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*** While Chemwatch has taken all efforts to ensure the accuracy of information in this publication, it is not intended to be comprehensive or to render advice. Websites rendered are subject to change.**

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ASIA PACIFIC

India Consults on Draft Revised Standard for Liquid Sulphur Dioxide

2022-08-11

The Bureau of Indian Standards (BIS) is consulting on the draft revision to the Indian Standard (IS): Liquid Sulphur Dioxide - Specification (hereinafter referred to as the Standard). The deadline for comments is September 28, 2022.

The Standard prescribes requirements and methods of sampling and test for liquid sulphur dioxide for use as refrigerant, fumigant, bleaching agent, antichlor and as a raw material in synthetic chemical, with reference to the following standards:

IS No.	Title
323: 2009	Rectified spirit for industrial use - Specification (second revision)
1070: 1992	Reagent grade water - Specification (third revision)
1260 (Part 1): 1973	Pictorial markings for handling and labelling of goods: Part 1 Dangerous goods (first revision)
7062: 1973	Glossary of terms used in gas industry

According to the Standard, this material shall be of the two grades below:

- Grade 1 - for refrigerating and air conditioning industries, and
- Grade 2 - for other uses.

It proposes the following requirements for liquid sulphur dioxide:

Characteristics	Requirements for	
	Grade 1	Grade 2
Color and sediment	To pass test	To pass test
Moisture, parts per million (w/v), Max	50	200
Non-volatile residue, parts per million (w/v), Max	2	1,000

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Characteristics	Requirements for	
Sulphur trioxide and sulphuric acid (as So ₃), parts per million (m/v), Max	10	50
Non-condensable gases in liquid phase, percent by volume, Max	0.02	0.02

Once the draft is approved, products conforming to the requirements of this standard could be certified with the BIS and be marked with the Standard Mark.

Read More

Chemlinked, 11-08-22

<https://chemical.chemlinked.com/news/chemical-news/india-consults-on-draft-revised-standard-for-liquid-sulphur-dioxide>

Japan Announces 185 New Chemicals Substances as General Chemical Substances under CSCL

2022-08-08

On July 29, 2022, the Japanese Ministry of Economy, Trade and Industry (METI), Ministry of Health, Labour and Welfare (MHLW), and Ministry of the Environment (MOE) released the Joint Notice No.4, announcing the names, serial numbers, and MITI numbers of 185 new chemical substances that have been notified for five years and evaluated to be neither persistent nor highly bioaccumulative under the Chemical Substance Control Law (CSCL).

Read More

Chemlinked, 08-08-22

<https://chemical.chemlinked.com/news/chemical-news/japan-announces-185-new-chemicals-substances-as-general-chemical-substances-under-cscl>

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Regulatory Update

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Inventory Update: Australia Adds 11 Chemicals into Australian Inventory of Industrial Chemicals

2022-08-04

In late July 2022, the Australian Government issued three notices to declare some updates of the Australian Inventory of Industrial Chemicals (AIIC).

According to Notice I (issued on July 22, 2022) and Notice III (issued on July 28, 2022), two chemicals have been added to AIIC in accordance with Section 83 of the Industrial Chemical Act 2019. Their assessment certificates do not include a condition on the period for which the industrial chemicals are permitted to be introduced, and such chemicals can be listed into AIIC even if 5 years have not yet passed since the assessment certificates were issued. Below are the details of the two chemicals.

	CAS Number	Chemical Name
Notice I	/	2,5-Furandione, polymer with 1-alkene, .alpha.-methyl-.omega.-(2-propen-1-yloxy)poly(oxy-1,2-ethanediyl) and 1-alkene, alkyl amide
Notice III	949495-68-5	Oils, Schinus terebinthifolius

According to Notice II (issued on July 27, 2022), nine chemicals have been added to AIIC in accordance with Section 82 of the Industrial Chemical Act 2019. Five years have passed since the assessment certificates were issued. Details of these nine chemicals are shown below.

Notice II	CAS Number	Chemical Name
	1043888-25-0	Hexanedioic acid, mixed 4-methyl-2-propylhexyl and 5-methyl-2-propylhexyl and 2-propylheptyl esters

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Notice II	CAS Number	Chemical Name
	1803166-30-4	2-Propenoic acid, 2-methyl-, 2-dodecylhexadecyl ester, polymer with methyl 2-methyl-2-propenoate and 2-tetradecyloctadecyl 2-methyl-2-propenoate
	1616796-88-3	1,3-Benzenedicarboxylic acid, polymer with 1,4-benzenedicarboxylic acid, 2,2-dimethyl-1,3-propanediol, 1,2-ethanediol and O,O,O-tris(4-isocyanatophenyl) phosphorothioate
	1847401-64-2	Decanedioic acid, polymers with glycerol, polyethylene glycol and succinic anhydride monopolyisobutylene derivs.
	1793072-86-2	2-Propenoic acid, 2-methyl-, 2-hydroxyethyl ester, polymer with hexadecyl 2-propenoate, octadecyl 2-propenoate and 3,3,4,4,5,5,6,6,7,7,8,8,8-tridecafluorooctyl 2-methyl-2-propenoate
	121436-73-5	Ethanaminium, N,N,N-trimethyl-2-[(1-oxo-2-propen-1-yl)oxy]-, chloride (1:1), polymer with ethenylbenzene
	145899-78-1	3-Oxazolidineethanol, 2-(1-methylethyl)-, 3,3'-carbonate
	152049-37-1	Hexanedioic acid, polymer with butanedioic acid, 1,4-butanediol and 2-hydroxybutanedioic acid

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Notice II	CAS Number	Chemical Name
	246867-88-9	Poly(oxy-1,2-ethanediyl), .alpha.-(2-hydroxy-3-sulfopropyl)-.omega.-hydroxy-, mono-C12-14-alkyl ethers, sodium salts

Chemical substances that are listed in the AIC can be introduced by any registered introducers (importers or manufactures). According to the Industrial Chemical Act 2019, introducers shall apply for registration before introducing an industrial chemical to Australia during a registration year (goes from September 1 to August 31). For chemicals not listed in AIC, introducers shall apply to the Executive Director for an assessment certificate for the introduction of such industrial chemicals.

Read More

Chemlinked, 04-08-22

<https://chemical.chemlinked.com/news/chemical-news/inventory-update-australia-adds-11-chemicals-into-australian-inventory-of-industrial-chemicals>

India Consults on Third Revision of Classification of Dangerous Goods

2022-08-04

India is consulting on a revision to the Classification of Dangerous Goods (Third Revision of IS 1446). It lists the proper shipping name, UN number, class or division, and the subsidiary hazard of 2,336 dangerous goods that are most commonly transported in India. The consultation period will end on September 20, 2022.

Read More

Chemlinked, 04-08-22

<https://chemical.chemlinked.com/news/chemical-news/india-consults-on-third-revision-of-classification-of-dangerous-goods>

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AMERICA

EPA Amends SNUR Regulations to Protect Workers' Health

2022-08-10

On July 5, 2022, the U.S. Environmental Protection Agency (EPA) issued a final rule amending the regulations governing significant new uses of chemical substances under the Toxic Substances Control Act (TSCA) to align with revisions that were made to the Occupational Safety and Health Administration (OSHA) Hazard Communications Standard (HCS) and changes to the OSHA Respiratory Protection Standard and the National Institute for Occupational Safety and Health (NIOSH) respirator certification requirements for the respiratory protection of workers from exposure to chemicals. 87 Fed. Reg. 39756. In addition, EPA is amending the regulations governing significant new use rules (SNUR) to address issues that have been identified by EPA and raised by stakeholders through public comments. EPA is also making a minor change to reporting requirements for premanufacture notices (PMN) and other TSCA notifications. EPA states that it "expects these changes to have minimal impact on the costs and burdens of compliance, while updating the significant new use reporting requirements to assist in addressing any potential risks to human health and the environment."

Changes to 40 C.F.R. Section 721.63, Protection in the Workplace

The final rule updates language pertaining to the respiratory protection requirements listed in 40 C.F.R. Sections 721.63(a)(4), (a)(5), and (a)(6) to be consistent with both OSHA and NIOSH requirements. In 40 C.F.R. Section 721.63(a)(4), which requires that respirators be used in accordance with 30 C.F.R. Part 11, EPA is replacing the reference to 30 C.F.R. Part 11 with a reference to 42 C.F.R. Part 84 to incorporate the most updated NIOSH regulation for testing and certifying respirators. According to EPA, most manufacturers and processors are already subject to and complying with 42 C.F.R. Part 84. EPA states that this change will apply to all previously issued SNURs that contain significant new use requirements pertaining to respiratory protection by clarifying that manufacturers and processors subject to current SNURs can follow updated respiratory protection requirements without triggering a significant new use notice (SNUN) requirement. EPA will include the updated language in the issuance of new SNURs "as appropriate."

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Read More

B&C, 10-08-22

<https://www.jdsupra.com/legalnews/epa-amends-snur-regulations-to-protect-6687999/>

The EPA Has Identified 23 U.S. Facilities Whose Toxic Air Pollution Puts People at Risk

2022-08-04

Following reporting by ProPublica and The Texas Tribune and attention from the EPA inspector general, the agency announced plans to “inform and engage” communities about elevated cancer risk from ethylene oxide. It should have done so years ago.

The U.S. Environmental Protection Agency on Wednesday announced plans to “engage and inform” nearly two dozen communities across the country where air pollution from commercial sterilizer plants has significantly increased lifetime cancer risks for nearby residents. The facilities use a toxic gas called ethylene oxide to sanitize medical and dental equipment and fumigate certain food products. The announcement comes after the EPA’s inspector general and news publications including ProPublica and The Texas Tribune highlighted the agency’s yearslong failure to inform communities of their risks.

Read More

ProPublica, 04-08-22

<https://www.propublica.org/article/epa-toxic-air-pollution-response>

Medical sterilizing facilities face growing scrutiny due to toxic gas concerns

2022-08-10

Southern California air regulators are investigating several facilities that sterilize medical equipment with a carcinogenic gas after preliminary monitoring confirmed their emissions may pose an elevated cancer risk to people who work nearby.

After months of screening for chemical emissions near large commercial sterilizers in Los Angeles and San Bernardino counties, the South Coast Air Quality Management District has issued several violation notices for

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improperly handling ethylene oxide (EtO), a colorless and odorless gas used to sterilize 50% of the country’s medical supplies.

“Ethylene oxide is an exceptionally good compound at sterilizing these kinds of equipment,” said Dr. Cyrus Rangan, director of the Bureau of Toxicology and Environmental Assessment at the Los Angeles County Department of Public Health. “The downside of it is that ethylene oxide is also a pretty powerful chemical. It’s got some carcinogenic properties. It’s one of a handful of chemicals where there’s pretty good evidence of a link to human cancer with prolonged exposure.”

Read More

Medical Xpress, 10-08-22

<https://medicalxpress.com/news/2022-08-medical-sterilizing-facilities-scrutiny-due.html>

EUROPE

Placing manufactured products on the market in Great Britain

2022-08-10

What you need to do to comply with regulations on manufactured products you place on the market in Great Britain.

Overview

An individual, fully-manufactured product is placed on the market when it’s first made available for distribution, consumption or use on the GB market in the course of a commercial activity, whether in return for payment or free of charge.

This requires an offer or agreement for the transfer of ownership, possession, or any other property right of an individual product, after the stage of manufacture is complete.

‘Placing a product on the market’ refers to individual products and not a type of product. It does not require the physical transfer of the product.

You can usually provide proof of placing on the market on the basis of any relevant document ordinarily used in business transactions, including:

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- contracts of sale concerning goods which have already been manufactured and meet the legal requirements
- invoices
- documents concerning the shipping of goods for distribution

Read More

Gov.uk, 10-08-22

<https://www.gov.uk/guidance/placing-manufactured-goods-on-the-market-in-great-britain>

NGO coalition launches campaign on food packaging

2022-08-08

Billed as “a one-stop shop for policymakers, advocates, and consumers,” in July 2022, Zero Waste Europe, CHEMTrust, and HEAL launched a new website for their Toxic Free Food Packaging campaign. The website provides a hub for information and resources about harmful chemicals in food contact materials (FCMs). It also includes products from the Food Packaging Forum such as the brand and retailer initiatives database (BRID), food contact chemicals database (FCCdb), and database on migrating and extractable food contact chemicals (FCCmigex). Moreover, it provides updates on the revision of European Union (EU) FCM legislation and recommendations on how citizens can call for toxic-free food packaging.

In May 2022, researchers from the German consumer organization Verbraucherzentrale Bundesverband (VZBV) reported consumers are concerned about food packaging safety while having little understanding of chemicals in packaging and assuming all FCMs and their components have been tested for safety (FPF reported). In reality, recent analysis by the European Environmental Bureau found that it can take the EU 20 years to remove a single harmful chemical from the market after it has been introduced (FPF reported).

Read More

Food Packaging Forum, 08-08-22

<https://www.foodpackagingforum.org/news/ngo-coalition-launches-campaign-on-food-packaging>

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Plastics policy in the UK needs clarity and reform

2022-08-02

On July 13, 2022, Greenpeace and Everyday Plastic, published results from The Big Plastic Count, a national voluntary plastic waste audit of nearly 100,000 UK homes. They found “on average, each household threw away 66 pieces of plastic packaging in one week... [and] if the totals for count week are assumed to be typical, this indicates that UK households are throwing away an estimated 1.85 billion pieces a week, or 96.57 billion pieces a year.” Food and drink packaging made up 83% of the 66 pieces with produce packaging and snack wrappers being the two most common items.

Greenpeace and Everyday Plastic asked the UK government to (i) set a target “to almost entirely eliminate single-use plastic in 15 years” with mandates for corporate plastic reporting and an interim target of 50% reduction by 2025; (ii) ban plastic waste exports; (iii) implement deposit return schemes and extended producer responsibility schemes (EPR) for drinks containers that are consistent across the UK; and (iv) “set an immediate moratorium on new incineration capacity.”

When information from The Big Plastic Count is combined with data from the recycling charity RECOUP about what types of plastic are recycled at what rates in the UK, the report authors found only 12% of plastic gets recycled within the UK. Another 17% is exported where it is often marketed as being recycled. However, the investigative reporting from Bloomberg in March 2022 found that the ultimate fate of exported plastic is questionable.

Read More

Food Packaging Forum, 02-08-22

<https://www.foodpackagingforum.org/news/plastics-policy-in-the-uk-needs-clarity-and-reform>

EU strategy for sustainable and circular textiles

2022-08-10

Textiles are the fabric of everyday life - in clothes and furniture, medical and protective equipment, buildings and vehicles. However, urgent action is needed as their impact on the environment continues to grow. EU consumption of textiles has, on average, the fourth highest impact on the environment and climate change, after food, housing and mobility. It is also the third highest area of consumption for water and land use,

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and fifth highest for the use of primary raw materials and greenhouse gas emissions.

By looking at the entire lifecycle of textile products and proposing actions to change how we produce and consume textiles, the Strategy presents a new approach, addressing these issues in a harmonised manner.

Objectives

The strategy aims to create a greener, more competitive sector that is more resistant to global shocks. The Commission's 2030 Vision for Textiles is that

- all textile products placed on the EU market are durable, repairable and recyclable, to a great extent made of recycled fibres, free of hazardous substances, produced in respect of social rights and the environment
- "fast fashion is out of fashion" and consumers benefit longer from high quality affordable textiles
- profitable re-use and repair services widely available
- the textiles sector is competitive, resilient and innovative with producers taking responsibility for their products along the value chain with sufficient capacities for recycling and minimal incineration and landfilling

Read More

European Commission, 10-08-22

https://environment.ec.europa.eu/strategy/textiles-strategy_en

INTERNATIONAL

Rainwater everywhere unsafe to drink due to chemicals: study

2022-08-10

Rainwater everywhere on the planet is unsafe to drink due to levels of toxic chemicals known as PFAS that exceed the latest guidelines, according to a new study by Stockholm University scientists. Commonly known as 'forever chemicals' because they disintegrate extremely slowly, PFAS (per- and polyfluoroalkyl substances) were initially found in packaging, shampoo or makeup but have spread to our entire environment, including water and air. "There is nowhere on Earth where the rain would be safe to drink, according to the measurements that we have taken," Ian Cousins, a

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professor at the university and the lead author of the study published in Environmental Science and Technology, told AFP.

Read More

The Jakarta Post, 10-08-22

<https://www.thejakartapost.com/world/2022/08/10/rainwater-everywhere-unsafe-to-drink-due-to-chemicals-study.html>

Research defines PFAS planetary boundary and calculates human health costs

2022-08-03

In a perspective article published on August 2, 2022, in the journal Environmental Science & Technology, Ian T. Cousins and co-authors from Stockholm University and ETH Zurich, hypothesized that per- and polyfluoroalkyl (PFAS) in the environment represent a planetary boundary that has now been exceeded. To test their hypothesis, Cousins et al. compared levels of PFAS measured in rainwater, surface water, and soils with guideline values. Specifically, they looked at the perfluoroalkyl acids (PFAAs), including perfluorooctanesulfonic acid (PFOS), perfluorooctanoic acid (PFOA), perfluorohexane-sulfonic acid (PFHxS), and perfluorononanoic acid (PFNA).

Based on the calculations for these four PFAA, Cousins and co-authors concluded that "PFAS define a new planetary boundary that has been exceeded, based on PFAS levels in environmental media being ubiquitously above guideline levels." For instance, concentrations of PFOA and PFOS measured in rainwater are often higher than US Environmental Protection Agency (EPA) Lifetime Drinking Water Health Advisory levels which are 0.004 ng/L for PFOA and 0.020 ng/L for PFOS. Notably, even in remote areas such as the Tibetan Plateau PFOA rainwater concentrations exceed that limit by approximately 14 times.

Read More

Food Packaging Forum, 03-08-22

<https://www.foodpackagingforum.org/news/research-defines-pfas-planetary-boundary-and-calculates-human-health-costs>

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REACH Update

AUG. 19, 2022

Cancer-causing PAHs further restricted in rubber granules

2022-08-10

From today, the concentration limit of eight polycyclic aromatic hydrocarbons (PAHs) in rubber granules and mulches used as infill on sports pitches and playgrounds has been reduced to 20 mg/kg.

The new, lower limit will ensure the safety of people - especially children - playing on these fields.

The restriction will not affect existing fields immediately but will ensure that any infill material used for refilling the fields is below the new limit.

The restriction was proposed by The Netherlands in July 2018 and adopted by the European Commission in July 2021.

[Read More](#)

ECHA Weekly, 10-08-22

https://echa.europa.eu/view-article/-/journal_content/title/9109026-203

Updated intention to identify substances of very high concern

2022-08-10

The intention for perfluoroheptanoic acid and its salts has been updated (EC -, CAS -).

Assessment of substance group published

A new report is now available for Chlorinated trialkylphosphates.

To get a full list of the substances covered in this group you can filter the list by group name from the following website. Similarly you can search there if your substances are covered in any assessment of regulatory needs.

Call for evidence: skin sensitising substances in consumer mixtures

France, Ireland and Germany are requesting interested parties to submit information related to skin sensitising substances in consumer mixtures. The information gathered will be used to assess the need for regulatory actions on skin sensitisers in consumer mixtures.

The deadline for comments is 30 September 2022.

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REACH Update

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For clarifications, contact the German competent authority.

Reminder: Consultations on proposed restriction of lead in outdoor shooting and fishing

There are currently two consultations ongoing for the proposed restriction of lead in outdoor shooting on fishing. We are looking for comments and scientific evidence on:

- the draft opinion of the Committee for Socio-Economic Analysis (SEAC). The deadline to give comments is 29 August 2022.
- two European Food Safety Authority (EFSA) datasets used by ECHA to assess the risks to human health from the use of lead in ammunition. The deadline to give comments is 6 October 2022.

[Read More](#)

ECHA Weekly, 10-08-22

https://echa.europa.eu/view-article/-/journal_content/title/9109026-203

Consultations on harmonised classification and labelling

2022-08-10

We are looking for comments on proposals for:

- 3-isocyanatomethyl-3,5,5-trimethylcyclohexyl isocyanate; isophorone di-isocyanate (EC 223-861-6, CAS 4098-71-9);
- folpet (ISO); N-(trichloromethylthio)phthalimide (EC 205-088-6, CAS 133-07-3; index number 613-045-00-1);
- 9-Octadecenoic acid (Z)-, sulfonated, potassium salts [1]; Reaction products of fatty acids, C18 (unsaturated) alkyl with sulfur trioxide, potassium salts [2]; 9(or 10)-sulphooctadecanoic acid, potassium salt [3] (EC 271-843-1 [1], - [2]; 267-966-5 [3]; CAS 68609-93-8 [1], - [2]; 67968-63-2 [3]);
- captan (ISO); 1,2,3,6-tetrahydro-N-(trichloromethylthio)phthalimide (EC 205-087-0, CAS 133-06-2); and
- 2-bromo-2-(bromomethyl)pentanedinitrile; [DBDCB] (EC 252-681-0, CAS 35691-65-7).

The deadline is 7 October 2022.

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REACH Update

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ECHA Weekly, 10-08-22

https://echa.europa.eu/view-article/-/journal_content/title/9109026-203

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Janet's Corner

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Periodic Table Changes

2022-08-19

CHANGES I WOULD MAKE TO THE PERIODIC TABLE

H	He											TBD	B	C	N	O	F	Ne																													
Li	Be											TBD	Al	Si	P	S	Cl	Ar																													
So	Mg	Ca	Sc	Ti	Tx	Cr	Mn	Fe	Co	Ni	Cu	Zn	Ga	Ge	As	Se	Br	Kr																													
Pm	Rb	Sr	Y	Zr	Nb	Mo	Tc	Ru	Rh	Pd	Sv	Cd	Cix	Tn	Cix	Cix	Io	Xe																													
Cs	Ba	La	Hf	Ta	Tg	Re	Os	Ir	Pt	Gd	Hg	Cix	Bd	Cix	Pb	At	Rn																														
Fr	Ra	Ac	Rf	Db	Sg	Bh	Hs	Mt	Ds	Rg	Cn	Nh	Fl	Mc	Lv	Ts	Og																														
<p>NEDDYMIUM CAN STAY - MAGNETS ARE COOL. THAT W ANNOYS ME</p> <p>MOVE</p> <p>INSERTING THE LANTHANIDES AND ACTINIDES PROPERLY MAKES THE TABLE TOO WIDE. TRIAGE IS NEEDED. EACH ELEMENT WILL BE OFFERED FREE TRAINING TO HELP ADJUST TO ITS NEW COLUMN.</p> <p>34% OF ALL ELEMENTS ARE NAMED AFTER YTTTERBY, SWEDEN (POP. 3,000) LET'S KEEP YTTTRIUM, BUT RENAME THE OTHER 3 AFTER BIGGER CITIES (TOKYIUM, DELHIUM, AND JAKARTAUM?) TO BE MORE FAIR.</p>																																															
		<table border="1"> <tr> <td>M</td> <td>M</td> <td>Nd</td> <td>Pm</td> <td>Sm</td> <td>Eu</td> <td>Gm</td> <td>Ty</td> <td>Dy</td> <td>Ho</td> <td>Dh</td> <td>Tm</td> <td>Jk</td> <td>Lu</td> </tr> <tr> <td>Th</td> <td>Pa</td> <td>U</td> <td>Np</td> <td>Pu</td> <td>Am</td> <td>Cm</td> <td>Bk</td> <td>Cf</td> <td colspan="5"></td> </tr> </table>																M	M	Nd	Pm	Sm	Eu	Gm	Ty	Dy	Ho	Dh	Tm	Jk	Lu	Th	Pa	U	Np	Pu	Am	Cm	Bk	Cf							
M	M	Nd	Pm	Sm	Eu	Gm	Ty	Dy	Ho	Dh	Tm	Jk	Lu																																		
Th	Pa	U	Np	Pu	Am	Cm	Bk	Cf																																							

<https://xkcd.com/2639/>

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Hazard Alert

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Cresols

2022-08-19

Cresols are organic compounds with the molecular formula C_7H_8O . They are a widely occurring natural and manufactured group of aromatic organic compounds, which are categorised as phenols (sometimes called phenolics). Depending on the temperature, cresols can be solid or liquid because they have melting points not far from room temperature. Like other types of phenols, they are slowly oxidised by long exposure to air and the impurities often give cresols a yellowish to brownish red tint. Cresols have an odour characteristic to that of other simple phenols, reminiscent to some of a "coal tar" smell. The name creosol reflects their structure, being phenols, and their traditional source, creosote. [1] There are three forms of cresols that differ slightly in their chemical structure: ortho-cresol (o-cresol), meta-cresol (m-cresol), and para-cresol (p-cresol). These forms occur separately or as a mixture. [2]

USES [2,3]

Mixed cresols are used as disinfectants, preservatives, and wood preservatives. o-Cresol is used as a solvent, disinfectant, and chemical intermediate. m-Cresol is used to produce certain herbicides, as a precursor to the pyrethroid insecticides, to produce antioxidants, and to manufacture the explosive, 2,4,6-nitro-m-cresol. p-Cresol is used largely in the formulation of antioxidants and in the fragrance and dye industries. Cresols may be formed normally in the body from other compounds. Cresols are found in many foods and in wood and tobacco smoke, crude oil, coal tar, and in chemical mixtures used as wood preservatives.

In the Environment [2]

In air, cresols quickly break down into other chemicals. They evaporate slowly from soil and water surfaces, but can be quickly degraded by bacteria. Cresols does not attach strongly to soils; therefore, they may move into groundwater below the soil surface. They may last longer in deep groundwater or water that does not have bacteria. In soil, half the total amount of cresols will break down in about a week. Cresols do not seem to accumulate in fish or other organisms.

Cresols are organic compounds with the molecular formula C_7H_8O .

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SOURCES & ROUTES OF EXPOSURE

Sources of Exposure [4]

Air—primary source of exposure	The primary way you can be exposed to cresols is by breathing air containing them. Releases of cresols into the air occur from: <ul style="list-style-type: none"> • industries using or manufacturing cresols • automobile exhaust • cigarette smoke • wood and trash burning
Water	Cresols have been detected in surface waters and groundwater, but generally at low levels (approximately 1 microgram per litre [$\mu\text{g/L}$] or less). Higher levels have been detected: <ul style="list-style-type: none"> • where petroleum spills have occurred • near hazardous waste sites • in industrial effluents
Workplace	A large number of workers are potentially exposed to cresols. Potential exposures occur in: <ul style="list-style-type: none"> • manufacture of cresols • chemical laboratories • coal gasification facilities • paint and varnish application • application of insulation lacquers to copper wires • wood-preserving facilities Exposure may occur through breathing and dermal contact with contaminated air and/or liquid cresols or products containing cresols.
Food	Low levels of cresols have been found in some foods such as tomatoes, tomato ketchup, asparagus, cheeses, butter, bacon, and smoked foods. Some drinks also contain cresols (coffee, black tea, wine, Scotch whisky, brandy, and rum).

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Air—primary source of exposure	The primary way you can be exposed to cresols is by breathing air containing them. Releases of cresols into the air occur from: <ul style="list-style-type: none"> • industries using or manufacturing cresols • automobile exhaust • cigarette smoke • wood and trash burning
Consumer products	Exposure may occur through accidental or intentional ingestion or contact of the skin with cleaners or disinfectants containing cresols.

Routes of Exposure [5]

Cresols may cause adverse health effects following exposure via:

- Inhalation
- Ingestion
- Eye Contact
- Dermal Contact

HEALTH EFFECTS [3]**Acute Effects**

Acute inhalation exposure by humans to mixed cresols results in respiratory tract irritation, with symptoms such as dryness, nasal constriction, and throat irritation. Mixed cresols are also strong dermal irritants. Ingestion of high levels of mixed cresols by humans has resulted in effects on the respiratory system, gastrointestinal system, blood, liver, kidney, and CNS. Animal studies have reported respiratory tract and eye irritation, and effects on the liver, kidney, and CNS from acute inhalation exposure to mixed cresols. Acute animal tests in rats have shown mixed cresols to have moderate acute toxicity, while o-cresol, m-cresol, and p-cresol have been shown to have high acute toxicity from oral exposure.

Chronic Effects

No information is available on the chronic effects of mixed cresols in humans. Animal studies have reported effects on the blood, liver, kidney, and CNS, as well as reduced body weight, from oral and inhalation exposure to mixed cresols. EPA has not established a Reference Concentration (RfC) or a Reference Dose (RfD) for mixed cresols. The

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California Environmental Protection Agency (CalEPA) has established a chronic reference exposure level of 0.004 milligrams per cubic metre (mg/m³) for mixed cresols based on bone marrow effects in rats. EPA has not established an RfC for o-, m-, or p-cresol. The RfD for o-cresol and m-cresol is 0.05 milligrams per kilogram body weight per day (mg/kg/d) based on decreased body weights and neurotoxicity in rats. The provisional RfD for p-cresol is 0.005 mg/kg/d based on neurological and respiratory effects in rabbits. The provisional RfD is a value that has had some form of Agency review, but it does not appear on IRIS.

Reproductive/Developmental Effects

No information is available on the reproductive or developmental effects of mixed cresols in humans. Animal studies have reported developmental effects, but only at maternally toxic doses, and no reproductive effects from oral exposure to mixed cresols.

Cancer Risk

Only anecdotal information is available on the carcinogenic effects of mixed cresols in humans. The only available oral animal study is a 13-week study that suggested that p-cresol may act as a promoter for tumours of the forestomach. Several dermal animal studies have suggested that o-cresol, m-cresol, and p-cresol may act as tumour promoters. EPA has classified o-cresol, m-cresol, and p-cresol as Group C, possible human carcinogens.

SAFETY [6]**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. Do not use an eye ointment. Seek medical attention.
- Skin Contact: If the chemical got onto the clothed portion of the body, remove the contaminated clothes as quickly as possible, protecting your own hands and body. Place the victim under a deluge shower. If the chemical got on the victim's exposed skin, such as the hands : Gently and thoroughly wash the contaminated skin with running water and non-abrasive soap. Be particularly careful to clean folds, crevices, creases and groin. Cold water may be used. If irritation persists, seek medical attention. Wash contaminated clothing before reusing.

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- **Serious Skin Contact:** Wash with a disinfectant soap and cover the contaminated skin with an anti-bacterial cream. Seek immediate medical attention.
- **Inhalation:** Allow the victim to rest in a well-ventilated area. Seek immediate medical attention.
- **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:** Do not induce vomiting. Examine the lips and mouth to ascertain whether the tissues are damaged, a possible indication that the toxic material was ingested; the absence of such signs, however, is not conclusive. Loosen tight clothing such as a collar, tie, belt or waistband. If the victim is not breathing, perform mouth-to-mouth resuscitation. Seek immediate medical attention.

Exposure Controls & Personal Protection

Engineering Controls

Provide exhaust ventilation or other engineering controls to keep the airborne concentrations of vapours below their respective threshold limit value. Ensure that eyewash stations and safety showers are proximal to the workstation location.

Personal Protective Equipment

The following personal protective equipment is recommended when handling cresols:

- 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;

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- 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

United States [7]

OSHA: The Occupational Safety & Health Administration has set the following Permissible Exposure Limit (PEL) for cresols:

- General Industry: 29 CFR 1910.1000 Table Z-1 - 5 ppm, 22 mg/m³ TWA; Skin
- Construction Industry: 29 CFR 1926.55 Appendix A - 5 ppm, 22 mg/m³ TWA; Skin
- Maritime: 29 CFR 1915.1000 Table Z-Shipyards - 5 ppm, 22 mg/m³ TWA; Skin

ACGIH: The American Conference of Governmental Industrial Hygienists has set a Threshold Limit Value (TLV) FOR CRESOLS OF 5 ppm, 22 mg/m³ TWA; Skin

NIOSH: The National Institute for Occupational Safety and Health (NIOSH) has set a Recommended Exposure Limit (REL) for cresols of 2.3 ppm, 10 mg/m³ TWA

Australia [8]

Safe Work Australia: Safe Work Australia has established a Time Weighted Average (TWA) concentration for cresol of 5ppm and 22mg/m³ for an 8-hour workday.

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Scientists create first full map of human immune system connectivity

2022-08-05

By using advanced screening methods to tune into the communications taking place between individual cells, scientists have produced the first full connectivity map of the human immune system. This new wiring diagram will help researchers better understand the way different disease such as cancer progress, and work towards next-generation treatments that fortify the body's defenses against them.

The breakthrough stems from new understanding of the signaling that takes place between different immune cells. Some of these patrol the body looking for signs of injury or disease, and then send messages to other immune cells to join the fight. One form of this communication takes place through proteins on surface of immune cells, which bind to receptor proteins on the surfaces of other cells.

Some of these receptor connections were already known to science, but researchers at the Wellcome Sanger Institute and ETH Zurich have been working to establish a more comprehensive diagram of them throughout the body. The achievement, which is decades in the making and only possible through recent technological advances, involved a technique called high-throughput surface receptor screening. This enabled the team to systematically map immune cell protein interactions on an unprecedented scale.

"Meticulously isolating and analyzing every immune cell and their interactions with others has given us the first map of the conversations between all of the immune cells in the human body," said Jarrod Shilts, first author from the Wellcome Sanger Institute. "This is a huge step in understanding the inner workings of the immune system and will hopefully be utilized by researchers all around the world to help develop new therapies that work with the body's defense mechanisms."

This wiring diagram details how immune cells connect and communicate throughout the body and includes previously unknown interactions. This offers valuable new insights into the way the body organizes its immune defenses, and may help efforts to develop treatments that increase their ability to fight disease, with immunotherapy for cancer a prime example.

"Immunotherapies work with the body's immune system to combat diseases such as cancer and autoimmunity," said Professor Gavin Wright, senior author. "They can be incredibly effective in certain groups of

"This is a huge step in understanding the inner workings of the immune system and will hopefully be utilized by researchers all around the world!"

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people, but not all, leaving some people without treatment. Our research, a culmination of over two decades of work, could hold the key to understanding why these treatments are more effective in some groups, and how they could be adapted to ensure that as many people as possible can benefit from them.”

Further, the map could offer a blueprint for the prevention and treatment of autoimmune diseases, in which a person’s immune system misinterprets signals and attacks their own body. An ability to observe the impacts of different disease on the immune system in fine detail and tailor new treatments to target specific surface protein shapes up as a powerful new weapon in the realm of medical science.

“This research has produced an incredible new tool that can be used to help highlight which proteins and pathways would be beneficial to target in drug development,” said Professor Berend Snijder. “It can also give insight into whether a drug will have impact on other pathways, which can cause side effects. All of this information may help in the development of new therapies and could give crucial supporting evidence to help ensure that the most effective treatments are put into clinical trials.”

The research was published in the journal Nature.

New Atlas, 5 August 2022

<https://newatlas.com>

Weevils in caves, fish, and an ant that ‘babysits’ caterpillars among 139 new species classified by CSIRO

2022-08-09

The CSIRO has released details of more than 136 new species of animals and three plants identified in the past year.

The new species include four fish, 117 insects, 11 jumping spiders, three plants, a frog, a millipede, an earthworm, and a marine trematode — a parasitic flatworm.

The trematode was found inside a fish.

Now called *Enenterum petrae*, it was named after the baby daughter of its identifier, Petra.

With only about 25 percent of Australia’s species known to science, scientific names are vital for researchers, governments and the community to better understand the nation’s vast ecosystems.

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David Yeates, director of the CSIRO’s Australian National Insect Collection, said choosing a favourite out of the newly identified species was a bit like being asked to “choose a favourite child”.

However, he said one of the most interesting is a species of ant — now known as *Anonychomyrma inclinata* — which “babysits” the caterpillars from one of Australia’s rarest butterflies, the bulloak jewel butterfly.

“The ants carry the little caterpillars out from under the bark of the bulloak tree to feed on the soft tips of the leaves or needles at night; they carry them out and then back,” Dr Yeates said.

It’s a symbiotic relationship, where the ants protect the caterpillars from other ants, and get something in return, he said.

“The ants feed on a sugary substance that the caterpillars produce from glands. The ants get this nice sugary secretion and the butterflies get protection.”

As well as it being a fascinating strategy, that knowledge helps to direct efforts to conserve the bulloak jewel butterfly.

“When we’re trying to manage that rare and beautiful butterfly, we know it only occurs where that ant occurs in that particular [species of] tree.”

With only an estimated 25 per cent of Australian species having been formally identified, this work highlights the important role that the CSIRO’s National Research Collections perform, according to Dr Yeates.

Australian fauna — especially insects — is still poorly researched compared with fauna in most other developed countries.

“That’s an important point for Australians to understand. Australia is still the land of discovery.

“We have a first world economy, good infrastructure, but we drive past new species all the time.

“For a biologist to come here from Europe or China for example, they think it’s the land of milk and honey, because there are so many new species for them to work on.”

Other species in today’s haul include the purple-tip anthias, which has been found in waters between about 110 and 119 metres deep, off southeast Queensland.

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Of the newly named fish species, three were types of anthias, and the fourth was a silverspot weedfish.

Most new fish species that are being classified are small, non-commercially viable species that tend to live in deep water where they are rarely encountered.

While that appears to be the trend, Dr Yeates said a few years ago a large, deepwater cod species was discovered at a fish market.

Of the newly discovered insects, 34 were beetles, including two new weevils found in the lava tubes at Undara Volcanic national park in Far North Queensland.

The two weevil species are the first cave-dwelling weevils to be described in Australia, according to the CSIRO.

The weevils have long, arachnid-like legs, are blind, and appear to have adapted to life in the darkness.

It's possible that the two species, called *Undarobius howarthi* and *U. irvini* are relics from a period when the region was covered in rainforest.

Not all the insects identified by CSIRO and their partners were from Australia; 39 were species of gall wasps from the Americas.

Gall wasps typically cause grotesque growths to form on plants, and can create problems if they become invasive pests, such as the native citrus gall wasp, which has spread across Australia.

How do scientists know if it is a new species?

One of the many challenges in identifying new species, is working out whether you in fact have a new animal, or just a funny looking, but known one.

Animals and plants can develop different physical properties, known as phenotypic expression, depending on pressures in their particular environment.

The Tasmanian blue gum for example, can reach 100 metres in height in Tasmania's forests, but stunted versions of the same species just a few metres tall are found on the coast.

Other species may change markedly depending on gender, and what stage of life they are at.

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Which is why it's important to have large collections such as the Australian National Research Collection.

Having lots of species in one place allows scientists to compare features to properly distinguish between their characteristics.

Even then, very specific expertise is required to work out where the animal or plants sits in its phylogenetic tree.

"What happens is that specimens that belong to new species accumulate in collections, and it's a fair bit of effort to figure out if they're new or not," Dr Yeates said.

"It can take quite a bit of time and effort, including looking at their genes and genomes to determine if they really are different."

It's likely that many species will become extinct in Australia, or have already become extinct, before we've had a chance to identify them.

Figuring out what's what, means we can better understand where conservation efforts need to be targeted, according to Dr Yeates.

"We can start to get information on how to manage it, whether it's declining, and what factors might impact its survival."

ABC News, 9 August 2022

<https://abc.net.au>

Artificial finger able to identify surface material with 90% accuracy

2022-08-08

A team of researchers at the Chinese Academy of Sciences, has developed an artificial finger that was able to identify certain surface materials with 90% accuracy. In their paper published in the journal *Science Advances*, the group describes how they used triboelectric sensors to give their test finger an ability to gain a sense of touch.

Prior research has led to the development of robotic fingers that have the ability to recognize certain attributes of certain surfaces, such as pressure or temperature—the team with this new effort, have taken such efforts further by adding the ability to identify a material that is being touched.

The finger was created by applying small square sensors to the tip of a finger-shaped object. Each of the squares was made of a different kind of

The researchers also tested the finger for endurance by having it touch a surface thousands of times and found that it held up well enough for industrial applications.

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plastic polymer, each chosen because of their unique electrical properties. When such sensors are moved close to an object, such as a flat surface, electrons from the sensors interact with the materials in unique ways.

The sensors beneath the polymer were all connected to their own processors inside of the finger, which were then connected together to allow for comparison of results and for machine learning-based data analysis. The researchers also attached a tiny LCD screen for displaying results. The researchers then tested their finger by having it touch various flat surfaces such as those made of glass, wood, plastic and silicon. They found it capable of detecting the right material on average 96.8% of the time, with a minimum accuracy of 90% for all of the surfaces. The researchers also tested the finger for endurance by having it touch a surface thousands of times and found that it held up well enough for industrial applications.

The researchers suggest that if their finger were to be used in an industrial setting it could be connected directly to a control mechanism. They also suggest it could be used to test products to ensure they meet manufacturing standards. And they also note that such a finger could also be used on a full-sized human robot, adding to its capabilities. They point out that the technology behind their finger could likely be used in prosthetic devices to help restore a certain degree of touch for people who have lost such an ability.

Tech Xplore, 8 August 2022

<https://techxplore.com>

More than half of human pathogenic diseases can be aggravated by climate change

2022-08-08

More than half of known human pathogenic diseases such as dengue, hepatitis, pneumonia, malaria, Zika and more, can be aggravated by climate change. That eye-opening and startling finding is the topic of a research paper published on August 8 in Nature Climate Change by a team of researchers from the University of Hawai'i at Mānoa.

The researchers carried out a systemic search for empirical examples about the impacts of 10 climatic hazards sensitive to greenhouse gas (GHG) emissions on each known human pathogenic disease. These hazards included warming, drought, heatwaves, wildfires, extreme precipitation,

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floods, storms, sea level rise, ocean biogeochemical change, and land cover change.

Combining two authoritative lists of all known infections and pathogenic diseases that have affected humanity in recorded history, researchers then reviewed over 70,000 scientific papers for empirical examples about each possible combination of a climatic hazard impacting each of the known diseases.

The research revealed that warming, precipitation, floods, drought, storm, land cover change, ocean climate change, fires, heatwaves and sea level changes were all found to influence diseases triggered by viruses, bacteria, animals, fungi, protozoans, plants and chromists. Pathogenic diseases were primarily transmitted by vectors, although case examples were also found for transmission pathways involving waterborne, airborne, direct contact and foodborne. Ultimately, the research found that more than 58%, or 218 out of 375, of known human pathogenic diseases had been affected at some point by at least one climatic hazard via 1,006 unique pathways.

"Given the extensive and pervasive consequences of the COVID 19 pandemic, it was truly scary to discover the massive health vulnerability resulting as a consequence of greenhouse gas emissions," said Camilo Mora, geography professor in the College of Social Sciences (CSS) and lead author of the study. "There are just too many diseases, and pathways of transmission, for us to think that we can truly adapt to climate change. It highlights the urgent need to reduce greenhouse gas emissions globally."

An interactive web-page showing each connection between a climatic hazard and a disease case was developed by the research team. The tool allows users to query specific hazards, pathways and disease groups, and see the available evidence.

The UH Mānoa research team included experts from CSS, Department of Earth Sciences in the School of Ocean and Earth Science and Technology (SOEST), Marine Biology Graduate Program in the School of Life Sciences, Department of Natural Resources and Environmental Management in the College of Tropical Agriculture and Human Resources (CTAHR), and Hawai'i Institute of Marine Biology in SOEST.

Key findings include:

- Climatic hazards are bringing pathogens closer to people. Numerous climatic hazards are increasing the area and duration of environmental

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suitability facilitating the expansion of vectors and pathogens. Warming and precipitation changes, for instance, were associated with range expansion of vectors such as mosquitoes, ticks, fleas, birds and several mammals implicated in outbreaks by viruses, bacteria, animals and protozoans, including dengue, chikungunya, plague, Lyme disease, West Nile virus, Zika, trypanosomiasis, echinococcosis and malaria.

- Climatic hazards are bringing people closer to pathogens. Climatic hazards were implicated with the forced displacement and migration of people, causing or increasing new contacts with pathogens. Storms, floods and sea level rise, for example, caused human displacements implicated in cases of leptospirosis, cryptosporidiosis, Lassa fever, giardiasis, gastroenteritis, Legionnaires' diseases, cholera, salmonellosis, shigellosis, pneumonia, typhoid, hepatitis, respiratory disease and skin diseases.
- Climatic hazards have enhanced specific aspects of pathogens, including improved climate suitability for reproduction, acceleration of the life cycle, increasing seasons/length of likely exposure, enhancing pathogen vector interactions (e.g., by shortening incubations) and increased virulence. Warming, for instance, had positive effects on mosquito population development, survival, biting rates and viral replication, increasing the transmission efficiency of West Nile virus.
- Climatic hazards have also diminished human capacity to cope with pathogens by altering body condition; adding stress from exposure to hazardous conditions; forcing people into unsafe conditions; and damaging infrastructure, forcing exposure to pathogens and/or reducing access to medical care. For example, drought was conducive to poor sanitation responsible for cases of trachoma, chlamydia, cholera, conjunctivitis, Cryptosporidium, diarrheal diseases, dysentery, Escherichia coli, Giardia, Salmonella, scabies and typhoid fever.

Researchers also found that, while the great majority of diseases were aggravated by climatic hazards, some were diminished (63 out of 286 diseases). Warming, for example, appears to have reduced the spread of viral diseases probably related to unsuitable conditions for the virus or because of a stronger immune system in warmer conditions. However, most diseases that were diminished by at least one hazard were at times aggravated by another and sometimes even the same hazard.

"We knew that climate change can affect human pathogenic diseases," said co-author Kira Webster, CSS geography Ph.D. student. "Yet, as our database grew, we became both fascinated and distressed by the overwhelming

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number of available case studies that already show how vulnerable we are becoming to our ongoing growing emissions of greenhouse gases."

Phys Org, 8 August 2022

<https://phys.org>

Prehistoric podiatry: How dinos carried their enormous weight

2022-08-10

Scientists have cracked an enduring mystery, discovering how sauropod dinosaurs—like Brontosaurus and Diplodocus—supported their gigantic bodies on land.

A University of Queensland and Monash University-led team used 3D modeling and engineering methods to digitally reconstruct and test the function of foot bones of different sauropods.

Dr. Andréas Jannel conducted the research during his Ph.D. studies at UQ's Dinosaur Lab and said the team found that the hind feet of sauropod had a soft tissue pad beneath the "heel," cushioning the foot to absorb their immense weight.

"We've finally confirmed a long-suspected idea and we provide, for the first time, biomechanical evidence that a soft tissue pad—particularly in their back feet—would have played a crucial role in reducing locomotor pressures and bone stresses," Dr. Jannel said.

"It is mind-blowing to imagine that these giant creatures could have been able to support their own weight on land."

Sauropods were the largest terrestrial animals that roamed the Earth for more than 100 million years.

They were first thought to have been semi-aquatic with water buoyancy supporting their massive weight, a theory disproved by the discovery of sauropod tracks in terrestrial deposits in the mid-twentieth century.

Monash University's Dr. Olga Panagiotopoulou said it had also been thought sauropods had feet similar to a modern-day elephant.

"Popular culture—think Jurassic Park or Walking with Dinosaurs—often depicts these behemoths with almost-cylindrical, thick, elephant-like feet," Dr. Panagiotopoulou said.

The sauropods had soft tissue pads to absorb their enormous weight and enable them to walk on land.

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"But when it comes to their skeletal structure, elephants are actually 'tip-toed' on all four feet, whereas sauropods have different foot configurations in their front and back feet.

"Sauropod's front feet are more columnar-like, while they present more 'wedge high heels' at the back supported by a large soft tissue pad."

UQ's Associate Professor Steve Salisbury said this was because sauropods and elephants had different evolutionary origins.

"Elephants belong to an ancient order of mammals called proboscideans, which first appeared in Africa roughly 60 million years ago as small, nondescript herbivores," Associate Professor Salisbury said.

"In contrast, sauropods—whose ancestors first appeared 230 million years ago—are more closely related to birds.

"They were agile, two-legged herbivores and it was only later in their evolution that they walked on all fours.

"Crucially, the transition to becoming the largest land animals to walk the earth seems to have involved the adaptation of a heel pad."

The researchers now plan to use the 3D modeling and engineering methods to make further discoveries.

"I'm keen to apply a similar method to an entire limb and to include additional soft tissue such as muscles, which are rarely preserved in fossils," Dr. Jannel said.

"We're also excited to study the limbs and feet of other prehistoric animals.

"This should allow us to answer different questions about the biomechanics of extinct animals and better understand their environmental adaptations, movement and lifestyle."

The study is published in Science Advances.

Phys Org, 10 August 2022

<https://phys.org>

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3D-printable 5-metal alloy proves ultra-strong but ductile

2022-08-10

With new manufacturing techniques comes the opportunity for brand new metal alloys with a huge range of possible properties. A team of researchers has now developed a new 3D-printable alloy with a specific nanostructure that makes it ultra strong and ductile.

Most common alloys, like stainless steel or bronze, are made with one primary metal mixed with smaller amounts of other elements. But an emerging class of materials known as high entropy alloys (HEAs) involves mixing five different elements together in roughly equal proportions. The resulting alloys end up with intriguing and useful properties, like high strength-to-weight ratios and stiffness that rises with the temperature.

The new study focuses on a HEA containing aluminum, cobalt, chromium, iron and nickel in equal measures. This particular mix has been experimented with for a few years now, but the team made it using a technique that hadn't been applied to it yet – laser powder bed fusion. Essentially, powdered forms of the original metals are laid out on a surface, then blasted with a high-powered laser that causes them to rapidly melt and resolidify.

This technique, a form of 3D printing, gives the final alloy a very different microstructure than it gets from other manufacturing methods. The team describes it as looking like a net, with alternating layers of different cubic crystalline structures. This gives the HEA a yield strength of around 1.3 Gigapascals, almost three times stronger than when it's made using conventional casting methods. At the same time, it's also more ductile, countering a common trade-off.

"This unusual microstructure's atomic rearrangement gives rise to ultrahigh strength as well as enhanced ductility, which is uncommon, because usually strong materials tend to be brittle," said Wen Chen, lead researcher on the study. "For many applications, a combination of strength and ductility is key. Our findings are original and exciting for materials science and engineering alike."

This specific combination of strength and ductility could make this alloy useful for components in aerospace, energy, transportation or other engineering fields.

This technique, a form of 3D printing, gives the final alloy a very different microstructure than it gets from other manufacturing methods.

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The research was published in the journal Nature.

New Atlas, 10 August 2022

<https://newatlas.com>

Potential long-term treatment for asthma found

2022-08-09

A possible way to tackle one of the underlying causes of asthma has been developed by researchers from Aston University and Imperial College London. In tests in mice, the researchers were able to virtually eliminate asthmatic symptoms within two weeks and return their airways to near normal.

Just under 5.5 million people in the U.K. receive treatment for asthma and around 1,200 people die of the disease each year.

Asthma causes the airways to become thickened and constricted, resulting in symptoms such as wheezing and shortness of breath.

Current treatments, including steroids, provide short term relief from these symptoms, by either relaxing the airways or reducing inflammation. However, no current drugs address the structural changes asthma makes to the airway and lungs, in order to offer a longer-lasting treatment.

Lead researcher, Dr. Jill Johnson, from Aston University's School of Biosciences, says that "by targeting the changes in the airway directly, we hope this approach could eventually offer a more permanent and effective treatment than those already available, particularly for severe asthmatics who don't respond to steroids. However, our work is still at an early stage and further research is needed before we can begin to test this in people."

The research focused on a type of stem cell known as a pericyte, which is mainly found in the lining of blood vessels. When asthmatics have an allergic and inflammatory reaction, for example to house dust mites, this causes the pericytes to move to the airway walls. Once there, the pericytes develop into muscle cells and other cells that make the airway thicker and less flexible.

This movement of the pericytes is triggered by a protein known as CXCL12. The researchers used a molecule called LIT-927 to block the signal from this protein, by introducing it into the mice's nasal passages. Asthmatic mice that were treated with LIT-927 had a reduction in symptoms within one week and their symptoms virtually disappeared

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within two weeks. The researchers also found that the airway walls in mice treated with LIT-927 were much thinner than those in untreated mice, closer to those of healthy controls.

The team are now applying for further funding to carry out more research into dosage and timing, This would help them to determine when might be the most effective time to administer the treatment during the progress of the disease, how much of LIT-927 is needed, and to better understand its impact on lung function. They believe that, should this research be successful, it will still be several years before the treatment could be tested in people.

The study is published in Respiratory Research.

Medical Xpress, 9 August 2022

<https://medicalxpress.com>

15 years of experiments have overturned a major assumption about how thirsty plants actually are

2022-08-09

Have you ever wondered just how much water plants need to grow, or indeed why they need it? Plants lose a lot of water when they take in carbon dioxide from the atmosphere, so they need up to 300 grams of water to make each gram of dry plant matter.

But it doesn't have to be that way. In a new paper published in Nature Plants, we report on a natural secret that could ultimately be used to help plants thrive while using less water.

An essential ingredient for plant growth

Plants are mostly made up of water – about 80% by weight. So we might expect plants would need around four grams of water for each gram of dry mass to achieve their ideal level of hydration.

That may be so, but they need a lot more water to grow. To produce one gram of new dry mass, a plant needs about 300 grams of water.

Why such a large difference between the amount of water required for hydration and the amount required for growth? Because almost all the water plants take up from the soil through their roots soon rises out into the atmosphere through their leaves.

Plant leaves are covered in microscopic valves called stomata. Stomata open to let in carbon dioxide from the air, which plants need for photosynthesis and growth.

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Plant leaves are covered in microscopic valves called stomata. Stomata open to let in carbon dioxide from the air, which plants need for photosynthesis and growth.

But when the stomata are open, the moist internal tissue of the leaf is exposed to the drier outside air. This means water vapour can leak out whenever the stomata are open.

A long-held assumption

Plant scientists have long assumed the opening and closing of the stomata almost entirely controlled the amount of water evaporating from a leaf. This is because we assumed the air in small pockets inside the leaves was fully saturated with water vapour (another way to say this is that the “relative humidity” is 100%, or very close to it).

If the air inside the leaf is saturated and the air outside is drier, the opening of the stomata controls how much water diffuses out of the leaf. The result is that large quantities of water vapour come out of the leaf for each molecule of carbon dioxide that comes in.

Why did we assume the air inside the leaves has a relative humidity near 100%? Partly because water moves from more saturated places to less saturated places, so we thought cells inside leaves could not sustain their hydration if exposed directly to air with relative humidity much lower than 100%.

But we also made this assumption because we had no method of directly measuring the relative humidity of the air inside leaves. (A recently developed “hydrogel nanoreporter” that can be injected into leaves to measure humidity may improve this situation.)

A secret revealed

However, in a series of experiments over the past 15 years, we have accumulated evidence that this assumption is not correct. When air outside the leaf was dry, we observed that the relative humidity in the air spaces inside leaves routinely dropped well below 100%, sometimes as low as 80%.

What is most remarkable about these observations is that photosynthesis did not stop or even slow down when the relative humidity inside the leaves declined. This means the rate of water loss from the leaves stayed constant, even as the air outside increased its “evaporative demand”

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(a measure of the drying capacity or “thirstiness” of air, based on temperature, humidity and other factors).

If the leaves restricted their loss of water only by closing their stomata, we would expect to see photosynthesis slowing down or stopping. So it appears plants can effectively control water loss from their leaves while stomata remain open, allowing carbon dioxide to continue diffusing into the leaf to support photosynthesis.

Using water wisely

We think plants are controlling the movement of water using special “water-gating” proteins called aquaporins, which reside in the membranes of cells inside the leaf.

Our next experiments will test whether aquaporins are indeed the mechanism behind the behaviour that we observed. If we can thoroughly understand this mechanism, it may be possible to target its activity, and ultimately provide agriculturalists with plants that use water more efficiently.

Over the coming decades, global warming will make the atmosphere increasingly thirsty for evaporated water. We are pleased to report that nature may yet reveal secrets that can be harnessed to boost plant production with limited water resources.

The Conversation, 9 August 2022

<https://theconversation.com>

New gene therapy could prevent genetic hearing loss

2022-08-11

Researchers at the Salk Institute have made a breakthrough that could lead to new treatments for genetic hearing loss. Gene therapy that delivers a particular protein can ensure faulty hair cells grow correctly, allowing for improved hearing.

Sensory hair cells are a vital part of our auditory system. They line the surface of the cochlea with long structures called stereocilia, which vibrate in response to sound waves and produce electrical signals that are then sent to the brain. But one form of genetic deafness arises due to a lack of a protein called EPS8, which regulates the length of these hair cells. Without it, they’re too short to work properly.

One form of genetic deafness arises due to a lack of a protein called EPS8, which regulates the length of these hair cells. Without it, they’re too short to work properly.

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For the new study, the researchers investigated whether restoring EPS8 could help those hair cells grow to their normal length and improve hearing. Working in mice that had been engineered to lack EPS8 and, as such, were deaf, the team then experimented with using an adeno-associated virus as a vehicle to deliver the protein to the animals' inner ears.

And sure enough, they found that the added EPS8 made the stereocilia grow longer, restoring some function to the cells that pick up lower frequency sounds.

However, there are some caveats. The treatment didn't work in mice after a certain age, suggesting it's important to get in early before the hair cells mature. In humans, that would require applying the gene therapy in utero, since by birth it would already be too late. But the team hopes that with further study, that window for treatment could be widened.

"EPS8 is a protein with many different functions, and we still have a lot more to uncover about it," said Uri Manor, co-senior author of the study. "I am committed to continuing to study hearing loss and am optimistic that our work can help lead to gene therapies that restore hearing."

Other teams have found promise in restoring hearing through gene therapy by targeting other genes. That includes regrowing either inner or outer hair cells, correcting mutations that cause them to become disorganized, or repairing age-related damage to other structures.

The new research was published in the journal *Molecular Therapy – Methods & Clinical Development*.

New Atlas, 11 August 2022

<https://newatlas.com>

New antibiotic molecule kills dozens of the toughest types of superbugs

2022-08-10

Bacteria are fast developing resistance to our best drugs, leaving us poised on the edge of a major health crisis. But a new antibiotic has shown promise against several key "superbugs," while minimizing damage against good bacteria in the body.

Bacteria are a textbook example of evolution in action. When they face environmental hazards – such as antibiotics – only the strongest survive

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to replicate, meaning that eventually the entire population has the ability to resist drugs. A class known as gram-negative bacteria are particularly problematic, defending themselves with thicker cell walls and molecular pumps that reject drugs.

Development progress on new antibiotics and other treatments has slowed right down. As such, we're rapidly running out of effective antibiotics, which threatens to return us to a "dark age of medicine" where once-minor infections become lethal again.

Scientists on the new study have now developed a novel antibiotic candidate that shows promise. The team started with an existing antibiotic that's effective against gram-positive bacteria, and adapted it with a series of structural modifications to try to make it stronger against gram-negative strains.

One of the modified compounds in particular stood out. Named fabimycin, the drug candidate worked well against more than 200 clinically isolated colonies of antibiotic-resistant bacteria, comprising a total of 54 strains of bugs like *E. coli*, *Klebsiella pneumoniae* and *Acinetobacter baumannii*. In tests in mice, fabimycin was found to clear up drug-resistant cases of pneumonia or urinary tract infections, reducing the bacteria levels even lower than they were pre-infection.

Importantly, fabimycin was relatively selective in its attack, leaving some types of harmless bacteria intact. That's an improvement over many existing antibiotics that are known to indiscriminately wipe out many beneficial bugs in the microbiome, leading to a range of adverse side effects.

Further development could eventually add fabimycin or similar molecules to our arsenal against superbugs, particularly those hard-to-treat infections.

The research was published in the journal *ACS Central Science*.

New Atlas, 10 August 2022

<https://newatlas.com>

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Graphene oxide membranes reveal unusual behaviour of water at the nanoscale

2022-08-05

Do more pores in a sieve allow more liquid to flow through it? As material scientists have uncovered, this seemingly simple question may have an unexpected answer at the nanoscale—and it could have important implications in the development of water filtration, energy storage and hydrogen production.

Researchers from UNSW Sydney, University of Duisburg-Essen (Germany), GANIL (France) and Toyota Technological Institute (Japan) experimenting with Graphene Oxide (GO) membranes have discovered the opposite can occur at the nanoscopic level. The research, published in *Nano Letters*, shows the chemical environment of the sieve and the surface tension of the liquid play a surprisingly important role in permeability.

The researchers observed that a density of pores doesn't necessarily lead to higher water permeability—in other words, having more tiny holes doesn't always allow water to flow through at the nanoscale. The study, supported by the European Union and Humboldt Research Foundation funding, shines new light on the mechanisms that govern water flow through GO membranes.

"If you create more and more holes in a sieve, you expect it to become more permeable to water. But surprisingly, that is the opposite of what happened in our experiments with graphene oxide membranes," says Associate Professor Rakesh Joshi, senior author of the study from the School of Materials Science & Engineering, UNSW Science.

Altering the chemical environment

GO is an extremely thin form of carbon that has shown promise as a material for water purification. The chemical compound is made up of a single layer of carbon atoms with oxygen and hydrogen atoms attached. If you imagine scattering LEGO bricks on your floor—the floor would be the carbon atoms, and the oxygen and hydrogen atoms would be the LEGO bricks.

In chemistry, molecules can have what's known as "functional groups" that are either hydrophobic (water repelling) or hydrophilic (water-attracting). The pores in graphene can also be hydrophobic or hydrophilic

"Surprisingly, more important for the water flux (flow of water through a membrane) isn't the number of pores, but whether the pores are

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hydrophobic or hydrophilic," says Tobias Foller, UNSW Scientia Ph.D. candidate and lead author of the study. "That's very unexpected as the GO layers are only one atom thick. One expects the water to just pass through the pores, no matter if they attract or repel water."

Despite the presence of many tiny holes in the GO filters used in the research, they exhibited a complete blockage of water in the case of hydrophobic pores.

"With filters, you usually expect more water flow with more holes. But in our case, where we have more holes, water flow is lower, and that's due to the chemical nature of the graphene oxide holes which are in this case water-repelling," says Prof. Marika Schleberger, a co-author of the study from Duisburg, Germany.

Unusual effects of surface tension

The researchers also say surface tension also contributes to the water interaction with the GO pores. Surface tension arises because molecules, like water, want to stick together. When confined in a sufficiently small space, the bonds between water (cohesion) and surrounding solid surfaces (adhesive force) can act to move the water. This explains how trees can overcome gravity to take water from their roots, up their capillaries, to their leaves.

In GO membranes—where the "capillaries" in this case are pores made at the scale of 1 millionth of a millimeter or less—the very forces that allow water to climb tree capillaries prevent it from flowing through membrane pores.

"When you confine water in the smallest possible capillaries—just the size of a few atoms—the water molecules attract themselves so much they form a tight network. Undisturbed, this network is so strong that it doesn't allow the molecules to be released and pass through the sieve, even if you increase the number of pores," says Mr. Foller.

Ultrafine sieves made of different materials have a diverse range of applications. The researchers say their findings will help scientists fine-tune liquid transport in atomic sieves and could advance developments like highly precise water filtration systems.

"By understanding which parameters will increase or decrease water flux, we can optimize many possible applications of graphene oxide for water purification, energy storage, hydrogen production and more," Mr. Foller says. "We hope other engineers and scientists can use this new knowledge

Surface tension contributes to the unusual interaction of water with the nanoscopic graphene oxide pores.

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to improve their own devices, and lead to new developments in the future.”

Phys Org, 5 August 2022

<https://phys.org>

The length of Earth's days has been mysteriously increasing, and scientists don't know why

2022-08-05

Atomic clocks, combined with precise astronomical measurements, have revealed that the length of a day is suddenly getting longer, and scientists don't know why.

This has critical impacts not just on our timekeeping, but also things like GPS and other technologies that govern our modern life.

Over the past few decades, Earth's rotation around its axis – which determines how long a day is – has been speeding up. This trend has been making our days shorter; in fact, in June 2022 we set a record for the shortest day over the past half a century or so.

But despite this record, since 2020 that steady speedup has curiously switched to a slowdown – days are getting longer again, and the reason is so far a mystery.

While the clocks in our phones indicate there are exactly 24 hours in a day, the actual time it takes for Earth to complete a single rotation varies ever so slightly. These changes occur over periods of millions of years to almost instantly – even earthquakes and storm events can play a role.

It turns out a day is very rarely exactly the magic number of 86,400 seconds.

The ever-changing planet

Over millions of years, Earth's rotation has been slowing down due to friction effects associated with the tides driven by the Moon. That process adds about about 2.3 milliseconds to the length of each day every century. A few billion years ago an Earth day was only about 19 hours.

For the past 20,000 years, another process has been working in the opposite direction, speeding up Earth's rotation. When the last ice age ended, melting polar ice sheets reduced surface pressure, and Earth's mantle started steadily moving toward the poles.

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Just as a ballet dancer spins faster as they bring their arms toward their body – the axis around which they spin – so our planet's spin rate increases when this mass of mantle moves closer to Earth's axis. And this process shortens each day by about 0.6 milliseconds each century.

Over decades and longer, the connection between Earth's interior and surface comes into play too. Major earthquakes can change the length of day, although normally by small amounts. For example, the Great Tōhoku Earthquake of 2011 in Japan, with a magnitude of 8.9, is believed to have sped up Earth's rotation by a relatively tiny 1.8 microseconds.

Apart from these large-scale changes, over shorter periods weather and climate also have important impacts on Earth's rotation, causing variations in both directions.

The fortnightly and monthly tidal cycles move mass around the planet, causing changes in the length of day by up to a millisecond in either direction. We can see tidal variations in length-of-day records over periods as long as 18.6 years. The movement of our atmosphere has a particularly strong effect, and ocean currents also play a role. Seasonal snow cover and rainfall, or groundwater extraction, alter things further.

Why is Earth suddenly slowing down?

Since the 1960s, when operators of radio telescopes around the planet started to devise techniques to simultaneously observe cosmic objects like quasars, we have had very precise estimates of Earth's rate of rotation.

A comparison between these estimates and an atomic clock has revealed a seemingly ever-shortening length of day over the past few years.

But there's a surprising reveal once we take away the rotation speed fluctuations we know happen due to the tides and seasonal effects. Despite Earth reaching its shortest day on June 29 2022, the long-term trajectory seems to have shifted from shortening to lengthening since 2020. This change is unprecedented over the past 50 years.

The reason for this change is not clear. It could be due to changes in weather systems, with back-to-back La Niña events, although these have occurred before. It could be increased melting of the ice sheets, although those have not deviated hugely from their steady rate of melt in recent years. Could it be related to the huge volcano explosion in Tonga injecting huge amounts of water into the atmosphere? Probably not, given that occurred in January 2022.

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Scientists have speculated this recent, mysterious change in the planet's rotational speed is related to a phenomenon called the "Chandler wobble" – a small deviation in Earth's rotation axis with a period of about 430 days. Observations from radio telescopes also show that the wobble has diminished in recent years; the two may be linked.

One final possibility, which we think is plausible, is that nothing specific has changed inside or around Earth. It could just be long-term tidal effects working in parallel with other periodic processes to produce a temporary change in Earth's rotation rate.

Do we need a 'negative leap second'?

Precisely understanding Earth's rotation rate is crucial for a host of applications – navigation systems such as GPS wouldn't work without it. Also, every few years timekeepers insert leap seconds into our official timescales to make sure they don't drift out of sync with our planet.

If Earth were to shift to even longer days, we may need to incorporate a "negative leap second" – this would be unprecedented, and may break the internet.

The need for negative leap seconds is regarded as unlikely right now. For now, we can welcome the news that – at least for a while – we all have a few extra milliseconds each day.

The Conversation, 5 August 2022

<https://theconversation.com>

Do spiders sleep? Study suggests they may snooze like humans

2022-08-08

It's a question that keeps some scientists awake at night: Do spiders sleep?

Daniela Roessler and her colleagues trained cameras on baby jumping spiders at night to find out. The footage showed patterns that looked a lot like sleep cycles: The spiders' legs twitched and parts of their eyes flickered.

The researchers described this pattern as a "REM sleep-like state." In humans, REM, or rapid eye movement, is an active phase of sleep when parts of the brain light up with activity and is closely linked with dreaming.

Other animals, including some birds and mammals, have been shown to experience REM sleep. But creatures like the jumping spider haven't

The study finds that some spiders show resting patterns that look like REM sleep.

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gotten as much attention so it wasn't known if they got the same kind of sleep, said Roessler, an evolutionary biologist at the University of Konstanz in Germany.

Their findings were published Monday in the journal Proceedings of the National Academy of Sciences.

Roessler and her team dug into the sleep question after she discovered the spiders hanging at night from threads of silk in their lab containers. She had recently scooped up some jumping spiders to study, a common species with a furry brown body and four pairs of big eyes.

"It was just the most unusual thing I've ever seen," Roessler said of the suspended spiders.

The research showed the spiders' overnight movements looked a lot like REM in other species, she said—like dogs or cats twitching in their sleep. And they happened in regular cycles, similar to sleep patterns in humans.

Many species similar to spiders actually don't have movable eyes, which makes it hard to compare their sleep cycles, explained study co-author Paul Shamble, an evolutionary biologist at Harvard University.

But these jumping spiders are predators that move their retinas around to change their gaze while they hunt, Shamble said. Plus, the young spiders have a see-through outer layer that gives a clear window into their bodies.

"Sometimes as a biologist, you just get really, really lucky," Shamble said.

The researchers still have to figure out if the spiders are technically sleeping while they're in these resting states, Roessler said. That includes testing whether they respond more slowly—or not at all—to triggers that would normally set them off.

Critters like the jumping spider are very far from humans on the evolutionary tree. Jerry Siegel, a sleep researcher who was not involved with the study, said he's doubtful that the spiders can really experience REM sleep.

"There may be animals that have activity in quiet states," said Siegel, of the UCLA Center for Sleep Research. "But are they REM sleep? It's hard to imagine that they could be the same thing."

But Barrett Klein, an entomologist at the University of Wisconsin-La Crosse who was also not involved with the study, said it was exciting to find REM-like signs in such a distant relative. Many questions remain about how

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widespread REM sleep is and what purpose it might serve for species, he said.

REM sleep is “still very much a black box,” Klein said.

Phys Org, 8 August 2022

<https://phys.org>

Brain volume study reveals anti-aging potential of taking the stairs

2022-08-04

Although we generally understand exercise to be good for us in all sorts of ways, scientists continue to make interesting inroads around the specifics of this relationship. The latest comes from a team in Germany which has found that even slight changes to regular physical activity, such as taking the stairs instead of the elevator, can counter the age-related loss of volume in brain regions linked to disease.

Research has demonstrated how exercise can help combat some of the effects of aging. This includes studies showing that regular physical activity can preserve the heart's elasticity, reduce mild cognitive impairment and induce hormones that protect against Alzheimer's and dementia. Scientists at the German Center for Neurodegenerative Diseases (DZNE) have looked to add to this growing body of evidence, by looking at exercise's impacts on specific regions of the brain.

“In previous research, the brain was usually considered as a whole,” says Fabienne Fox, lead author of the study. “Our goal was to take a more detailed look at the brain and find out which regions of the brain physical activity impacts most.”

To do so, the scientists tapped into data from a population-based study of more than 2,500 subjects aged 30 to 94. This involved analyzing brain volume and thickness of the cortex through MRIs and assessing their physical activity, with the subjects made to wear an accelerometer on their thigh for seven days.

“We were able to show that physical activity had a noticeable effect on almost all brain regions investigated,” said Fox. “Generally, we can say that the higher and more intense the physical activity, the larger the brain regions were, either with regard to volume or cortical thickness. In particular, we observed this in the hippocampus, which is considered the

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control center of memory. Larger brain volumes provide better protection against neurodegeneration than smaller ones.”

Those that stand to benefit most may be inactive older adults. The scientists found that the largest, and almost sudden, volume increases were observed when comparing inactive subjects over 70 with moderately active ones.

“In principle, this is very good news – especially for those who are reluctant to exercise,” says study author Ahmad Aziz. “Our study results indicate that even small behavioral changes, such as walking 15 minutes a day or taking the stairs instead of the elevator, may have a substantial positive effect on the brain and potentially counteract age-related loss of brain matter and the development of neurodegenerative diseases. In particular, older adults can already profit from modest increases of low intensity physical activity.”

Genetic analysis of brain regions most impacted by uptake in physical activity indicated that they are home to high amounts of mitochondria, which provide our body with energy but need a lot of oxygen to do so.

“Compared to other brain regions, this requires increased blood flow,” said Aziz. “This is ensured particularly well during physical activity, which could explain why these brain regions benefit from exercise.”

The analysis also revealed a large overlap in genes impacted by physical activity and those impacted by diseases such as Alzheimer's and Parkinson's. This offers a possible explanation for the protective benefits of exercise against these types of conditions.

“With our results, we want to provide a further impetus to become more physically active – to promote brain health and prevent neurodegenerative diseases,” said Fox. “Even modest physical activity can help. Thus, it's just a small effort – but with a big impact.”

The research was published in the journal *Neurology*.

New Atlas, 4 August 2022

<https://newatlas.com>

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Backyard hens' eggs in Australia contain 40 times more lead on average than shop eggs, research finds

2022-08-09

There's nothing like the fresh eggs from your own hens, the more than 400,000 Australians who keep backyard chooks will tell you. Unfortunately, it's often not just freshness and flavor that set their eggs apart from those in the shops.

Our research, newly published in *Environmental Pollution*, found backyard hens' eggs contain, on average, more than 40 times the lead levels of commercially produced eggs. Almost one in two hens in our Sydney study had significant lead levels in their blood. Similarly, about half the eggs analyzed contained lead at levels that may pose a health concern for consumers.

Even low levels of lead exposure are considered harmful to human health, including among other effects cardiovascular disease and decreased IQ and kidney function. Indeed, the World Health Organization has stated there is no safe level of lead exposure.

So how do you know whether this is a likely problem in the eggs you're getting from backyard hens? It depends on lead levels in your soil, which vary across our cities. We mapped the areas of high and low risk for hens and their eggs in our biggest cities—Sydney, Melbourne and Brisbane—and present these maps here.

Our research details lead poisoning of backyard chickens and explains what this means for urban gardening and food production. In older homes close to city centers, contaminated soils can greatly increase people's exposure to lead through eating eggs from backyard hens.

What did the study find?

Most lead gets into the hens as they scratch in the dirt and peck food from the ground.

We assessed trace metal contamination in backyard chickens and their eggs from garden soils across 55 Sydney homes. We also explored other possible sources of contamination such as animal drinking water and chicken feed.

Our data confirmed what we had anticipated from our analysis of more than 25,000 garden samples from Australia gardens collected via the VegeSafe program. Lead is the contaminant of most concern.

The World Health Organization has stated there is no safe level of lead exposure.

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The amount of lead in the soil was significantly associated with lead concentrations in chicken blood and eggs. We found potential contamination from drinking water and commercial feed supplies in some samples but it is not a significant source of exposure.

Unlike for humans, there are no guidelines for blood lead levels for chickens or other birds. Veterinary assessments and research indicate levels of 20 micrograms per deciliter ($\mu\text{g}/\text{dL}$) or more may harm their health. Our analysis of 69 backyard chickens across the 55 participants' homes showed 45% had blood lead levels above $20\mu\text{g}/\text{dL}$.

We analyzed eggs from the same birds. There are no food standards for trace metals in eggs in Australia or globally. However, in the 19th Australian Total Diet Study, lead levels were less than $5\mu\text{g}/\text{kg}$ in a small sample of shop-bought eggs.

The average level of lead in eggs from the backyard chickens in our study was $301\mu\text{g}/\text{kg}$. By comparison, it was $7.2\mu\text{g}/\text{kg}$ in the nine commercial free-range eggs we analyzed.

International research indicates that eating one egg a day with a lead level of less than $100\mu\text{g}/\text{kg}$ would result in an estimated blood lead increase of less than $1\mu\text{g}/\text{dL}$ in children. That's around the level found in Australian children not living in areas affected by lead mines or smelters. The level of concern used in Australia for investigating exposure sources is $5\mu\text{g}/\text{dL}$.

Some 51% of the eggs we analyzed exceeded the $100\mu\text{g}/\text{kg}$ "food safety" threshold. To keep egg lead below $100\mu\text{g}/\text{kg}$, our modeling of the relationship between lead in soil, chickens and eggs showed soil lead needs to be under $117\text{mg}/\text{kg}$. This is much lower than the Australian residential guideline for soils of $300\text{mg}/\text{kg}$.

To protect chicken health and keep their blood lead below $20\mu\text{g}/\text{kg}$, soil concentrations need to be under $166\text{mg}/\text{kg}$. Again, this is much lower than the guideline.

How did we map the risks across cities?

We used our garden soil trace metal database (more than 7,000 homes and 25,000 samples) to map the locations in Sydney, Brisbane and Melbourne most at risk from high lead values.

Deeper analysis of the data showed older homes were much more likely to have high lead levels across soils, chickens and their eggs. This finding matches other studies that found older homes are most at risk of legacy

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contamination from the former use of lead-based paints, leaded petrol and lead pipes.

What can backyard producers do about it?

These findings will come as a shock to many people who have turned to backyard food production. It has been on the rise over the past decade, spurred on recently by soaring grocery prices.

People are turning to home-grown produce for other reasons, too. They want to know where their food came from, enjoy the security of producing food with no added chemicals, and feel the closer connection to nature.

While urban gardening is a hugely important activity and should be encouraged, previous studies of contamination of Australian home garden soils and trace metal uptake into plants show it needs to be undertaken with caution.

Contaminants have built up in soils over the many years of our cities' history. These legacy contaminants can enter our food chain via vegetables, honey bees and chickens.

Urban gardening exposure risks have typically focused on vegetables and fruits. Limited attention has been paid to backyard chickens. The challenge of sampling and finding participants meant many previous studies have been smaller and have not always analyzed all possible exposure routes.

Mapping the risks of contamination in soils enables backyard gardeners and chicken keepers to consider what the findings may mean for them.

Particularly in older, inner-city locations, it would be prudent to get their soils tested. People can do this at VegeSafe or through a commercial laboratory. Soils identified as a problem can be replaced and chickens kept to areas of known clean soil.

Phys Org, 9 August 2022

<https://phys.org>

Making high quality lighting with nanotechnology and...old fish scales?

2022-08-09

You've heard of carbon nanotubes, now get ready for carbon nano-onions. The nanometre-sized particles (made from layers of carbon atoms connected in sheets, hence "onions") are excellent electrical conductors

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and have a bevy of other weird chemical properties, but are largely harmless to people and the environment. This makes them encouraging candidates for new electronics, energy storage, and biomedical technologies.

What's the catch? While carbon nano-onions were first made in 1980, they remained difficult to synthesise. Typically, they need high temperatures, a vacuum, and a lot of time to make – or expensive feedstock and very corrosive acids and bases.

But a team of Japanese researchers has figured out how to make carbon nano-onions in a few seconds – by microwaving fish waste.

Ultimately, the researchers hope their cheap and environmentally friendly method of making carbon nano-onions could be useful in next generation LEDs and QLED displays.

In a paper published in Green Chemistry, the researchers describe a method for synthesising carbon nano-onions (CNOs) from fish scales, which have been extracted from fish waste and cleaned. It's done via a technique called microwave pyrolysis: submitting the scales to microwave radiation.

The researchers aren't exactly sure why this method works. They suspect it's got to do with the collagen in the fish scales, which is an excellent absorber of microwave radiation. The collagen heats up so quickly it triggers pyrolysis: the breaking down of the collagen into gases. These gases then promote the formation of CNOs.

The CNOs made have a couple of impressive chemical properties. They have a high crystallinity (meaning they form ordered and structured patterns when clumped together), and high "functionalisation" (meaning they're bonded to other small molecules on their surface).

The combination of these properties means that the CNOs can do some interesting optical things – like glow bright blue.

"The CNOs exhibit ultra-bright visible-light emission with an efficiency (or quantum yield) of 40%," says co-author Dr Takashi Shirai, an associate professor at the Nagoya Institute of Technology, Japan.

"This value, which has never been achieved before, is about 10 times higher than that of previously reported CNOs synthesised via conventional methods."

Recycling something organic into electronics: apparently it's possible.

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The researchers used this property to make LEDs and blue-light-emitting thin films with their CNOs.

“The stable optical properties could enable us to fabricate large-area emissive flexible films and LED devices,” says Shirai.

“These findings will open up new avenues for the development of next-generation displays and solid-state lighting.”

Cosmos, 9 August 2022

<https://cosmosmagazine.com>

How complex is your life? Computer scientists found a way to measure it

2022-08-10

Nobel laureate economist Richard Thaler famously quipped:

People aren't dumb, the world is hard.

Indeed, we routinely encounter problems in our everyday lives that feel complex – from choosing the best electricity plan, to deciding how to effectively spend our money.

Australian pay hundreds of millions of dollars each year to comparison websites and consumer-focused groups such as CHOICE to help them make decisions about products and services.

But how can we objectively measure how “complex” our decisions really are? Our recently published research offers one potential way to do this, by drawing on concepts from computer and systems science.

Why bother measuring complexity?

There are several factors when it comes to measuring complexity in any scenario. For instance, there may be a number of options to choose from and each option may have several different features to consider.

Suppose you want to buy jam. This will be easy if there are only two flavours available, but difficult if there are dozens. Yet choosing an electricity plan would be much harder even with just two options.

In other words, you can't isolate one particular factor when trying to determine the complexity of something. You have to consider the problem as a whole – and this requires a lot more work.

In practical terms, being able to gauge the complexity of a wide range of tasks could help provide people with the necessary support they need to tackle these tasks day-to-day.

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The ability to accurately measure complexity could have a wide range of practical applications, including informing the design of:

- regulation on how complex products should be
- easy to navigate digital systems including websites, apps and smart device programs
- easy to understand products. These may be financial products (superannuation and insurance plans, credit card schemes), physical products (devices) or virtual products (software)
- artificial intelligence (AI) that offers advice when problems are too complex for humans. For example, a scheduler AI may let you book meetings yourself, before jumping in to suggest optimal meeting times and locations based on your history.

How we study human decision-making

Computer science can help us solve problems: information goes in and one (or more) solutions come out. However, the amount of computation needed for this can vary a lot, depending on the problem.

We and our colleagues used a precise mathematical framework, called “computational complexity theory”, that quantifies how much computation is needed to solve any given problem.

The idea behind it is to measure the amount of computational resources (such as time or memory) a computer algorithm needs when problem-solving. The more time or memory it needs, the more complex the problem is.

Once this is established, problems can be categorised into “classes” based on their complexity.

In our work, we were particularly interested in how complexity (as determined through computational complexity theory) corresponds with the actual amount of effort people must put into solving certain problems.

We wanted to know whether computational complexity theory could accurately predict how much humans would struggle in a certain situation and how accurate their problem-solving would be.

Testing our hypothesis

We focused on three types of experimental tasks, for which you can see examples below. All of these task types sit within a broader class of complex problems called “NP-complete” problems.

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Each task type requires a different ability to perform well in. Specifically:

- “satisfiability” tasks require abstract logic
- “travelling salesperson” tasks require spatial navigation skills and
- “knapsack” tasks require arithmetic.

All three are ubiquitous in real life and reflect day-to-day problems such as software testing (satisfiability), planning a road trip (travelling salesperson), and shopping or investing (knapsack).

We recruited 67 people, split them into three groups, and made each group solve between 64-72 different variations of one of the three types of task.

We also used computational complexity theory and computer algorithms to figure out which tasks were “high complexity” for a computer, before comparing these with the results from our human problem solvers.

We expected – assuming computational complexity theory is congruent with how real people solve problems – that our participants would spend more time on tasks identified as being “high complexity” for a computer. We also expected lower problem-solving accuracy on these tasks.

In both cases that’s exactly what we found. On average, people did twice as well on the lowest complexity cases compared to the highest complexity cases.

Computer science can measure ‘complexity’ for humans

Our results suggest effort alone is not enough to ensure someone does well on a complex problem. Some problems will be hard no matter what – and these are the spaces in which advanced decision aids and AI can shine.

In practical terms, being able to gauge the complexity of a wide range of tasks could help provide people with the necessary support they need to tackle these tasks day-to-day.

The most important result was that our computational complexity theory-based predictions about which tasks humans would find harder were consistent across all three types of task – despite each requiring different abilities to solve.

Moreover, if we can predict how hard humans will find tasks within these three problems, then it should be able to do the same for the more than 3,000 other NP-complete problems.

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These include similarly common hurdles such as task scheduling, shopping, circuit design and gameplay.

Now, to put research into practice

While our results are exciting, there’s still a long way to go. For one, our research used quick and abstract tasks in a controlled laboratory environment. These tasks can model real-life choices, but they’re not representative of actual real-life choices.

The next step is to apply similar techniques to tasks that more closely resemble real-life choices. For instance, can we use computational complexity theory to measure the complexity of choosing between different credit cards?

Progress in this space could help us unlock new ways to aid people in making better choices, every day, across various facets of life.

The Conversation, 10 August 2022

<https://theconversation.com>

Nearby star’s midlife crisis illuminates the future of our own Sun

2022-08-10

Soon after European astronomers developed the first telescopes at the start of the 17th century, they observed dark spots speckling the Sun’s surface. They also handed their modern successors a mystery. From about 1645 to 1715, the spots, now known to be indicators of solar activity, all but disappeared. Gathering sunspot counts and other historical observations, astronomer John Eddy concluded nearly 50 years ago that the Sun had essentially taken a 70-year nap, which he called the Maunder Minimum after an astronomer couple who had previously studied it.

Now, it appears the Sun is not the only star that takes long naps. By building a decades-long record of observations of a few dozen stars at specific wavelengths that trace stellar activity, a team of astronomers has identified another star going through its own Maunder Minimum period. “I am more convinced this is a Maunder Minimum star than anything else I’ve seen,” says Jennifer van Saders, an astronomer at the University of Hawaii, Manoa, who was not involved in the discovery.

The finding, reported in a preprint last month on arXiv, could help explain what triggered the Sun’s strange behavior 400 years ago and suggests

It appears the Sun is not the only star that takes long naps.

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more such episodes are likely. "This is the way to study the past and future of the Sun," van Saders says. She adds the discovery supports a theory she and colleagues have advanced: that such events are an occasional symptom of a critical transition in the magnetic field of Sun-like stars about halfway through their lifetime—a midlife crisis of sorts. Some astronomers speculate that the Sun's transition helped favor the emergence of life on Earth, and that searching for stars in a similar stage could help identify other solar systems conducive to complex life.

Scientists have known for decades that our Sun's activity surges and ebbs on a roughly 11-year cycle, which corresponds to how often its magnetic poles flip their orientation. During a solar maximum, sunspots proliferate, marking weak points in the magnetic field, where plasma from the Sun's atmosphere can lash out in violent loops. Astronomers have spotted young Sun-like stars with similar cycles, and older ones that have totally stable activity. But no one had spotted a cycling star suddenly turning flat.

In 2018, as part of undergraduate research at Pennsylvania State University, University Park, Anna Baum set out to combine observations of the telltale wavelengths from 59 stars taken by the Mount Wilson Observatory and the W. M. Keck Observatory to produce a 50-year chronology of star evolution. During a 7-year gap in data while Keck was upgrading a detector, one star appeared to show a drastic shift. Its activity went from cycling over a 17-year period to being virtually flat, and it's stayed that way for the past 18 years.

Baum thought at first she'd made an error; perhaps the observatories were even looking at two different stars. But earlier this year, her colleagues came across additional observations that filled in the data gap, capturing the star's emissions as it switched from active to quiet. The recovered data set "hit the jackpot," says Jacob Luhn, an astronomer at the University of California, Irvine, and lead author on the preprint.

The discovery reinforces one popular theory about why these extended quiescent periods happen. Stars spin more slowly with age because their solar winds act as "magnetic brakes," like a child sticking out their arms while revolving in a chair. In 2016, van Saders and her colleague Travis Metcalfe of the White Dwarf Research Corporation noticed that at some point, stars stop hitting the brakes and their velocity stabilizes—a shift, they proposed, that stems from a change in the stars' magnetic field. Then, last year, Dibyendu Nandi and colleagues at the Center of Excellence in Space Sciences India pinned down the idea with computer simulations that linked the stabilizing of the spin rate to a weakening magnetic field.

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During this transition, as the star heads toward a "lazy" state in which its activity is flat rather than cycling, random perturbations in its magnetic field can result in temporary cycle shutoffs like the Maunder Minimum, Nandi says.

The theory predicts that this transition state will emerge in middle-aged stars—just like our Sun and this newly identified napping star. "Everything about this discovery has actually corroborated what we've been talking about for the last 5 years," Metcalfe says. "We definitely knew about stars that were not cycling, but we didn't know how they got there—this is like the missing link in that evolutionary picture."

Our Sun's magnetic transition probably began around the same time life on Earth first crawled out of the sea, and that may be no coincidence, Metcalfe suggests. The incoming particles and radiation from active stars damage DNA and promote mutations, speeding evolution. They "may be part of the necessary ingredients to get life started," he says. But at some point, energetic space weather poses a threat to complex life—"like a giant cosmic reset button that's always going off," he adds.

Stars undergoing a transition from cycling to stable could provide the ideal balance of spark and protection to nurture life. "If we're looking for technological civilizations," Metcalfe says, "maybe the best place to look is around stars that are in the second half of [their] lifetimes"—in other words, just entering a midlife crisis.

Science, 10 August 2022

<https://science.org>

Can you actually catch a yawn?

2022-08-11

Is it really possible to catch a yawn? Why do we do it anyway? Weirdly, for such a common behaviour there is still much that science doesn't know about yawns.

But let's explore what science does know...

What exactly is a yawn?

A yawn is an involuntary breathing movement. It involves a jaw gaping wide and a deep, long breath. Then your muscles contract briefly, and then you exhale and shut your mouth.

Why do we yawn and why do we yawn when another person yawns?

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This movement is not unique to people. Animals of all shapes and sizes yawn – not just mammals, but birds, reptiles and fish have all been observed yawning – or at least exhibiting “yawn-like behaviour”. The Siamese fighting fish, for instance, opens its mouth in little bursts that some researchers say are yawns!

In humans, a yawn lasts about 5 or 6 seconds – in other animals it can be shorter or longer. According to a 2021 study in *Communications Biology*, the length of the yawn is linked to brain size. The researchers analysed 1291 yawns from video footage of 101 different mammal and bird species, finding the mammals had an average yawn length of 3.40 seconds, while birds, with a tiny brain, lasted 1.46 seconds on average.

Because it's so widespread, there's probably a good biological reason for yawning. Right?

Why do we yawn?

In fact, we don't yet have a completely solid answer. This is partly because it's kind of hard to test yawns in a clinical setting. They're involuntary, but we all know it's possible to deliberately go through the motions of a yawn and feel similar – or stifle a yawn you feel coming on. And if you know you're supposed to be yawning for science, is that going to affect the way you yawn?

That said, there are still a few hundred studies on yawning. That's not enough to give us bulletproof facts, but it's more than enough to give us some good theories.

One idea is yawning helps to cool the brain. Ambient air is usually cooler than your body, so pulling in a lot of it in a yawn might help to cool you down. The yawn also triggers blood flowing to the brain, which cools the brain further.

Another part of the puzzle is the time of day we yawn most – just before or after sleep. Yawning might play a role in the change from sleepy to alert, or in switching between other mental states.

Another theory suggests that ear pressure could have a role to play – and, of course, seeing someone else yawn might be a trigger.

One popular theory is that yawning increases our blood oxygen. This was actually debunked in a 1987 study, and since then no-one's been able to find much evidence to support the theory.

So whatever yawning is for, it's probably not about getting more oxygen.

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Is it actually contagious?

Given “why we yawn” is a tricky question, you can bet that contagious yawning is even harder to untangle.

But in fact, the contagious yawn effect is so well-established it's often used to induce yawning in yawning studies. So you're not imagining things: people definitely yawn more when they've seen someone else do it.

We're not the only social animal to “catch” a yawn. Playing videos of yawns to apes like chimpanzees, baboons and bonobos makes them yawn more. There's some evidence that dogs yawn in response to humans. Interestingly, a 2009 study in *Animal Cognition* found that dogs don't catch yawns from other dogs.

Even reading or thinking about yawning is likely to induce it: you've likely been yawning a little more while reading this article.

So why is yawning contagious?

There are a few theories for this as well, and nothing completely certain.

A 2010 review in *Neuroscience & Biobehavioral Reviews* lists a few different theories. One element is social: we often use yawning to indicate boredom or tiredness. If you notice someone else in a meeting seems bored, you might start to become disengaged yourself – and not feel as determined to suppress your own yawns.

But we know it goes deeper than that. MRI scans have shown that watching someone else yawn activates regions in the brain linked to imitation, empathy, and social behaviour. But none of this research is conclusive.

Another theory suggests there's an evolutionary advantage to yawning. If one person yawns because they're ready to go to sleep, that indicates to the rest of the group that it's safe to sleep. Alternatively, rousing yawns can enhance a group's vigilance or coordinate behaviour.

We're getting into very speculative territory here. There are likely some social factors to yawning, some biological, and some neurological ones – and some that are a combination.

Cosmos, 11 August 2022

<https://cosmosmagazine.com>

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Mentally exhausted? Study blames buildup of key chemical in brain

2022-08-11

You know the feeling. You've been cramming for a test or presentation all day, when suddenly you can't remember simple things, like what you ate for breakfast, or where exactly Belize is. Now, a study hints at why we get so unraveled after hours of hard mental labor: a toxic buildup of glutamate, the brain's most abundant chemical signal.

The study isn't the first to try to explain cognitive fatigue—and it is bound to stir up controversy, says Jonathan Cohen, a neuroscientist at Princeton University who wasn't involved with the work. Many scientists once thought doing difficult mental tasks used up more energy than easy tasks, exhausting the brain like exercise can do to muscles. Some even suggested drinking a sugary milkshake would make you mentally sharper than an artificially sweetened one, he says. But Cohen and many others in the field are skeptical of such simplistic explanations. "It's all been debunked," he says.

In the new study, researchers looked at whether levels of glutamate are related to behavior that so often manifests when we're mentally exhausted. Seeking easy, immediate gratification, for example, or acting impulsively. Glutamate typically excites neurons, playing key roles in learning and memory, but too much of it can wreak havoc on brain function, causing problems ranging from cell death to seizures.

The scientists used a noninvasive technique called magnetic resonance spectroscopy, which can detect glutamate through a combination of radio waves and powerful magnets. They chose to focus on a brain region called the lateral prefrontal cortex, which helps us stay focused and make plans. When a person becomes mentally exhausted, this region becomes less active.

The researchers divided 39 paid study participants into two groups, assigning one to a series of difficult cognitive tasks that were designed to induce mental exhaustion. In one, participants had to decide whether letters and numbers flashing on a computer screen in quick succession were green or red, uppercase or lowercase, and other variations. In another, volunteers had to remember whether a number matched one they'd seen three characters earlier. The experiment lasted for about 6 hours, with two 10-minute breaks and a simple lunch of a sandwich and

Toxicity of excess glutamate may contribute to cognitive fatigue, but some experts are skeptical.

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piece of fruit. In the second group, people did much easier versions of the same tasks.

As the day dragged on, the researchers repeatedly measured cognitive fatigue by asking participants to make choices that required self-control—deciding to forgo cash that was immediately available so they could earn a larger amount later, for example. The group that had been assigned to more difficult tasks made about 10% more impulsive choices than the group with easier tasks, the researchers observed. At the same time, their glutamate levels rose by about 8% in the lateral prefrontal cortex—a pattern that did not show up in the other group, the scientists report today in *Current Biology*.

"We're still far from the point where we can say that working hard mentally causes a toxic buildup of glutamate in the brain," says the study's first author, Antonius Weihler, a computational psychiatrist at the GHU Paris Psychiatry and Neurosciences. But if it does, it underscores the well-known restorative powers of sleep, which "cleanses" the brain by flushing out metabolic waste. It might be possible to use glutamate levels in the prefrontal cortex to detect severe fatigue and monitor recovery from conditions such as depression or cancer, the team suggests.

Abnormal glutamate signaling occurs in many brain disorders. There are already drugs that target the neuronal receptors for glutamate, including esketamine, a form of the anesthetic ketamine which is used to treat depression, and memantine, which is used to treat the symptoms of Alzheimer's disease. Researchers are also exploring glutamate-based therapies for a number of other disorders, such as schizophrenia and epilepsy.

One important limitation of the study is that the scanners used aren't powerful enough to distinguish between glutamate and another closely related molecule, glutamine, notes Alexander Lin, a clinical spectroscopist at Brigham and Women's Hospital. But the findings "provide the basis for examining how glutamate could potentially be modulated by medications or devices such as neurostimulation," he says.

Sebastian Musslick, a neuroscientist at Brown University, doubts metabolic waste will turn out to be a key contributor to cognitive fatigue. He suspects instead that the uptick in glutamate as the brain tires serves a purpose. The organs in our bodies are in constant communication with our brains, letting us know when we need to eat, sleep, drink water, and go to the bathroom. Maybe the prefrontal cortex's glutamate is sending a similar status update to the brain's internal monitoring system, Musslick suggests.

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For Cohen, the most compelling reason to be skeptical of the idea that waste products play an important role in cognitive fatigue is that it can't explain the human ability to often push through cognitive fatigue, or effortlessly perform demanding computational tasks such as face recognition that require megawatts of energy for computers to perform. To juggle this many demanding tasks, the brain has to have a more sophisticated computational system for allocating effort than the simple buildup or depletion of metabolic byproducts, he says. "It just can't be that easy."

Science, 11 August 2022

<https://science.org>

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Technical Notes

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

CHEMICAL EFFECTS

[Ecotoxicity of Heteroaggregates of Polystyrene Nanospheres in Chironomidae and Amphibian](#)

[DNA Oxidative Damage as a Sensitive Genetic Endpoint to Detect the Genotoxicity Induced by Titanium Dioxide Nanoparticles](#)

[Sublethal Exposure to Cadmium Induces Chemosensory Dysfunction in Fire Ants](#)

ENVIRONMENTAL RESEARCH

[The Path to UVCB Ecological Risk Assessment: Grappling with Substance Characterization](#)

[Endocrine disrupting chemicals in the environment: Environmental sources, biological effects, remediation techniques, and perspective](#)

PHARMACEUTICAL/TOXICOLOGY

[Advanced Respiratory Models for Hazard Assessment of Nanomaterials- Performance of Mono-, Co- and Tricultures](#)

[Glyphosate differentially affects the allergic immune response across generations in mice](#)

OCCUPATIONAL

[Effect of Occupational Extremely Low-Frequency Electromagnetic Field Exposure on the Thyroid Gland of Workers: A Prospective Study](#)

[Urinary polycyclic aromatic hydrocarbon metabolites, plasma p-tau231 and mild cognitive impairment in coke oven workers](#)

[Occupational Exposure to \$\beta\$ -d-Glucans, Mould Allergens, Endotoxins and Cultivable Fungi in Pig Farms](#)