancer, than those who didn't drink coffee at all. This benefit was observed across types of coffee, including ground, instant, and decaffeinated varieties. The protective effects of coffee were most apparent in people

Investigators found that coffee drinkers were significantly less likely to die from any cause, cardiovascular disease, or cancer, than those who didn't drink coffee at all.

who drank about two to four cups a day, among whom death was about 30% less likely, regardless of whether they added sugar to their coffee or not. Individuals who drank coffee with artificial sweetener did not live significantly longer than those who drank no coffee at all; however, the investigators suggested that this result may have been skewed by higher rates of negative health factors, such as obesity and hypertension, in the artificial sweetener group.

Liu and colleagues noted that their findings align with previous studies linking coffee consumption with survival. Like those other studies, the present data revealed a "U-shaped" benefit curve, in which moderate coffee consumption was associated with longer life, whereas low or no consumption and high consumption were not.

Although the present findings suggested that adding sugar did not eliminate the health benefits of coffee, Liu and colleagues still cautioned against sweetened beverages, citing widely known associations between sugar consumption and poor health.

In an accompanying editorial, Christina C. Wee, MD, MPH, deputy editor of Annals of Internal Medicine, pointed out a key detail from the data: the amount of sugar added to coffee in the U.K. study may be dwarfed by the amount consumed by some coffee drinkers across the pond.

"The average dose of added sugar per cup of sweetened coffee [in the study] was only a little over a teaspoon, or about 4 grams," Wee wrote. "This is a far cry from the 15 grams of sugar in an 8-ounce cup of caramel macchiato at a popular U.S. coffee chain."

Still, Wee, an associate professor of medicine at Harvard Medical School, Boston, and director of the obesity research program in the division of general medicine at Beth Israel Deaconess Medical Center, Boston, suggested that your typical coffee drinker can feel safe in their daily habit.

"The evidence does not suggest a need for most coffee drinkers – particularly those who drink it with no or modest amounts of sugar – to eliminate coffee," she wrote. "So drink up – but it would be prudent to avoid too many caramel macchiatos while more evidence brews."

Estefanía Toledo, MD, MPH, PhD, of the department of preventive medicine and public health at the University of Navarra, Pamplona, Spain, offered a similar takeaway.

"For those who enjoy drinking coffee, are not pregnant or lactating, and do not have special health conditions, coffee consumption could be

CHEMWATCH
Bulletin Board
Curiosities
JUN. 17, 2022

considered part of a healthy lifestyle," Toledo said in a written comment. "I would recommend adding as little sugar as possible to coffee until more evidence has been accrued."

Toledo, who previously published a study showing a link between coffee and extended survival, noted that moderate coffee consumption has "repeatedly" been associated with lower rates of "several chronic diseases" and death, but there still isn't enough evidence to recommend coffee for those who don't already drink it.

More long-term research is needed, Toledo said, ideally with studies comparing changes in coffee consumption and health outcomes over time. These may not be forthcoming, however, as such trials are "not easy and feasible to conduct."

David Kao, MD, assistant professor of medicine-cardiology and medical director of the school of medicine at the University of Colorado at Denver, Aurora, said that the study conducted by Liu and colleagues is a "very well-executed analysis" that strengthens our confidence in the safety of long-term coffee consumption, even for patients with heart disease.

Kao, who recently published an analysis showing that higher coffee intake is associated with a lower risk of heart failure, refrained from advising anyone to up their coffee quota.

"I remain cautious about stating too strongly that people should increase coffee intake purely to improve survival," Kao said in a written comment. "That said, it does not appear harmful to increase it some, until you drink consistently more than six to seven cups per day."

The study was supported by the National Natural Science Foundation of China, the Young Elite Scientist Sponsorship Program by CAST, the Guangdong Basic and Applied Basic Research Foundation, and others. Toledo and Kao disclosed no relevant conflicts of interest.

Medscape, 31 May 2022

https://medscape.com

We're told AI neural networks 'learn' the way humans do. A neuroscientist explains why that's not the case

2022-06-06

Recently developed artificial intelligence (AI) models are capable of many impressive feats, including recognising images and producing human-like

It's easy to assume human-like behaviour means human-like understanding.

language. But just because AI can perform human-like behaviours doesn't mean it can think or understand like humans.

As a researcher studying how humans understand and reason about the world, I think it's important to emphasise the way AI systems "think" and learn is fundamentally different to how humans do – and we have a long way to go before AI can truly think like us.

A widespread misconception

Developments in AI have produced systems that can perform very human-like behaviours. The language model GPT-3 can produce text that's often indistinguishable from human speech. Another model, PaLM, can produce explanations for jokes it has never seen before.

Most recently, a general-purpose AI known as Gato has been developed which can perform hundreds of tasks, including captioning images, answering questions, playing Atari video games, and even controlling a robot arm to stack blocks. And DALL-E is a system which has been trained to produce modified images and artwork from a text description.

These breakthroughs have led to some bold claims about the capability of such AI, and what it can tell us about human intelligence.

For example Nando de Freitas, a researcher at Google's AI company DeepMind, argues scaling up existing models will be enough to produce human-level artificial intelligence. Others have echoed this view.

In all the excitement, it's easy to assume human-like behaviour means human-like understanding. But there are several key differences between how AI and humans think and learn.

Neural nets vs the human brain

Most recent AI is built from artificial neural networks, or "neural nets" for short. The term "neural" is used because these networks are inspired by the human brain, in which billions of cells called neurons form complex webs of connections with one another, processing information as they fire signals back and forth.

Neural nets are a highly simplified version of the biology. A real neuron is replaced with a simple node, and the strength of the connection between nodes is represented by a single number called a "weight".

With enough connected nodes stacked into enough layers, neural nets can be trained to recognise patterns and even "generalise" to stimuli

CHEMWATCH
Bulletin Board
Curiosities
JUN. 17, 2022

that are similar (but not identical) to what they've seen before. Simply, generalisation refers to an AI system's ability to take what it has learnt from certain data and apply it to new data.

Being able to identify features, recognise patterns, and generalise from results lies at the heart of the success of neural nets – and mimics techniques humans use for such tasks. Yet there are important differences.

Neural nets are typically trained by "supervised learning". So they're presented with many examples of an input and the desired output, and then gradually the connection weights are adjusted until the network "learns" to produce the desired output.

To learn a language task, a neural net may be presented with a sentence one word at a time, and will slowly learns to predict the next word in the sequence.

This is very different from how humans typically learn. Most human learning is "unsupervised", which means we're not explicitly told what the "right" response is for a given stimulus. We have to work this out ourselves.

For instance, children aren't given instructions on how to speak, but learn this through a complex process of exposure to adult speech, imitation, and feedback.

Another difference is the sheer scale of data used to train AI. The GPT-3 model was trained on 400 billion words, mostly taken from the internet. At a rate of 150 words per minute, it would take a human nearly 4,000 years to read this much text.

Such calculations show humans can't possibly learn the same way AI does. We have to make more efficient use of smaller amounts of data.

Neural nets can learn in ways we can't

An even more fundamental difference concerns the way neural nets learn. In order to match up a stimulus with a desired response, neural nets use an algorithm called "backpropagation" to pass errors backward through the network, allowing the weights to be adjusted in just the right way.

However, it's widely recognised by neuroscientists that backpropagation can't be implemented in the brain, as it would require external signals that just don't exist.

Some researchers have proposed variations of backpropagation could be used by the brain, but so far there is no evidence human brains can use such learning methods.

Instead, humans learn by making structured mental concepts, in which many different properties and associations are linked together. For instance, our concept of "banana" includes its shape, the colour yellow, knowledge of it being a fruit, how to hold it, and so forth.

As far as we know, AI systems do not form conceptual knowledge like this. They rely entirely on extracting complex statistical associations from their training data, and then applying these to similar contexts.

Efforts are underway to build AI that combines different types of input (such as images and text) – but it remains to be seen if this will be sufficient for these models to learn the same types of rich mental representations humans use to understand the world.

There's still much we don't know about how humans learn, understand and reason. However, what we do know indicates humans perform these tasks very differently to AI systems.

As such, many researchers believe we'll need new approaches, and more fundamental insight into how the human brain works, before we can build machines that truly think and learn like humans.

The Conversation, 6 June 2022

https://theconversation.com

Think most venomous snakes don't climb? Think again

2022-06-05

There are a lot of misconceptions about Australian snakes that can lead to potentially dangerous false identifications.

One myth that still gets brought up from time to time is that most venomous snakes don't climb — ie. if you see a snake in a tree or on a roof, it's either a harmless tree snake or a python.

But a study conducted by three snake experts has conclusively dismissed that idea.

Their research, published in Herpetology Notes late last year, found instances of climbing in a huge range of venomous Australian snakes (elapids), including king browns (Pseudechis australis), tiger snakes

One myth that still gets brought up from time to time is that most venomous snakes don't climb.

CHEMWATCH
Bulletin Board
Curiosities
JUN. 17, 2022

(Notechis scutatus), and the spectacularly patterned Collett's snake (Pseudechis colletti).

In total, their research, which was based on literature studies, surveys, and personal observations, found instances of 20 different species of venomous snakes engaging in arboreal behaviour — tree climbing.

When their observations were expanded to include venomous snakes climbing things other than trees, or snakes under extreme stress, such as when fleeing predators or rising floodwaters, the number of climbing species rose to 31.

"Even though we have 31 species recorded, which is just over a quarter of all [Australian] elapids, that number is likely to be higher," said Matt Sleeth, ecologist and lead author on the paper.

"Due to the difficulty of surveying this behaviour in these animals, it is likely that there are more [venomous elapid] snakes that do climb."

A sliver of truth?

So, where does the misconception come from?

Like most rumours, it is grounded in some truth.

In Australia, there are five families of land snake — the pythons, file snakes, blind snakes, the rear-fanged snakes or colubrids, and the front-fanged snakes or elapids.

Blind snakes are small, shy and rarely seen, file snakes are aquatic and live in northern swamps and billabongs, and pythons are widespread, non-venomous and are prolific climbers.

Then there are the other two: elapids and colubrids.

Almost all our venomous snakes belong to the elapidae family.

Globally, elapids include the cobras of Asia and Africa, the mambas of Africa, as well as coral snakes, sea snakes, and in Australia, over 130 species of land and sea snake.

While many elapids have evolved venom, Australia's elapids are singular in their potency. The world's most venomous land snake, the inland taipan, is capable of killing around 250,000 mice with the venom from a single bite, according to the LD50 parameter.

Elapids are thought to have arrived in Australia many millions of years ago as a sea snake, according to evolutionary ecologist Rick Shine from the University of Sydney.

"In the case of the elapids, the ancestor that has come from Asia to Australia looks to be of a modern-day krait — a sea snake species," Professor Shine said.

Today, sea kraits are among the most venomous snakes in the world, meaning Australia's elapids likely had a headstart in their development of potent venom.

It also means that Australia's elapids started out as ground snakes.

Though some may have moved into the trees, Australia then underwent a process of aridification — much of the vast forest that once covered the continent converted to deserts and grasslands.

If any of those early Australian elapids had moved into the trees, the aridification of Australia would have counted against them, according to Matt Sleeth.

"Compared to places like Asia and Africa where there is plenty of forested habitat, Australia is much drier, so the potential for [tree dwelling] to be beneficial is limited," he said.

Selecting for non-venomous climbers

Which brings us to the colubrids or rear-fanged snakes like the common tree snake, brown tree-snake, and keelback.

The colubrids are the world's most successful family of snakes, and Australia is unique in being the only continent where elapids outnumber colubrids — only 10 species of colubrids occur here, according to the Queensland Museum.

The colubrids are thought to have arrived in Australia after the elapids, but there is still some debate as to exactly when.

And the path that they took to get here probably explains why many of Australia's colubrids are tree specialists.

"The colubrids came a lot more recently down through Asia and New Guinea," he said.

What that means is that their migration path was a heavily forested one that favoured tree-dwelling species.

CHEMWATCH
Bulletin Board
Curiosities
JUN. 17, 2022

"There's probably a connection there where you're likely to get more tree-dwelling species," Professor Shine said.

That migration pathway is the likely explanation for why many of Australia's non-venomous colubrids are climbers.

Combined with the presence of non-venomous pythons, which also tend to climb, it's easy to see where the myth that climbing snakes are non-venomous came from.

But while it might be a trend, it shouldn't be mistaken for a rule, according to Matt Sleeth.

"Myths among the public are pretty rampant, especially among non-charismatic species like snakes," he said.

"Generally speaking, if you do see a snake in a tree it's probably going to be a non-venomous python or a tree snake … but it doesn't have to be that way."

ABC News, 5 June 2022

https://abc.net.au

Yes, women might 'feel the cold' more than men. Here's why

2022-06-07

We all have different preferences for when it's the right time to bring out the winter blankets. And the thermostat's setting often forms the basis of office arguments between women and men regarding the "correct" temperature for it to be set.

Between the sexes, there are always more similarities than differences. But research does consistently show women prefer a higher indoor temperature to men.

But is there any science backing up the widespread belief women "feel the cold" more than men?

Biological differences between men and women

At around the same body weight, women tend to have less muscle to generate heat. Women also have more fat between the skin and the muscles, so the skin feels colder, as it's slightly further away from blood vessels.

Women tend to have a lower metabolic rate than men, which reduces heat production capacity during cold exposure.

In a world rife with misinformation, support a newsroom making a difference

Women also tend to have a lower metabolic rate than men, which reduces heat production capacity during cold exposure, making women more prone to feeling cold as the temperature drops.

Hormonal differences

The hormones oestrogen and progesterone, found in large quantities in women, contribute to the core body and skin temperatures.

Oestrogen dilates blood vessels at the extremities. This means more heat can be lost to the surrounding air. And progesterone can cause the vessels in the skin to constrict, meaning less blood will flow to some areas to keep the internal organs warmer, leaving women feeling cooler. This hormone balance changes throughout the month alongside the menstrual cycle.

The hormones also make women's hands, feet and ears stay around three degrees Celsius cooler than men's.

The core body temperature is highest in the week after ovulation, as progesterone levels increase. This means that around this time, women may be particularly sensitive to cooler outside temperatures.

Although the hands and feet are cooler, women do have warmer average core temperatures than men. This is likely the source of the saying "cold hands, warm heart".

Is it just humans?

The phenomenon that some of us prefer warmer temperatures to others isn't unique to humans. Studies on many species of birds and mammals report that males commonly congregate in cooler areas where there is shade, while females and offspring stay in warmer environments where there is sunlight.

Male bats prefer to rest at the cool, high peaks of mountains, whereas females remain in the warmer valleys.

Female mammals may have developed a preference for warmer climates to encourage them to rest with offspring during stages when the young are unable to regulate their own body temperature.

So the difference between heat-sensing mechanisms may provide an evolutionary advantage.

CHEMWATCH
Bulletin Board
Curiosities
JUN. 17, 2022

So how do we agree on the ideal temperature?

The "Scandinavian sleep method", where couples sleep with separate blankets, is one way to overcome the differences in temperature preferences.

In the workplace, personal comfort systems are thermal systems that heat or cool and can be locally positioned in individual work stations such as desktops, chairs, or near the feet and legs. Examples include small desk fans, heated chairs and blankets, or footwarmers.

These systems provide individualised thermal comfort to meet personal needs without affecting others in the same space, and have been found to produce higher comfort satisfaction in the workplace.

They may also be an energy-efficient method to balance thermal comfort and health in office environments.

The Conversation, 7 June 2022

https://theconversation.com

COVID mRNA vaccines can be quickly updated for new variants. So, where's my Omicron booster?

2022-06-06

Since Omicron was declared a variant of concern at the end of November, it quickly swept the globe, becoming the dominant COVID variant in many countries including Australia.

It's the latest in a growing line of variants, and probably not going to be the last.

Yet every one of the hundreds of millions of approved mRNA vaccines administered around the globe were made to their original recipe, which was based on the COVID virus that first emerged in Wuhan.

One of the most promising aspects of the new mRNA COVID vaccines is their ability to be rapidly adjusted for maximum protection in the face of new variants.

So where's my Omicron booster?

Remind me again: how do mRNA vaccines work?

Giving a person (or mouse) multiple vaccines with ever-so-slight differences in their makeup can cause a phenomenon called "immunological imprinting".

Vaccines based upon mRNA contain a blueprint in the form of genetic material — called messenger RNA — that, when injected into our muscle, is "read" by our cells.

Using that RNA message as a guide, our cells construct replicas of the spike protein that the SARS-CoV-2 virus uses to infect us.

The freshly built spike proteins are pushed outside the cells, a bit like a flag, alerting the immune system.

In response, a type of white blood cell called B cells pump out antibodies — Y-shaped molecules that form an immune "memory" of the spike.

But as the SARS-CoV-2 virus mutated its genetic code and slightly remoulded its spike protein, it was better able to fly under our immune system's radar.

The process of tailoring mRNA vaccines for new variants is "very straightforward", says Archa Fox, an RNA biologist at the University of Western Australia.

"The beauty of the RNA [vaccine] platform is that you can very easily change the DNA template that you use to make the RNA.

"It's the bread and butter of biochemists and molecular biologists, so very routine for [vaccine] companies."

Large companies such as Pfizer and Moderna can feasibly make an Omicron-specific vaccine for testing within a week or so, says Colin Pouton, a pharmaceutical biologist at Monash University.

"And if an Omicron vaccine is going to be any good to you and I, it has to produce new antibodies against Omicron."

So first, they test if the Omicron vaccine does that in mice.

"But if you do animal experiments [with an Omicron-specific booster shot], and look for protection against Omicron, an Omicron version of their vaccine actually doesn't do any better than the original Wuhan vaccine," Professor Pouton says.

So, what's going on?

Slight spanner in the immune works

CHEMWATCH
Bulletin Board
Curiosities
JUN. 17, 2022

Giving a person (or mouse) multiple vaccines with ever-so-slight differences in their makeup can cause a phenomenon called "immunological imprinting".

"When you give a vaccine, you prime the immune response to produce antibodies … then you boost it by giving a second dose or a third dose," Professor Pouton says.

But if you're then vaccinated against a slightly different variant, you might make fewer antibodies that specifically work on that new viral variant.

That's because, when confronted with a similar vaccine, your immune system prefers to recruit existing antibody-producing B cells back into action, rather than develop new ones.

(This also happens with the seasonal flu vaccine, and is partly why it's only partially effective. But you should still get it.)

And not all antibodies are created equal.

Our immune system, when presented with a spike protein, gets to work making antibodies that recognise and attach to many different parts of the spike.

Antibodies that help stop a virus from infecting cells are called neutralising antibodies.

We want these, and they work by blocking the very end of a virus's spike protein, called the "receptor-binding domain".

This is the bit that latches onto ACE2 receptors on our cells (hence "receptor binding"), and allows the virus to slip inside.

Another way to think of it is to imagine the spike protein is an arm, and the very end section is a hand that can grab hold of and twist open the ACE2 door handle.

If you get a really big, oversized clothes peg — this is a neutralising antibody — and clamp it onto the palm of the "hand" or between its fingers, you have a physical barrier between the hand and the door handle, and it won't be able to open the door and infect the cell.

Pegs that prefer to dangle off the elbow or up near the shoulder won't do much to stop the hand from working. These pegs are our non-neutralising antibodies.

And non-neutralising antibodies make up the lion's share of COVID-vaccine-generated antibodies, says Dale Godfrey, an immunologist at the Peter Doherty Institute for Infection and Immunity.

"Only about 10-20 per cent of antibodies bind the receptor-binding domain compared to the rest of the spike protein when people are immunised with whole-spike vaccine."

So, how do we get around this?

Scientists are looking for ways to beef up neutralising antibodies while avoiding immunological imprinting.

One way to do this is to make "slimmed down" versions of variant-specific vaccines.

Professors Pouton and Godfrey are involved in a trial of two such vaccines.

One is an mRNA vaccine, which contains instructions for our cells to make only the receptor-binding domain and not the rest of the spike, and the other comprises lab-made receptor-binding domain proteins.

"We're trying to say [to the immune system], 'here's a new target which you haven't seen before,'" Professor Pouton says.

"Don't bother making all those antibodies to the rest of the spike protein — just to the new receptor-binding domain."

The vaccines in the trial are based on the Beta variant, as that was the variant of concern when the project began.

The Beta variant shares some of Omicron's mutations, Professor Godfrey says.

"As to whether this means the vaccine will provide superior protection against Omicron, we think and hope so, but don't know yet."

Pfizer and Moderna are continuing with clinical trials to see how their Omicron-specific whole-spike vaccines fare in people.

Moderna is also trialling a "bivalent" version that combines the original vaccine, as well as the new Omicron-specific spike mRNA.

We might not have to wait too long to find out how well they work.

A Pfizer spokesperson said they would share next-generation vaccine data "in the coming weeks".

CHEMWATCH
Bulletin Board
Curiosities
JUN. 17, 2022

A Moderna spokesperson said the company expected to have first data on the bivalent vaccine this month "to inform selection of its candidate for the northern hemisphere [autumn] 2022 booster".

Moderna is also in phase one trials of a receptor-binding-domain-specific Omicron booster, Professor Pouton says, but it's very early days.

Eventually, he adds, the hope is COVID vaccines could become routine seasonal vaccines, like the yearly flu shot, and won't need to run the clinical trial gauntlet each time.

"It's still not certain whether we will need annual vaccines, but a lot of people would say we probably will — maybe not everyone, but certainly vulnerable people or ageing people."

ABC News, 6 June 2022

https://abc.net.au

The mystery of why most life-long smokers don't get lung cancer is solved

2022-05-30

The rise in cell mutations halted after 23 pack years of exposure.

Cigarette smoking is overwhelmingly the main cause of lung cancer, yet only a minority of smokers develop the disease. A study led by scientists at Albert Einstein College of Medicine and published online today in Nature Genetics suggests that some smokers may have robust mechanisms that protect them from lung cancer by limiting mutations. The findings could help identify those smokers who face an increased risk for the disease and therefore warrant especially close monitoring.

"This may prove to be an important step toward the prevention and early detection of lung cancer risk and away from the current herculean efforts needed to battle late-stage disease, where the majority of health expenditures and misery occur," said Simon Spivack, M.D., M.P.H., a co-senior author of the study, professor of medicine, of epidemiology & population health, and of genetics at Einstein, and a pulmonologist at Montefiore Health System.

Overcoming Obstacles to Study Cell Mutations

It's long been assumed that smoking leads to lung cancer by triggering DNA mutations in normal lung cells. "But that could never be proven until our study, since there was no way to accurately quantify mutations in normal cells," said Jan Vijg, Ph.D., a study co-senior author and professor

and chair of genetics, professor of ophthalmology and visual sciences, and the Lola and Saul Kramer Chair in Molecular Genetics at Einstein (also at the Center for Single-Cell Omics, Jiaotong University School of Medicine in Shanghai, China). Dr. Vijg overcame that obstacle a few years ago by developing an improved method for sequencing the entire genomes of individual cells.

Single-cell whole-genome sequencing methods can introduce sequencing errors that are hard to distinguish from true mutations—a serious flaw when analyzing cells containing rare and random mutations. Dr. Vijg solved this problem by developing a new sequencing technique called single-cell multiple displacement amplification (SCMDA). As reported in Nature Methods in 2017, this method accounts for and reduces sequencing errors.

The Einstein researchers used SCMDA to compare the mutational landscape of normal lung epithelial cells (i.e., cells lining the lung) from two types of people: 14 never-smokers, ages 11 to 86; and 19 smokers, ages 44 to 81, who had smoked a maximum of 116 pack years. (One pack year of smoking equals 1 pack of cigarettes smoked per day for one year.) The cells were collected from patients who were undergoing bronchoscopy for diagnostic tests unrelated to cancer.

"These lung cells survive for years, even decades, and thus can accumulate mutations with both age and smoking," said Dr. Spivack. "Of all the lung's cell types, these are among the most likely to become cancerous."

Mutations Caused by Smoking

The researchers found that mutations (single-nucleotide variants and small insertions and deletions) accumulated in the lung cells of non-smokers as they age—and that significantly more mutations were found in the lung cells of the smokers. "This experimentally confirms that smoking increases lung cancer risk by increasing the frequency of mutations, as previously hypothesized," said Dr. Spivack. "This is likely one reason why so few non-smokers get lung cancer, while 10% to 20% of lifelong smokers do."

Another finding from the study: The number of cell mutations detected in lung cells increased in a straight line with the number of pack years of smoking—and, presumably, the risk for lung cancer increased as well. But interestingly, the rise in cell mutations halted after 23 pack years of exposure.

CHEMWATCH
Bulletin Board
Curiosities
JUN. 17, 2022

"The heaviest smokers did not have the highest mutation burden," said Dr. Spivack. "Our data suggest that these individuals may have survived for so long in spite of their heavy smoking because they managed to suppress further mutation accumulation. This leveling off of mutations could stem from these people having very proficient systems for repairing DNA damage or detoxifying cigarette smoke."

The finding has led to a new research direction. "We now wish to develop new assays that can measure someone's capacity for DNA repair or detoxification, which could offer a new way to assess one's risk for lung cancer," said Dr. Vijg.

The study is titled, "Single-cell analysis of somatic mutations in human bronchial epithelial cells in relation to aging and smoking." Additional Einstein authors include: Zhenqiu Huang, Ph.D., Shixiang Sun, Ph.D., Moonsook Lee, M.S., Yakov Peter, Ph.D., Ali Sadoughi, M.D., Chirag Shah, M.D., and Kenny Ye, Ph.D., Miao Shi, Ph.D., Spencer Waldman, B.S., Ava Marsh, B.A., Taha Siddiqui, M.B.B.S., Alexander Y. Maslov, M.D., Ph.D. (also at Voronezh State University of Engineering Technology, Voronezh, Russia), and Xiao Dong, Ph.D. (also at University of Minnesota, Minneapolis MN).

The Brighter Side of News, 30 May 2022

https://www.thebrighterside.news

How the giraffe got its neck: 'unicorn' fossil could shed light on puzzle

2022-06-02

How did the giraffe get its long neck? Researchers say a species of giraffoid that lived millions of years ago in China could shed light on this puzzler. The animal, named after a mythical unicorn-like creature, had a thick headpiece optimized for high-speed head-bashing fights1.

The giraffe's neck has intrigued researchers for decades. There should be a good reason for the extraordinary length, because it causes hardship. A giraffe's heart needs to pump blood 2 metres up to the head, which requires a high blood pressure and management to avoid fainting or stroke. "It's beautifully adapted to this, but it's a big cost," says Rob Simmons, a behavioural ecologist at the University of Cape Town in South Africa, who was not involved in the study.

One prevailing theory is that giraffes evolved longer necks to reach higher trees for food. "This is widely believed; it's really entrenched," says

A newly described species of ancient giraffoid had a thick helmet designed for fierce headbutting.

Simmons. This makes sense, but isn't as simple as it sounds — research has shown that giraffes tend to eat from lower levels2, and tall giraffes aren't more likely to survive drought3, when food competition is highest. Another idea is that giraffes evolved longer necks for sexual competition, with male giraffes engaging in violent neck-swinging fights and longer necks attracting mates. This 'necks for sex' theory is sometimes contested by the fact that males don't have longer necks than females4. "It been very difficult for the traditional giraffe researchers to accept this sexual selection idea," says Simmons.

The ancient giraffoid's fossilized remains, described on 2 June in Science1, add some more data to the debate.

Head-bashing beast

Co-author Jin Meng first stumbled on a skull with four vertebrae lying on the sands of the Junggar Basin in northern China, back in 1996. "He cried: 'A strange beast!'," says Shi-Qi Wang, a palaeontologist at the Chinese Academy of Sciences Institute of Vertebrate Paleontology and Paleoanthropology in Beijing. Over two decades, Meng and colleagues found more than 77 fossils of the same species, including another 2 skulls and some teeth.

They describe the specimen as a previously unknown giraffe relative that lived in the Miocene, about 16.9 million years ago. It probably looked more like the short-necked African Okapi (Okapia johnstoni) than a giraffe, and had a 5-cm thick hard structure on the top of its head made of layers of keratin. They named it Discokeryx xiezhi after the xiezhi, a unicorn-like creature in Chinese mythology. "This legend might derive from some fossil giraffoids," speculates Wang. The animal's complex head and neck bone structure shows that it was "exquisitely adapted for power and strength to aid male–male combat", says Simmons, to compete for and impress potential mates.

The new giraffoid fits into a family tree with a plethora of species that had strange headgear. Wang and colleagues map out more than a dozen types of helmets and horns in giraffoids and their close relatives.

Wang thinks that as ancestral giraffoids left the forest and entered grasslands, they fought ever-more fiercely with their necks, which grew longer as their fighting style evolved. But high foraging probably also had a role, he says.

CHEMWATCH
Bulletin Board
Curiosities
JUN. 17, 2022

Palaeoungulate biologist Nikos Solounias at the New York Institute of Technology College of Osteopathic Medicine in Old Westbury is not convinced that the newly described headbutting ruminant is a particularly close relative of modern giraffes or can tell us much about their necks. "All ruminants fight with their horns and neck," he says. "Giraffes fight differently; they have a different evolutionary history." But Simmons argues that the work shows sexual selection having a strong role in the neck shape of an ancestral giraffoid, which opens the door for it to be "equally likely" for modern giraffes. "This paper is going to open people's eyes that we should take this sexual selection theory seriously," says Simmons.

Nature, 2 June 2022

https://nature.com

Styrofoam-munching superworms could hold key to plastic upcycling

2022-06-09

Packing material, disposable cutlery, CD cases: Polystyrene is among the most common forms of plastic, but recycling it isn't easy and the vast majority ends up in landfills or finds its way to the oceans where it threatens marine life.

Polystyrene is among the most common forms of plastic, but recycling it isn't easy.

Scientists at Australia's University of Queensland have now discovered that superworms—the larvae of Zophobas morio darkling beetles—are eager to dine on the substance, and their gut enzymes could hold the key to higher recycling rates.

Chris Rinke, who led a study that was published in the journal Microbial Genomics on Thursday, told AFP previous reports had shown that tiny waxworms and mealworms (which are also beetle larvae) had a good track record when it came to eating plastic, "so we hypothesized that the much larger superworms can eat even more."

Superworms grow up to two inches (five centimeters) and are bred as a food source for reptiles and birds, or even for humans in countries such as Thailand and Mexico.

Rinke and his team fed superworms different diets over a three week period, with some given polystyrene foam, commonly known as styrofoam, some bran, and others not fed at all.

"We confirmed that superworms can survive on a sole polystyrene diet, and even gain a small amount of weight—compared to a starvation

control group—which suggests that the worms can gain energy from eating polystyrene," he said.

Although the polystyrene-reared superworms completed their life cycle, becoming pupae and then fully developed adult beetles, tests revealed a loss of microbial diversity in their guts and potential pathogens.

These findings suggested that while the bugs can survive on polystyrene, it is not a nutritious diet and impacts their health.

Next, the team used a technique called metagenomics to analyze the microbial gut community and find which gene-encoded enzymes were involved in degrading the plastic.

Bio-upcycling

One way to put the findings to use would be to provide superworms with food waste or agricultural bioproducts to consume alongside polystyrene.

"This could be a way to improve the health of the worms and to deal with the large amount of food waste in Western countries," said Rinke.

But while breeding more worms for this purpose is possible, he envisages another route: creating recycling plants that mimic what the larvae do, which is to first shred the plastic in their mouths then digest it through bacterial enzymes.

"Ultimately, we want to take the superworms out of the equation," he said, and he now plans more research aimed at finding the most efficient enzymes, then enhancing them further through enzyme engineering.

The breakdown products from that reaction could then be fed to other microbes to create high-value compounds, such as bioplastics, in what he hopes would become an economically viable "upcycling" approach.

Phys Org, 9 June 2022

https://phys.org

Want to reduce stroke risk? Sit less. Move more. Do chores.

2022-06-07

Imagine watching "The Batman" movie back-to-back four times every day or driving a whopping 390 miles each way on a daily commute. Either

"Light-intensity physical activity can include vacuuming, sweeping the floor, washing the car, leisure strolling, stretching, or playing catch."

CHEMWATCH
Bulletin Board
Curiosities
JUN. 17, 2022

uncomfortable choice will take about 12 hours—or the same amount of time most Americans stay seated throughout any day.

The dangerous consequences of prolonged inactivity in humans are widely known. Too much sitting leads to an increased risk of heart disease, Type 2 diabetes, and other chronic illnesses, including depression. To offset the severe side effects of a sedentary lifestyle, doctors recommend adults complete at least 150 minutes of moderate to vigorous aerobic exercise a week.

However, a new study from San Diego State University, published in JAMA Network Open, found that doing lighter intensity daily activities such as household chores can significantly reduce the risk of stroke.

"Light-intensity physical activity can include vacuuming, sweeping the floor, washing the car, leisure strolling, stretching, or playing catch," said Steven Hooker, dean of SDSU's College of Health and Human Services and lead researcher of the cohort study.

"We observed that both physical activity and being sedentary independently impacted stroke risk. Our research demonstrates that strategies for stroke prevention should focus on both."

Hooker and his research colleagues measured both the amount of time participants were sedentary and the duration and intensity of physical activity in 7,600 adults ages 45 and older and then compared the data to the incidence of strokes in participants over seven years.

They found those who were sedentary for 13 hours or more a day had a 44% increased risk of having a stroke.

"The findings are more potent because the activity and sedentary behaviors were measured with an accelerometer, providing substantially more accurate data than previous studies that relied on self-reported measures," said Hooker, a former coordinator of the California Active Aging Project with a history of research into healthy lifestyles for older adults.

Study participants wore a hip-mounted accelerometer, a sensitive motion detector that precisely recorded physical activity and the duration of sitting and inactivity.

Even though smartphones and smartwatches valiantly attempt to motivate Americans to move more, a shocking percentage of adults don't exercise enough. The CDC reports only 23% of U.S. adults meet the weekly recommendations for aerobic and muscle-strengthening activity.

But, if 10,000 steps a day or closing an exercise ring on your watch seem out of reach, Hooker said getting up and doing even ten minutes of light to moderate physical activity a few times throughout the day is an effective strategy in reducing the likelihood of having a stroke.

"For overall heart and brain health, move more within your capacity, and sit less," said Hooker.

Medical Xpress, 7 June 2022

https://medicalxpress.com

Immune protein may drive alcoholism relapse

2022-06-08

The anxiety that occurs during withdrawal from excessive alcohol use, and contributes to relapse, may be driven in part by the release of an immune protein in the brain, according to a new study from scientists at Scripps Research.

The discovery, reported online June 6, 2022, in Molecular Psychiatry, illuminates the molecular details of the brain's response to alcohol withdrawal, and suggests that the immune protein, colony stimulating factor 1 (CSF1), could be a target of future treatments for alcohol use disorder (AUD).

"Alcohol withdrawal activates the stress system in the brain, which contributes to relapse, and in this study, we linked this stress response to CSF1, a neuroimmune mediator, opening up new opportunities for therapeutic intervention," says study senior author Marisa Roberto, Ph.D., professor and Schimmel Family Chair in the Department of Molecular Medicine at Scripps Research.

The study's first author, who performed many of the experiments, is Reesha R. Patel, Ph.D., a former postdoctoral researcher in the Roberto lab.

Alcohol is by far the most used and abused recreational drug. According to the 2019 National Survey on Drug Use and Health, nine million men and more than five million women in the United States have an alcohol use disorder (AUD), which is defined as an inability to control alcohol use despite its negative impact on the user's health, social life and/or employment. Drug treatments, talk-therapy and support group-based treatments are available, but relapse is common, mainly due to the limited understanding of the brain-circuit dysfunctions underlying AUD.

Research scientists find the immune protein CSF1 may contribute to anxiety during alcohol withdrawal.

CHEMWATCH
Bulletin Board
Curiosities
JUN. 17, 2022

Scientists know that relapse-promoting alcohol withdrawal symptoms include rising feelings of anxiety, caused at least in part by the release of stress molecules such as corticotropin-releasing factor (CRF) within the brain. CRF stimulates receptors on neurons in the prefrontal cortex, and in the limbic system, a set of more primitive brain structures that process emotions. If scientists could fully identify and characterize these CRF-sensitive neuronal populations, they could understand better how anxiety occurs during withdrawal and potentially devise effective treatments to block it.

Toward that end, Roberto and her team, in the new study, identified a population of neurons in the medial prefrontal cortex (mPFC) of mice that are sensitive to CRF because they express a CRF receptor called CRF1. The scientists showed that these neurons are involved in altering mood and behavior during alcohol exposure and withdrawal.

The team's initial experiments revealed that deletion of these CRF-sensitive neurons makes the mice less anxious, suggesting that the neurons normally mediate anxiety-like behaviors.

The researchers subsequently found that these CRF-sensitive mPFC neurons become less excitable—less likely to fire signals to other neurons when stimulated—in alcohol-dependent mice that experience alcohol withdrawal. In contrast, nearby mPFC neurons lacking CRF receptors become more excitable.

"These CRF-sensitive mPFC neurons appear to constitute a unique neuronal population that undergoes profound neuroadaptations with chronic alcohol exposure," says study co-author Pauravi Gandhi, Ph.D., a postdoctoral research associate in the Roberto lab.

Intriguingly, the researchers found that alcohol withdrawal, even as it dialed down the excitability of the CRF-sensitive neurons, also induced large increases in CSF1 gene expression within these neurons. CSF1 is an immune protein best known for its role in stimulating stem cells to mature into large white blood cells called macrophages. In the brain, CSF1 is thought to have a similar role in sustaining brain-resident immune cells called microglia. Moreover, prior research in mice has suggested that under conditions of chronic stress, CSF1 production rises in the mPFC, driving microglia to prune connections between neurons, which in turn causes signs of anxiety and depression.

Looking more closely at CSF1's role in alcohol withdrawal, Roberto and colleagues artificially increased CSF1 production in CRF-sensitive mPFC

neurons in mice, and observed that the animals exhibited many of the same neuronal and behavioral changes seen in alcohol withdrawal—suggesting that elevated CSF1 levels in mPFC may be a key driver of alcohol-withdrawal signs and symptoms.

"Targeting CSF1 therefore may be a good strategy for treating AUD, and we're now eager to test that in our preclinical models," Patel says.

"Ethanol withdrawal-induced adaptations in prefrontal corticotropin releasing factor receptor 1-expressing neurons regulate anxiety and conditioned rewarding effects of ethanol" was co-authored by Reesha Patel, Sarah Wolfe, Vittoria Borgonetti, Pauravi Gandhi, Larry Rodriguez, Angela Snyder, Shannon D'Ambrosio, Michal Bajo, Alain Domissy, Steven Head, Candice Contet, R. Dayne Mayfield, Amanda Roberts and Marisa Roberto.

Medical Xpress, 8 June 2022
https://medicalxpress.com

CHEMWATCH
Bulletin Board

(NOTE: OPEN YOUR WEB BROWSER AND CLICK ON HEADING TO LINK TO SECTION)

CHEMICAL EFFECTS

Comparison of the extractability of organophosphorus flame retardants in landfill media using organic and green solvents

Genotoxicity of Graphene-Based Materials

ENVIRONMENTAL RESEARCH

Adsorption, Structure, and Dynamics of Short- and Long-Chain PFAS Molecules in Kaolinite: Molecular-Level Insights

Aminocatalysts are more environmentally friendly than hydrogen-bonding catalysts

PM 2.5 air pollution exposure and nonalcoholic fatty liver disease in the Nationwide Inpatient Sample

PHARMACEUTICAL/TOXICOLOGY

Alterations in reproductive hormone levels among farm women and their children occupationally exposed to organophosphate pesticides

Meta-analysis of epigenome-wide association studies in newborns and children show widespread sex differences in blood DNA methylation

OCCUPATIONAL

Citizens' Perception and Concerns on Chemical Exposures and Human Biomonitoring-Results from a Harmonized Qualitative Study in Seven European Countries

Characterization of Exposure to Cleaning Agents Among Health Workers in Two Southern African Tertiary Hospitals

The Dangers of Reused Personal Protective Equipment: Healthcare Workers and Workstation Contamination