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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

EPA calls for community input into national ambient air quality standards

2019-05-31

Environment Protection Authority Victoria (EPA) is calling for community input into proposed changes to key national air quality standards. "Australia's air quality has improved significantly over recent decades and is considered good by world standards. However, air pollution remains an important environmental and human health issue. Predictions for a drier, hotter climate, together with projected population increases, pose important challenges to future air quality," said EPA Executive Director – Regulatory Standards, Assessment and Permissioning, Tim Eaton. "EPA Victoria has been leading the national review of ozone, nitrogen dioxide and sulphur dioxide ambient air quality standards. It is vital these are reviewed as we now know that the effects of air pollution on human health from these pollutants are observable at concentrations below the current National Environment Protection (Ambient Air Quality) Measure (AAQ NEPM) standards." The National Environment Protection Council (NEPC) has signalled its intention to vary these standards to reflect the latest science on the health risks from these air pollutants. Health risks from exposure to these pollutants include effects on the respiratory and the cardiovascular system. Those most at risk of experiencing adverse effects are people with existing lung diseases (such as asthma), children and the elderly. An Impact Statement prepared by the NEPC presents options for tighter AAQ NEPM monitoring and reporting standards for these pollutants and is now available for public consultation. The proposed standards for nitrogen dioxide and sulfur dioxide would become significantly stricter, while the AAQ NEPM would include a new, eight-hour ozone standard. The Impact Statement has been developed in consultation with the Commonwealth Government and all states and territories. It is supported by a large body of work that pulls together air quality and health information, considers the feasibility of updating the standards, and the costs and benefits of a range of potential abatement measures that could be introduced to lower concentrations for these pollutants. "The Impact Statement provides an opportunity for all interested Victorians to review the evidence supporting the options for varying the AAQ NEPM standards and to give their views on the proposed strengthened standards," said Mr Eaton. While the AAQ NEPM itself does not compel or direct pollution control measures, it does provide strong

Environment Protection Authority Victoria (EPA) is calling for community input into proposed changes to key national air quality standards.

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guidelines on air quality standards for each jurisdiction. The Impact Statement, supporting documents and link to upload written submissions are available at: <http://www.nepc.gov.au/nepms/ambient-air-quality/proposed-variation/consultation-2019>

About the AAQ NEPM

The AAQ NEPM is an instrument established in 1998 under the National Environment Protection Act (1994) (NEPC Act) to provide a nationally consistent framework for monitoring and reporting on six common ambient air pollutants – carbon monoxide, lead, nitrogen dioxide, photochemical oxidants (ozone), sulfur dioxide and particulate matter (PM) in the larger size fraction of PM₁₀. It was varied in 2003 to include finer particles PM_{2.5}. It was varied in 2016 following a review of the PM₁₀ and PM_{2.5} standards to reflect the latest scientific evidence at that time and to ensure it provides an adequate level of health protection against the impacts of particle air pollution for the Australian community. Jurisdictions monitor and report against the air quality standards and goals for each of the pollutants. The standards and goals aim to guide policy formulation that allows for the adequate protection of human health and wellbeing. The AAQ NEPM does not compel or direct pollution control measures. Victoria and the ACT have implemented a stronger reporting standard for annual PM₁₀ concentration of 20 micrograms per cubic metre. The AAQ NEPM standard is 25 micrograms per cubic metre.

EPA Victoria, 24 May 2019

<http://www.epa.vic.gov.au/>

Australian Public Assessment Reports for prescription medicines (AusPARs)

2019-05-31

An AusPAR provides information about the evaluation of a prescription medicine and the considerations that led the Therapeutic Goods Administration (TGA) to approve or not approve an application. Before a prescription medicine can be made available in Australia, the company legally responsible for supplying the product must lodge a submission with the TGA. The TGA then evaluates the safety, quality and effectiveness of the product to determine if the benefits to people taking the medicine outweigh the risks. If a company wants to change something about the medicine once it is available, they also need to lodge a submission for the TGA to evaluate. Please be aware that the AusPAR contains the

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version of the Product Information for that prescription medicine which was approved with the submission which the AusPAR describes. Product Information may have been updated since the AusPAR was prepared. The following table contains products that have been recently added to AusPAR.

Date	Active Ingredient	Product Name
23 May	<u>Safinamide</u>	Xadago
23 May	<u>Tafenoquine (as succinate)</u>	Kozenis
21 May	<u>Benralizumab</u>	Fasenra
16 May	<u>Adalimumab</u>	Hadlima
9 May	<u>Sofosbuvir / Velpatasvir / Voxilaprevir</u>	Vosevi
7 May	<u>Avelumab</u>	Bavencio
7 May	<u>Olaparib</u>	Lynparza
6 May	<u>Dexamethasone (intravitreal implant)</u>	Ozurdex
6 May	<u>Evolocumab</u>	Repatha

TGA, 23 May 2019

<http://www.tga.gov.au/>

China Welcomes Available Data from Industry for Risk Assessment of 23 Substances

2019-05-29

On 27 May 27 2019, China's Solid Waste and Chemicals Management Centre (SCC) under the Ministry of Ecology and Environment (MEE) announced that it will begin to collect information on 23 chemical substances from all relevant industries. The data will include physicochemical properties, toxicology and ecotoxicology data, quantities, uses, mode of production, local environmental exposure data, etc. The information gathered will facilitate environmental risk assessment of 23 chemical substances. Information on the hazards and uses of existing chemicals in China has been difficult to collect because there are no requirements for chemical enterprises to generate and disclose such information to the authority. In January 2019, China MEE issued a draft regulation on Chemical Substance Environmental Risk Assessment and Control, which proposed that environmental risk assessment of

On 27 May 27 2019, China's Solid Waste and Chemicals Management Centre (SCC) under the Ministry of Ecology and Environment (MEE) announced that it will begin to collect information on 23 chemical substances from all relevant industries.

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designated priority substances should be undertaken. As planned, industry will be required to report necessary data and the MEE will collect and analyse the data to assess substance risk. This new initiative will shape development of future mandatory regulations. The 23 substances are detailed [here](#). The authority welcomes feedback from industry. Further information is available at: [SCC Announcement](#)

Chemlinked, 29 May 2019

<http://chemlinked.com/en/news>

AMERICA

California Moving to Prohibit Use of Chlorpyrifos

2019-05-31

On 8 May 2019, the California Environmental Protection Agency (CalEPA) announced that the state's Department of Pesticide Regulation is acting to ban the use of the pesticide chlorpyrifos in California by initiating a cancellation of the pesticide. CalEPA and the California Department of Food and Agriculture also announced that Gov. Gavin Newsom will propose \$5.7 million in new funding in the May Revision budget proposal to support the transition to safer, more sustainable alternatives, and plans to convene a working group to recommend alternative pest management solutions. "California's action to cancel the registration of chlorpyrifos is needed to prevent the significant harm this pesticide causes children, farmworkers, and vulnerable communities," said CalEPA Secretary Jared Blumenfeld. "This action also represents a historic opportunity for California to develop a new framework for alternative pest management practices." The agency reported that the decision to ban chlorpyrifos follows mounting evidence, including recent findings by the state's independent Scientific Review Panel on Toxic Air Contaminants, that the pesticide causes serious health effects in children and other sensitive populations at lower levels of exposure than previously understood. In April, chlorpyrifos was formally listed as a toxic air contaminant, which California law defines as "an air pollutant which may cause or contribute to an increase in mortality or an increase in serious illness, or which may pose a present or potential hazard to human health." The listing requires DPR to develop control measures to protect the health of farmworkers and others living and working near where the pesticide is used. DPR has determined, in consultation with CDFA, the Office of Environmental Health Hazard Assessment, and the California Air Resources Board that sufficient

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additional control measures are not feasible. As a result, DPR intends to begin the process of cancelling the registrations for products containing chlorpyrifos and convening a cross-sector working group to identify safer alternatives to avoid replacing chlorpyrifos with an equally harmful pesticide. DPR also will consult with county agricultural commissioners and local air pollution control districts before filing for cancellation. The cancellation process could take up to two years. During the cancellation process, DPR's recommendations to county agricultural commissioners for tighter permit restrictions on the use of chlorpyrifos will remain in place. These include a ban on aerial spraying, quarter-mile buffer zones, and limiting use to crop-pest combinations that lack alternatives. DPR will support aggressive enforcement of these restrictions, CalEPA reported. The proposed cancellation would apply to dozens of agricultural products containing the pesticide. The pesticide has been prohibited by the U.S. Environmental Protection Agency for residential uses since 2001.

Environmental Protection News, 8 May 2019

<http://www.eponline.com>

EPA Seeks Comment on Proposed Options for Regulating Perchlorate in Drinking Water

2019-05-31

The United States Environmental Protection Agency (EPA) released a notice of proposed rulemaking that seeks public input on a range of options regarding the regulation of perchlorate in public drinking water systems. The agency is seeking comment on a proposed National Primary Drinking Water Regulation (NPDWR) for perchlorate to establish a Maximum Contaminant Level (MCL) and a health-based Maximum Contaminant Level Goal (MCLG) at 56 micrograms per litre. In addition, the agency is seeking comment on three alternative regulatory options:

- An MCL and MCLG for perchlorate set at 18 micrograms per litre.
- An MCL and MCLG for perchlorate set at 90 micrograms per litre.
- Withdrawal of the agency's 2011 determination to regulate perchlorate in drinking water.

The agency is requesting comment on all relevant aspects of the proposed rule but is especially interested in the perchlorate monitoring and reporting requirements for public water systems and a list of treatment technologies that would enable water systems to comply with the MCL, including affordable compliance technologies for small

The United States Environmental Protection Agency (EPA) released a notice of proposed rulemaking that seeks public input on a range of options regarding the regulation of perchlorate in public drinking water systems.

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systems serving 10,000 persons or less. EPA is also requesting comment on its methodology for deriving the MCLG, the underlying assumptions and analysis of its cost and benefit estimates, and other specific items listed in the proposed rule. Perchlorate is commonly used in solid rocket propellants, munitions, fireworks, airbag initiators for vehicles, matches, and signal flares. Perchlorate may occur naturally, particularly in arid regions such as the southwestern United States and is found as an impurity in hypochlorite solutions used for drinking water treatment and nitrate salts used to produce nitrate fertilizers, explosives, and other products. EPA will accept public comment on the proposal for 60 days after publication in the Federal Register via <http://www.regulations.gov> [Docket ID No. EPA-HQ-OW-2018-0780].

U.S EPA, 23 May 2019

<http://www.epa.gov>

EPA Designates Chemicals as Inactive under TSCA

2019-05-31

On 15 May 2019, the United States Environmental Protection Agency announced the availability of a signed action identifying chemical substances for inactive designation under the Toxic Substances Control Act (TSCA). The signed action is a companion to the first version of the TSCA Inventory on which all listings were designated as active or identified as inactive. EPA regulations at [40 CFR 710.23](#) provide that the Agency's designation of a chemical substance as inactive becomes effective 90 days after it identifies the chemical substance for such designation. Subject to certain exceptions, once a chemical substance is designated as inactive, any person who intends to manufacture (including import) or process that substance must submit a Notice of Activity (NOA) Form B to EPA prior to such manufacturing or processing. Agency regulations also allow an NOA Form B to be submitted during the 90-day transition period between EPA's identification of a chemical substance for inactive designation and the effective date for such designation.

Important Dates Surrounding the Signed Action

The signed action initiates the 90-day period after which substances identified as inactive will be designated as inactive. Because it was signed on 6 May 2019, inactive designations will become effective on 5 August 2019. Accordingly, the obligation to submit an NOA Form B before manufacturing or processing an inactive substance will take effect on 5 August 2019. The Agency had previously stated, during a

On 15 May 2019, the United States Environmental Protection Agency announced the availability of a signed action identifying chemical substances for inactive designation under the Toxic Substances Control Act (TSCA).

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webinar on 13 March 2019, that 20 May 2019 would be the date on which substances identified as inactive would be designated as inactive. So, the practical effect of this action is to extend the effective date of inactive designations from 20 May 2019 until 5 August 2019. To summarise, the 2016 amendments to TSCA established a forward-looking reporting requirement that goes into effect upon EPA's designation of a chemical substance as inactive. More specifically, anyone intending to manufacture or process a chemical substance that is designated as inactive, for a non-exempt commercial purpose, must notify the Agency before the inactive substance is manufactured or processed. Upon receipt of a forward-looking notification, EPA must designate the substance as active.

Product Supply Chain Intelligence, 24 May 2019

<https://psi.ul.com/en>

Consultation on the updates to Canada Cosmetic Ingredient Hotlist: Prohibited and Restricted Ingredients

2019-05-31

On 3 May 2019, Health Canada launched a public consultation on proposed updates to the Cosmetic Ingredient Hotlist: Prohibited and Restricted Ingredients. The deadline for comments is 1 July 2019. Please provide comments no later than the deadline. The updates are as follows:

1. Dihydrocoumarin is naturally occurring in some plant derivatives at low levels. Data indicates that the ingredient may cause sensitization at higher concentrations but can be used at low levels without significant risk.

On 3 May 2019, Health Canada launched a public consultation on proposed updates to the Cosmetic Ingredient Hotlist: Prohibited and Restricted Ingredients.

Ingredient Information			Restriction		
Chemical	CAS (including but not limited to)	Synonyms and Related Compounds (including but not limited to)	Conditions of Use by product type	Maximum Concentration Permitted	Warnings and Cautionary Statements (to the effect of)
Dihydrocoumarin	119-84-6		a) Leave-on products	0.035%	
			a) Rinse-off products	0.35%	

2.

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Ingredient Information			Restriction		
Chemical	CAS (including but not limited to)	Synonyms and Related Compounds (including but not limited to)	Conditions of Use by product type	Maximum Concentration Permitted	Warnings and Cautionary Statements (to the effect of)
Thiurams	97-77-8; 137-26-8	Disulfiram; Thiram	Latex products	14%	

3.

Ingredient Information			Restriction		
Chemical	CAS (including but not limited to)	Synonyms and Related Compounds (including but not limited to)	Conditions of Use by product type	Maximum Concentration Permitted	Warnings and Cautionary Statements (to the effect of)
Eucalyptus oil	8000-48-4				"This product contains eucalyptus oil which is poisonous," "Keep out of reach of children", and "If swallowed, call a Poison Control Centre or doctor immediately."

4.

Ingredient	CAS (including but not limited to)	Synonyms and Related Compounds (Including but not limited to)
Bromates	7789-38-0; 7758-01-2	Sodium bromate; Potassium bromate

5.

Ingredient Information			Restriction		
Chemical	CAS	Synonyms and Related Compounds (including but not limited to)	Conditions of Use by product type	Maximum Concentration Permitted	Warnings and Cautionary Statements (to the effect of)

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Ingredient Information		Restriction		
Thioglycolic acid and its salts	68-11-1	a) Eyelash curling products	a) 11% with a pH of 7 to 9.5	a) "For professional use only.," "Avoid direct skin contact, wear suitable gloves.," "Avoid contact with eyes and, in the event of contact with eyes, rinse immediately with plenty of water and seek medical attention."
		b) Hair dyes, waving or straightening products	b) 8% with a pH of 7 to 9.5	b) "Avoid direct skin contact, wear suitable gloves.," "Not for use in the area of the eye."
		c) Hair dyes, waving and straightening products for professional use	c) 11% with a pH of 7 to 9.5	c) "For professional use only.," "Avoid direct skin contact, wear suitable gloves.," "Not for use in the area of the eye."
		d) Depilatory products	d) 5% with a pH of 7 to 12.7	d) "Avoid contact with eyes and, in the event of contact with eyes, rinse immediately with plenty of water and seek medical attention."

Further Information is available at:

[Consultation on proposed updates to the Cosmetic Ingredient Hotlist: Prohibited and Restricted Ingredients](#)

CIRS, 14 May 2019

<http://www.cirs-reach.com>

Health Canada Restricts Alcohol Content of Flavoured Purified Beverages

2019-05-31

On 29 May 2019, Health Canada published regulations restricting the amount of alcohol that can be included in flavoured purified alcoholic beverages. These are a new and growing class of beverages in Canada that pose an increasing public health risk, especially to younger Canadians, according to the agency. Their alcohol content can equal four standard alcoholic drinks in a single-serve container, and they are often highly sweetened, "which makes it very easy to unintentionally consume large amounts of alcohol in a very short period of time, potentially leading to

Flavoured purified alcoholic beverages are a new and growing class of beverages in Canada that pose an increasing public health risk, especially to younger Canadians, Health Canada reports.

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serious alcohol-related harms," the agency reported. Up to now, an adult weighing 180 pounds would find himself or herself over the legal limit for impaired driving by consuming a single container of flavoured purified alcohol in one hour. Ginette Petitpas Taylor, Canada's minister of Health, announced the new regulations, which take effective immediately. Under the new regulations, single-serve flavoured purified alcoholic beverages are now limited to 25.6 mL of alcohol (representing 1.5 standard drinks) when they are packaged in containers of a volume of 1,000 mL or less. Many other single-serve alcoholic beverages on the market, such as coolers and traditional beer, are sold in formats that contain between 1.0 and 1.5 standard alcoholic drinks. The 1.5 standard drink limit is below the daily recommended limit for women, and consuming two such containers is still within the recommended limit for special occasions, which is three drinks. Health Canada reported that this is consistent with Canada's Low-Risk Alcohol Drinking Guidelines, which recommend consumption of no more than two standard drinks per day for women and no more than three standard drinks per day for men. "In Canada, single-serve flavoured purified alcoholic beverages have been implicated in numerous hospitalisations and at least two deaths in the past year and a half. This is a tragedy. Health Canada has taken action to help protect Canadians—particularly youth—from unintentional overconsumption of alcohol, because excessive drinking can lead to alcohol-related harms, including acute alcohol poisoning and death," Taylor said. "I remain very concerned about the prevalence of problematic alcohol use, especially among Canadian youth. These regulations restricting alcohol content in single-serve flavoured purified alcoholic beverages can help to reduce the potential health harms and keep youth safe," said Dr. Theresa Tam, chief public health officer of Canada.

Occupational Health & Safety News, 29 May 2019

<http://www.ohsonline.com>

Comprehensive PFAS legislation introduced in Wisconsin

2019-05-31

On 24 May 2019, Wisconsin State Senators Dave Hansen (D-Green Bay) and Mark Miller (D-Monona) introduced legislation (LRB-2297/2) which, if enacted, could have significant impacts on the State of Wisconsin's regulation of per- and polyfluoroalkyl substances, otherwise known as PFAS. By extension, the proposed legislation could significantly affect the regulated community, including municipalities/Local Government Units,

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publicly owned treatment works, parties holding air and wastewater discharge permits, and many others.

The proposed legislation includes the following features:

By statutory amendments:

- Requires the Wisconsin Department of Natural Resources (WDNR) to determine, initially, if an emission standard is needed for protection of public health and welfare related to PFAS and, if such a determination is made, requires the WDNR to consider all PFAS to be air contaminants and to require reporting of any emissions of PFAS (i.e. a reporting level of zero pounds per year).
- Requires WDNR, following a recommendation by the Department of Health for a Wisconsin Administrative Code NR 140 Enforcement Standard (ES) for PFAS, to use such number as the interim ES and as the interim Maximum Contaminant Level (or MCL) for public water systems and water suppliers, and to use a standard that is 20% of the ES as the Preventative Action Limit (or PAL).
- Allows the WDNR to require persons who possess or control PFAS to provide proof of financial responsibility for remediation and long-term care to address potential remediation caused by PFAS contamination.
- Allows for budgeting for (a) sampling and testing leachate and groundwater at landfills for PFAS, (b) creating a model to assist in identifying and prioritising sites with “likely” PFAS contamination, (c) conducting a survey local and state emergency responders regarding the use of firefighting foam containing PFAS, (d) the administration and enforcement related to PFAS, and (e) investigating for PFAS and for providing alternate drinking water supply for persons if no responsible party is available.

As “Emergency Rules”:¹

- Requires the WDNR to establish and enforce acceptable levels and standards, performance standards, monitoring requirements and required response actions for any PFAS in drinking water, groundwater, surface water, air, solid waste, beds of navigable waters, and soil and sediment, if the department determines that the substances may be harmful to human health or the environment.
- Requires WDNR to add PFAS to the list of groundwater contaminants under Wis. Stats. §160.05.
- Requires WDNR to include PFAS in wastewater discharge toxic and pre-treatment effluent standards under Wis. Stats. §283.21.

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- Requires WDNR to characterise PFAS as a hazardous waste under Wis. Stats. §291.05.
- Requires WDNR to establish criteria for certifying laboratories to test for PFAS and to certify laboratories that meet these criteria.

These rules must cover, at a minimum, PFOA and PFOS, as well as PFHxS, PFNA, PFBS and PFHpA compounds. These are just a few of the substantive requirements contained in this bill relating to PFAS. The Bill provides that the rules would remain in effect until the earlier of 1 July 2022, or until permanent rules take effect. The LRB document can be [accessed here](#).

National Law Review, 29 May 2019

<http://www.ohsonline.com>

EUROPE

EU Publishes New Glossary of Common Ingredient Names for Use in the Labelling of Cosmetic Products

2019-05-31

On 8 May 2019, the European Commission published Decision (EU) 2019/701, establishing a glossary of common ingredient names for use in the labelling of cosmetics which replaces the old glossary adopted in Decision 96/335/EC (as amended by 2006/257/EC). Decision 96/335/EC will be repealed on 8 May 2020. Article 33 of the Cosmetics Regulation (EC) No 1223/2009 established the requirements for a glossary of common ingredients in cosmetics, taking into account internationally recognised nomenclatures including the International Nomenclature of Cosmetic Ingredients (INCI). An inventory of ingredients and their common nomenclature was published in Decision 96/335/EC (as amended). Due to the great number of new ingredients introduced on the market in years following publication of the initial inventory, the inventory has become outdated. Additionally, the requirements set out in Article 5a of Directive 76/768/EEC, with regards to the inventory content (e.g., function of the ingredient, restrictions of use) go beyond the requirements of Article 33 of Regulation (EC) No 1223/2009. Therefore, the new inventory confines its content to Article 33, and does not provide information such as CAS or ingredient function.

[Colourant and perfuming names](#)

On 8 May 2019, the European Commission published Decision (EU) 2019/701, establishing a glossary of common ingredient names for use in the labelling of cosmetics which replaces the old glossary adopted in Decision 96/335/EC (as amended by 2006/257/EC).

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Colourants, other than those used in hair colourants, are required by Article 19(1) of Regulation (EC) No 1223/2009 to be named according to the CI (Colour Index) nomenclature, where applicable for the purposes of labelling. Therefore, the CI number should be listed as the common ingredient name. In addition, as noted in the decision, some ingredients used in perfume and aromatic compositions do not have an INCI name. For those ingredients, the “perfuming names” that have been used in the EU for labelling purposes are listed in the glossary. According to Article 33 of Regulation (EC) No 1223/2009, the common ingredient names listed in the glossary are to be used at the latest 12 months after its publication in the Official Journal of the European Union. The Decision will enter into force 20 days after its publication. In other words, one is permitted to use these names starting on May 28, 2019, but it will be mandatory to do so by 28 May 2020.

Further information is available at: [Commission Decision \(EU\) 2019/701](#)

Product Supply Chain Intelligence, 21 May 2019

<https://psi.ul.com/en>

French watchdog bans sale of common pesticide

2019-05-31

The French food safety agency ANSES recently barred the sale of epoxiconazole, a widely-used pesticide, citing a “worrying danger” to humans. The fungicide, mainly produced by the German chemical giant BASF, is used for about half of France’s cereal crops and 70 percent of beetroot cultivation, ANSES said. The agency says the substance, already a suspected carcinogen, is thought to be “toxic” to human reproduction. ANSES took up the question after the European Union adopted new regulations in late 2017 concerning endocrine disruptors. “A guide published in June 2018 at the European level set scientific criteria to say whether an active substance is an endocrine disruptor,” ANSES managing director Caroline Semaille told AFP. “On the basis of the new guide, we can establish and confirm that (epoxiconazole) is an endocrine disruptor.” The pesticide, of which 200 tonnes is sold in France each year under dozens of brand names, presents “a worrying danger for man and the environment”, the agency said in a statement. According to the World Health Organization, an endocrine disruptor is a substance, or mixture of substances, which disrupts hormonal system functions and consequently is harmful to human health and reproduction, including at very weak levels of exposure. People are exposed to hormone-disrupting chemicals

The French food safety agency ANSES recently barred the sale of epoxiconazole, a widely-used pesticide, citing a “worrying danger” to humans.

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through everyday products including food and drink, medications, pesticides, cosmetics, plastics, detergents, flame retardants, and toys. The suspect compounds have been linked to altered reproductive function in males and females, increased incidence of breast cancer, disturbance of the nervous and immune systems, abnormal growth, and stunted development in children. The EU rules finally adopted in 2017 did not satisfy activists and cover only chemical agricultural inputs and biocides. ANSES singled out epoxiconazole because of its widespread use but will subject other substances to the EU guidelines, Semaille said. The agency will relay its decision to Brussels, which is to decide whether to renew authorisation for use of the pesticide by April 2020. The products must be removed from sale in France within 12 months, Semaille said. She noted that “alternatives in the same family (of substances) such as triazoles” exist, and that “new substances are being evaluated at the European level.” The debate over the use of pesticides is highly sensitive, needing to balance concern for human health over the needs of the agricultural sector. Controversy over the herbicide glyphosate has taken the spotlight in recent years, but the government has set a wider goal of reducing the use of chemical agricultural inputs by 25 percent by 2020 and halving them by 2025.

Science News, 29 May 2019

<http://www.sciencenews.org>

British Safety Council Calls for UK to Recognize Air Pollution as Occupational Health Hazard

2019-05-31

The British Safety Council has recently released the report *Impact of air pollution on the health of outdoor workers*, which argues that ambient air pollution should be recognized as an occupational health hazard in Britain. The report is part of the charity's campaign to limit the hazards that air pollution poses to the health of outdoor workers. According to the BSC, air pollution is considered the largest environmental risk to public health, connected with as many as 36,000 early deaths annually in the United Kingdom. Ambient air pollution can be linked to cancer, lung and heart disease, type 2 diabetes, infertility, and early dementia, the organisation said. BSC launched its Time to Breathe campaign, focused on the protection of outdoor workers from air pollution, in March 2019. This report is the next step in the campaign, gathering evidence about the causes and consequences of air pollution in Britain. In the report, the British Safety Council calls for the following measures:

The British Safety Council's recently released report, *Impact of air pollution on the health of outdoor workers*, makes an argument for recognising air pollution as an occupational health hazard in Britain.

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- The UK to adopt the World Health Organization's exposure limits for the main pollutants;
- Government action to ensure ambient air pollution is treated as an occupational health issue and adopt a Workplace Exposure Limit for Diesel Engine Exhaust Emissions (DEEE);
- Improvements to pollution monitoring across the UK, so that all regions can have the same accuracy in emissions data as London;
- Recognition that protection from the dangers of air pollution should be enshrined in law as a human right.

"The impact of air pollution on people working in large cities is starting to be recognised as a major public health risk. However, we are yet to see any true commitment to addressing this issue by the government and the regulators," said Lawrence Waterman, Chairman of the British Safety Council. "The Time to Breathe campaign, together with our recent report, is a call to action for policymakers, regulators and industry leaders. The social and economic implications of ambient air pollution are clear. It must be recognized as an occupational health hazard, much like some toxic substances such as asbestos. Breathing clean air is not a privilege but a basic human right for the thousands of people who are undertaking vital work outdoors." The report can be read [here](#).

Occupational Health & Safety, 22 May 2019

<http://www.ohsonline.com>

Quinolizidine alkaloids in food and feed opinion – have your say on draft

2019-05-31

The European Food Safety Authority (EFSA) is publicly consulting on its scientific opinion on the risks for animal and human health related to the presence of quinolizidine alkaloids in food and feed. Quinolizidine alkaloids are naturally occurring compounds that can be present in lupin seeds. If these alkaloids are not properly removed in a "debitting process", they can trigger poisoning in humans which affects the nervous, cardiovascular and digestive systems. The [public consultation](#) is open until 5 July 2019.

EFSA, 23 May 2019

<http://www.efsa.europa.eu>

The European Food Safety Authority (EFSA) is publicly consulting on its scientific opinion on the risks for animal and human health related to the presence of quinolizidine alkaloids in food and feed.

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Cosmetic Products Regulation Annexes III and V amended

2019-05-31

The following substance has been added to Annex III and amended in Annex V of the Cosmetic Products Regulation (EC) No. 1223/2009 (CPR) as per Commission Regulation (EU) 2019/698 of 30 April 2019:

- 1-(4-Chlorophenoxy)-1-(imidazol-1-yl)-3,3-dimethylbutan-2-one

Yorda's Hive, 28 May 2019

<https://www.yordasgroup.com/hive/news>

REACH Update

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SweNanoSafe Launches Free Web Tool to Help Register Nanomaterials under REACH

2019-05-30

On 16 May 2019, the Swedish National Platform for Nanosafety (SweNanoSafe) announced the availability of eREACHNano, "a new web tool focused on helping small and medium-sized companies that may lack sufficient in-house expertise on the regulation covering nanomaterials." The web tool explains the data requirements for nanoforms according to the guideline documents of the Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH) regulation, including:

- Definition of nanomaterials;
- Types of nanomaterials;
- Overview of nanomaterial-specific annexes to existing REACH guidance;
- Chemical and physical characterisation of nanomaterials;
- Testing of nanomaterials; and
- Exposure and risk assessment of nanomaterials.

SweNanoSafe notes that the December 2018 amendments clarifying the information requirements for nanomaterials have not yet been included. The information requirements will apply beginning 1 January 2020. The information requirements will be included in a subsequent version of the web tool to be launched later in 2019.

Nano & Other Emerging Technologies Blog, 28 May 2019

<http://nanotech.lawbc.com>

The web tool explains the data requirements for nanoforms according to the guideline documents of the Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH)

Targeted public consultation on harmonised classification and labelling

2019-05-30

The proposal for the harmonised classification and labelling (CLH) of clomazone (ISO); 2-(2-chlorobenzyl)-4,4-dimethyl-1,2-oxazolidin-3-one (EC 617-258-0, CAS 81777-89-1), submitted by Denmark, was subject to a public consultation, which ended on 8 February 2019. During the main consultation, industry provided new study reports, the findings of which may potentially impact the classification proposal for reproductive toxicity. All interested parties are invited to submit comments in direct relation to

REACH Update

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the subject of the targeted consultation by 10 June 2019. Comments can be submitted at: [Give comments](#)

ECHA News, 29 May 2019

<http://echa.europa.eu>

New proposals and an intention to harmonise classification and labelling

2019-05-30

An intention to harmonise the classification and labelling has been received for N-1-naphthylaniline (EC 201-983-0, CAS 90-30-2).

Three proposals have been submitted for:

- Dibutyltin bis(2-ethylhexanoate) (EC 220-481-2, CAS 2781-10-4);
- Reaction mass of 3-(difluoromethyl)-1-methyl-N-[(1R,4SR,9RS)-1,2,3,4-tetrahydro-9-isopropyl-1,4-methanonaphthalen-5-yl]pyrazole-4-carboxamide and of 3-(difluoromethyl)-1-methyl-N-[(1R,4SR,9SR)-1,2,3,4-tetrahydro-9-isopropyl-1,4-methanonaphthalen-5-yl]pyrazole-4-carboxamide; isopyrazam (EC 632-619-2, CAS 881685-58-1); and
- 2-[N-ethyl-4-[(5-nitrothiazol-2-yl)azo]-m-toluidino]ethyl acetate (EC 239-203-6, CAS 15141-18-1).

Further information is available at: [Registry of CLH intentions](#)

ECHA News, 29 May 2019

<http://echa.europa.eu>

20 new testing proposals consultations open

2019-05-30

The European Chemicals Agency (ECHA) has launched 20 new public consultations on testing proposals. The deadline for comments is 11 July 2019. There are currently 36 open public consultations on testing proposals. Further information testing proposals is available at:

[Give comments](#)

ECHA News, 29 May 2019

<http://echa.europa.eu>

A new intention and 3 proposals to harmonise the classification and labelling have been received.

REACH Update

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New intention to identify a substance of very high concern

2019-05-30

A new intention has been received for diisohexyl phthalate (EC 276-090-2, CAS 71850-09-4). Further information is available at: Registry of SVHC intentions until outcome

ECHA News, 29 May 2019

<http://echa.europa.eu>

Authorisations granted for uses of bis(2-methoxyethyl) ether (diglyme)

2019-05-30

The European Commission has granted authorisations for bis(2-methoxyethyl) ether (diglyme) (EC 203-924-4, CAS 111-96-6) for one use to Roche Diagnostics GmbH and one use to Life Technologies AS with a review period expiring on 22 August 2029.

ECHA News, 29 May 2019

<http://echa.europa.eu>

New manual available on using and reporting (Q)SARs

2019-05-30

A new manual explains how to apply the European Chemicals Agency's (ECHA) practical guide on (Q)SARs for substances under the Biocidal Products Regulation. The manual complements the practical guide, so you are encouraged to consult both documents. A separate (Q)SAR reporting template is also available. Further information on the new manual is available at: More

ECHA News, 29 May 2019

<http://echa.europa.eu>

Watch our webinar on the new IUCLID web interface for biocides

2019

The European Chemicals Agency (ECHA) has published a video on the new IUCLID web interface for biocides. This video introduces you to the latest

A new intention has been received for diisohexyl phthalate.

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improvements and functionalities for biocides submissions. It includes the creation and navigation of a BPR dossier, the comparison tool, and the report generator. Video is available at: [Video and presentations](#)

ECHA News, 29 May 2019

<http://echa.europa.eu>

Public consultation on harmonised classification and labelling

2019-05-30

The European Chemicals Agency (ECHA) is seeking comments on the harmonised classification and labelling proposals for:

- A group entry for 2-ethylhexanoic acid and its salts except those specified elsewhere in the annex to the dossier. The aim is to add relevant salts to the existing entry in Annex VI to CLP for 2-ethylhexanoic acid (EC 205-743-6, CAS 149-57-5), to remove EC and CAS numbers from the existing entry and to assign a classification for reproductive toxicity to the group entry.
- Isoflucypram; N-(5-chloro-2-isopropylbenzyl)-N-cyclopropyl-3-(difluoromethyl)-5-fluoro-1-methyl-1H-pyrazole-4-carboxamide (EC -, CAS 1255734-28-1).

The deadline for comments is 26 July 2019. Comments can be submitted at: [Give comments](#)

ECHA News, 29 May 2019

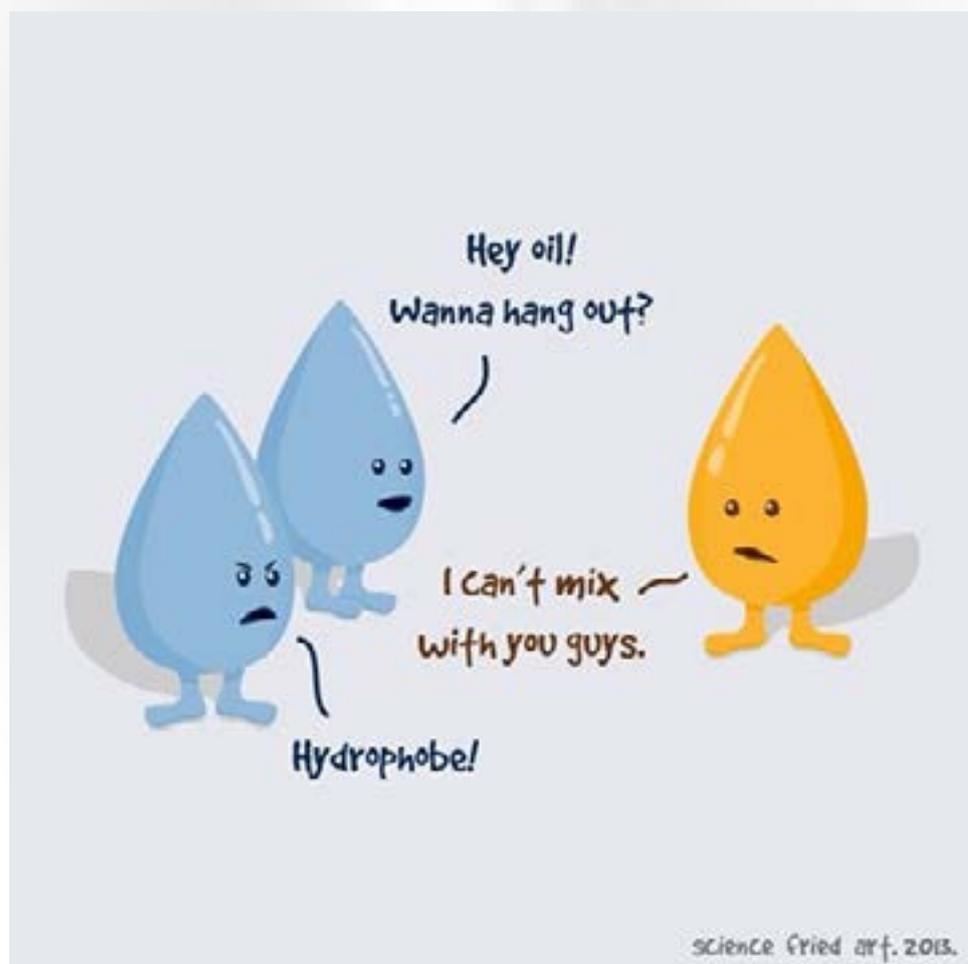
<http://echa.europa.eu>

Janet's Corner

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Hydrophobe

2019-05-31



Hazard Alert

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Plutonium

2019-05-13

Plutonium is a transuranic radioactive chemical element with symbol Pu and atomic number 94. It is an actinide metal of silvery-grey appearance that tarnishes when exposed to air, and forms a dull coating when oxidized. The element normally exhibits six allotropes and four oxidation states. It reacts with carbon, halogens, nitrogen, silicon and hydrogen. When exposed to moist air, it forms oxides and hydrides that expand the sample up to 70% in volume, which in turn flake off as a powder that is pyrophoric. It is radioactive and can accumulate in bones, which makes the handling of plutonium dangerous. [1] Very small amounts of plutonium occur naturally. Plutonium-239 and plutonium-240 are formed in nuclear power plants when uranium-238 captures neutrons. [2]

USES [3]

Plutonium is a key fissile component in modern nuclear weapons; care must be taken to avoid accumulation of amounts of plutonium which approach critical mass, the amount of plutonium which will self-generate a nuclear reaction. Despite not being confined by external pressure as is required for a nuclear weapon, it will nevertheless heat itself and break whatever confining environment it is in. Shape is relevant; compact shapes such as spheres are to be avoided. Plutonium could also be used to manufacture radiological weapons. The plutonium isotope ^{238}Pu is an alpha emitter with a half-life of 87 years. These characteristics make it well suited for electrical power generation for devices which must function without direct maintenance for timescales approximating a human life time. It is therefore used in RTGs such as those powering the Galileo and Cassini space probes. Plutonium-238 was used on the Apollo-14 lunar flight in 1971 to power seismic devices and other equipment left on the Moon, and it was also the power supply of the two Voyager spacecraft launched in 1977. Plutonium-239 can also be used as a fuel in a new generation of fast-breeder nuclear weapons, which burn a mixed oxide (MOX) fuel consisting of uranium and plutonium.

IN THE ENVIRONMENT [4]

- Plutonium released during atmospheric testing of nuclear bombs, which ended in 1980, is the source of most of the plutonium in the environment worldwide.

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- Plutonium is also released to the environment from research facilities, waste disposal, nuclear fuel reprocessing facilities, nuclear weapons production facilities, and accidents at facilities where plutonium is used.
- Plutonium can be transported in the atmosphere.
- It can be deposited on land or water by settling or by precipitation.
- Plutonium can stick to particles in soil, sediment, and water.
- Plutonium will undergo radioactive decay in the environment.

SOURCES & ROUTES OF EXPOSURE

Sources of Exposure [4]

- Everyone is exposed to very low levels of plutonium in air, and possibly in drinking water and food.
- Exposure to higher levels could occur from an accidental release during its use.
- Exposure during transport and disposal is unlikely because transport containers are virtually indestructible by accident or fire; disposal sites are deep underground and away from the public.
- Workers at nuclear facilities using plutonium may be exposed to higher levels of it.
- People who live near facilities that use plutonium in their operations may be exposed to it from accidental releases to the air.

Routes of Exposure [5]

- Inhalation – The exposure route of primary concern for workers and the general population.
- Oral – Minor route of exposure.
- Dermal – Minor route of exposure

HEALTH EFFECTS [3]

- The alpha radiation plutonium emits does not penetrate the skin, but can irradiate internal organs it is inhaled or ingested.
- Extremely small particles of plutonium on the order of micrograms can cause lung cancer if inhaled into the lungs.
- Considerably larger amounts may cause acute radiation poisoning and death if ingested or inhaled; however, so far, no human is known

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to have died because of inhaling or ingesting plutonium and many people have measurable amounts of plutonium in their bodies.

- When people breathe it in, plutonium may remain in the lungs or move to the bones or organs. Generally, it stays in the body for a long time and continually exposes body tissues to radiation. After a few years this could result in the development of cancer.
- Furthermore, plutonium may affect the ability to resist disease and the radioactivity from plutonium may cause reproductive failure.

SAFETY [6]

First Aid Measures

- **Inhalation:** Remove from exposure area to a restricted area with fresh air as quickly as possible. If breathing has stopped, perform artificial respiration by administering oxygen; mouth-to-mouth resuscitation should be avoided to prevent exposure to the person rendering first aid. Any evidence of serious contamination indicates that treatment must be instituted. (Inhalation of radioactive particles may indicate that other parts of the body were also contaminated, such as the digestive tract, skin and eyes.) If time permits, wipe the face with wet filter paper, force coughing and blowing of the nose. Get medical attention immediately. The victim may be contaminated with radioactive particles. Thorough decontamination should be started before the victim is moved to the medical area. Any personnel involved in rendering first aid must be monitored for radioactivity and thoroughly decontaminated if necessary.
- **Skin Contact:** Remove victim to a suitable area for decontamination as quickly as possible. Remove clothing and shoes immediately. Thoroughly wash the victim with soap and water, paying particular attention to the head, fingernails and palms of the hands. Upon completion of washing, monitor the victim for radioactivity. It is imperative that the skin should be decontaminated as quickly as possible. Minute skin injuries greatly increase the danger of isotope penetration into the victim; shaving should not be attempted. If water and soap have been inadequate in removing the radioactive compound, decontaminating compounds consisting of surfactants and absorbent substances may be effective. Complexing reagents may also be of use. The use of organic solvents is to be avoided, as they may increase the solubility and absorption of the radioactive substance. Skin contamination with radioactivity may be an indication that other parts of the body have been exposed. Contaminated clothing must

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be stored in an airtight, chemically compatible container for later decontamination or disposal. The water used to wash the victim must be stored in an airtight, chemically compatible container for later disposal. Any personnel involved in rendering first aid to the victim must be monitored for radioactivity and decontaminated if necessary.

- Eye Contact: Remove victim to a restricted area for decontamination. Thoroughly wash eyes with large amounts of water, occasionally lifting the upper and lower lids (approximately 15 minutes). Following the water treatment, provide an isotonic solution. Do not use eyebaths, rather provide a continuous and copious supply of fluid. Monitor the victim for radioactivity. If activity is present, rewash the eyes, and remonitor until little or no radioactivity is present. Get medical attention immediately. Any water used to wash the victim's eyes must be stored in an airtight, chemically compatible container for later disposal. Any other articles that are used to decontaminate the victim must also be stored in similar containers for later decontamination or disposal. Any personnel involved in rendering first aid to the victim must be monitored for radioactivity and decontaminated if necessary.
- Ingestion: In the case of ingestion of radioactive substances, the mouth should be rinsed out immediately after the accident, care being taken not to swallow the water used for this purpose. Vomiting should be induced either mechanically, or with syrup of ipecac. Do not induce vomiting in an unconscious person. Lavage may be useful. Care should be taken to avoid aspiration. The vomitus and lavage fluids should be saved for examination and monitoring. Get medical attention immediately. The gastric fluids and fluids used for lavage must be stored in airtight, chemically compatible containers for later disposal. The victim must be monitored for radioactivity and decontaminated, if necessary, before being transported to a medical facility. Any personnel involved in rendering first aid to the victim must be monitored for radioactivity and decontaminated if necessary.

Fire Information

- Negligible fire hazard in bulk form; however, dust, powder, or fumes are flammable or explosive when exposed to heat or flames.
- Small fires should be extinguished with Metal-X (Class D) fire extinguisher.
- Do not move damaged containers; move undamaged containers out of fire zone. Contact the local, State, or Department of Energy radiological response team. Use suitable agent for surrounding fire. Cool containers with flooding amounts of water, apply from as far a

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distance as possible. Avoid contamination of water sources and sewers. Avoid breathing dusts or vapours, keep upwind. Keep unnecessary people out of area until declared safe by radiological response team.

Exposure Controls and Personal Protection

- At a minimum, provide process enclosure ventilation. Depending upon work activities, a more stringent ventilation system may be necessary to comply with exposure limits.
- A High Efficiency Particulate Air (HEPA) filtration system may be required for handling and storing this material.
- One method of controlling external radiation exposure is to provide adequate shielding. The absorbing material used and the thickness required to attenuate the radiation to acceptable levels depends on the type of radiation, its energy, the flux and the dimensions of the source.
- Alpha Particles: For the energy range of alpha particles usually encountered, a fraction of a millimetre of any ordinary material is sufficient for absorbance. Thin rubber, acrylic, stout paper, or cardboard will suffice.
- Beta Particles: Beta particles are more penetrating than alpha, and require more shielding. Materials composed mostly of elements of low atomic number such as acrylic, aluminium and thick rubber are most appropriate for the absorption of beta particles. For example, 1/4 inch of acrylic will absorb all beta particles up to 1 MeV.
- Gamma Rays: The most suitable materials shielding gamma radiation are lead and iron. The thickness required will depend on whether the source is producing narrow or broad beam radiation. Primary and secondary protective barriers may be required to block all radiation.
- Eye Protection: Employee must wear appropriate eye protection that will not allow the introduction of particles into the eyes. Contact lenses should not be worn.
- Clothing, glove and eye protection equipment will provide protection against alpha particles, and some protection against beta particles, depending on thickness, but will not shield gamma radiation.
- Clothing: Overgarments, including head coverings and foot covering, should be worn by any employee engaged in handling radioactive substances. These garments are also recommended even if the employee is working with a "glovebox" containment system. Certain clothing fibres may be useful in dosimetry so clothing should be kept.

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In the event of an accident, large scale release or a large scale clean-up, full protective clothing will be necessary.

- **Gloves:** Employee must wear appropriate protective gloves to prevent contact with this substance. Used gloves may present a radioactive contamination hazard and should be disposed of as radioactive waste.
- **Respirator:** Respirators should provide protection for the respiratory tract against inhalation of most of the radioactive particles encountered in the workplace. Respirators will not offer protection against beta and gamma radiation, but will block alpha particles. Respiratory equipment must be jointly certified by NIOSH/MSHA. The following respiratory protection is recommended. Lower levels of protection may be appropriate depending on containment systems. Consult a qualified health physicist for more information.
- **General conditions:** Type 'C' supplied-air respirator with a full face-piece operated in pressure-demand or other positive pressure mode or with a full face piece, helmet or hood operated in continuous-flow mode.
- **Self-contained breathing apparatus with a full face piece** operated in pressure-demand or other positive pressure mode.
- **For firefighting and other immediately dangerous to life or health conditions:** Self-contained breathing apparatus with full face piece operated in pressure-demand or other positive pressure mode.
- **Supplied-air respirator with full face piece and operated in pressure-demand or other positive pressure mode in combination with an auxiliary self-contained breathing apparatus** operated in pressure-demand or other positive pressure mode.

REGULATION

United States [2]

The U.S. Nuclear Regulatory Commission (USNRC) has recommended the following radiation exposure limits for the general public and for workers:

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General public	0.1 rem/year for the general public and 0.5 rem/year for people who work with patients in nuclear medicine. These regulations are for all forms of radiation combined, so they are not only for plutonium.
Workers	5 rem/year for workers in industries where exposure to radiation may occur and 0.5 rem for the pregnancy period following the declaration of pregnancy by a woman in an industry where exposure to radiation may occur.

These recommended radiation exposure limits are for all forms of radiation combined and are not specific to plutonium. The limits are expressed in units called rem (roentgen equivalent man). A rem is a radiation unit that expresses the radiation equivalent dose to a particular organ or tissue. The limits on equivalent dose are used to calculate the limits on the amount of radioactive substances that can be inhaled or ingested.

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Gossip

CHEMWATCH

New electrochemical method detects PFOS and PFOA

2019-05-16

Bubbles and tiny electrodes may hold the key to faster, more cost-effective detection of perfluorinated surfactants that can contaminate drinking water. Researchers have developed an electrochemistry-based method to detect surfactants, specifically perfluorooctane sulfonate (PFOS) and perfluorooctanoic acid (PFOA), with high sensitivity and specificity (Anal. Chem. 2019, DOI: 10.1021/acs.analchem.9b01060). Perfluorinated surfactants are highly stable due to perfluoroalkyl moieties, and are common in products like non-stick coatings and fire-fighting foam. Chronic exposure to two such perfluoroalkyl substances, PFOS and PFOA, has been linked to health issues in humans. Though these two chemicals are no longer used in industry, they persist in the environment and can contaminate drinking water. Long Luo, an analytical chemist at Wayne State University, began his search for a novel way to detect these harmful chemicals after one such PFOS/PFOA contamination event in a Michigan town during the summer of 2018. The most commonly used detection method uses high-performance liquid chromatography with tandem mass spectrometry (HPLC-MS/MS), which requires complex instrumentation and can cost up to \$300 per sample, Luo says. Hoping to develop a simpler, less expensive method, the team turned to electrochemistry. Their method is based on a phenomenon known as electrochemical bubble nucleation. Applying electric potential to an electrode in an aqueous solution splits water into hydrogen gas and oxygen. Ramping up the current, increases gas concentration near the electrode until a bubble forms, blocking the electrode surface and causing the current to drop. Surfactants reduce surface tension and make it easier for such bubbles to form, meaning the amount of current required to form those bubbles is inversely related to surfactant concentration. To test their method, Luo and his collaborators fabricated tiny platinum electrodes less than 100 nm in diameter (smaller electrodes are more sensitive). The team could detect PFOS and PFOA concentrations as low as 80 µg/L and 30 µg/L, respectively. Preconcentrating samples using solid-phase extraction moved the limit of detection below 70 ng/L—the health advisory level for drinking water set by the U.S. Environmental Protection Agency. The method also remained sensitive and selective for surfactant detection even in the presence of a 1,000-fold greater concentration of poly(ethylene glycol), a non-surfactant molecule with a molecular weight similar to that of PFOS. “Electrochemical methods, in general, have great promise for measuring very low concentrations of contaminants in complex matrices,” says Michelle Crimi, an environmental engineer at Clarkson University. “I look forward to

Bubble nucleation is the basis for rapid and cost-effective analysis

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hearing more about the future of this technology, including its validation in field-contaminated water samples." Creating a handheld device for testing water in streams and other field sites—not just drinking water—is the ultimate goal, Luo says. An important step in that process will be developing a pre-treatment phase to eliminate other surfactants that also promote bubble formation at electrodes, like sodium dodecyl sulfate. Such interference would be unlikely in drinking water samples, Luo says, because most compounds are not as stable as perfluoroalkyl substances and are destroyed during water treatment processing.

Chemical & Engineering News, 13 May 2019

<http://pubs.acs.org/cen/news>

Review on the synthesis and anti-oxidation of copper nanowires for transparent conductive electrodes

2019-05-14

In a paper to be published in the forthcoming issue in NANO, a team of researchers have reviewed the methods of synthesising copper nanowires (Cu NWs) and techniques to improve its oxidation resistance. With excellent electrical, optical, and thermal properties, Cu NWs are an attractive alternative to indium tin oxide (ITO) as a traditional electrode material. However, it is still a challenge to improve the aspect ratio and long-term chemical stability of Cu NWs. To explore the effect of capping agents on Cu NWs, the type of capping agent is usually changed to vary the length and diameter of NWs, because different capping agents have different effects on the aspect ratio of NWs. In order to explore how to improve the conductivity and oxidation resistance of Cu NWs, various post-processing methods are carried out to find the best treatment method. During the synthesis of Cu NWs, ethylenediamine (EDA) as a capping agent requires a simple operation, but the aspect ratio of NWs is very low. The NWs synthesised by nickel acetylacetonate as a capping agent have larger aspect ratio. However, Ni will be introduced and Cu will be polluted. Oleamine (OLA) and alkylamine synthesised NWs have the largest aspect ratio, which exceeds 3000, and requires a simple operation, making this the best method. In the aspect of improving the conductivity of Cu NWs, high temperature annealing can reduce the oxide layer on the surface of Cu NWs and improve conductivity, but high temperature can also cause the breakage of NWs. High intensity pulsed light technology is the best way to improve the conductivity of NWs, which can remove the oxide layer and weld NWs together, but the equipment is too expensive. Organic acid cleaning can remove the oxide layer on the surface of NWs

Researchers have reviewed the methods of synthesising copper nanowires and techniques to improve its oxidation resistance.

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without causing any damage to the NWs, and the operation is simple, making it a viable alternative (e.g., 55 Ω /sq. at 94% transparency). For Cu NWs, improving their long-term chemical stability is the most important, as it will directly affect their applications. Cu NWs are now being used to make low-cost, transparent electrodes in touch screens, OLEDs and solar cells. With the development of science and technology, flexible transparent conductors remain the central focus of many researchers towards achieving flexible electronic displays and durable solar cells. Other emerging applications such as stretchable conductors, electronic skins and sensor devices would continue to expand the horizon of Cu NWs.

EurekaAlert, 6 May 2019

<http://www.eurekaalert.org>

Smart pill bottle keeps drugs safe

2019-05-14

A smart pill bottle that sends wireless alerts when it detects tampering, overdose or unsafe storage conditions is just one of many potential health applications for new sensor technology being developed by a team at KAUST. Digital technology offers opportunities to improve traditional approaches to issues threatening human health. For example, networks of tiny wearable sensors deployed in hospitals can be used to track influenza outbreaks in real time. But the high costs associated with electronic manufacturing means that these sensors aren't available where they're needed most--to the low-income populations that suffer disproportionately from epidemics. Muhammed Hussain, doctoral student Sherjeel Khan and colleagues are working to make sensors more accessible using cheaper materials. For example, they recently demonstrated that it is feasible to create temperature and humidity sensors from paper by drawing circuits with conductive ink. The team has now developed a stretchy sensor--an anisotropic conductive tape with a range of touch-sensitive applications. Assembled by sandwiching tiny silver particles between two layers of adhesive copper tape, the new material is nonconductive in its normal state. But when pressed by a finger, the double-layered tape makes an electrical connection that sends a signal to an external reader. "Similar devices have been used in flat panel displays," explains Khan, "but we've made them simple to build and easy to use by almost anyone." The researchers used their technology to create a smart pill bottle to help fight the problem of prescription drug abuse. After 3D-printing a lid that uses light-emitting diodes to count the number of pills dispensed, they taped paper-based humidity and temperature

A smart pill bottle that sends wireless alerts when it detects tampering, overdose or unsafe storage conditions is just one of many potential health applications for new sensor technology being developed by a team at KAUST.

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sensors to its underside. The bottle was then sealed with an outer layer of conductive tape that acts as a touch sensor. If someone attempts to break into the bottle, or the insides become dangerously moist, a flexible control module inside the bottle analyses the signals and delivers warnings to cell phones via a Bluetooth connection. The conductive tape could be used on its own or as part of a modular sensor system, and so Hussain envisions it could help groups looking for quick tests of innovative health sensors. This sensor development that is easy to build also opens up broader possibilities for researchers. "If you give researchers a 'do it yourself opportunity,' there is a good chance they will use it to expand the horizon of electronics and empower humanity with better technology," Hussain adds.

EurekaAlert, 6 May 2019

<http://www.eurekaalert.org>

Meet the blue crew, scientists trying to give food, flowers, and more a colour rarely found in nature

2019-05-14

As a solid-state chemist at the chemical giant Dupont, Subramanian had put his name on hundreds of publications and dozens of patents. He identified a new superconductor and found a more environmentally friendly route to produce the chemical fluorobenzene. When he left the company to work at Oregon State University here in 2006, he set out to develop a multiferroic, a material with a combination of electronic and magnetic properties that could lead to faster computers. Following one of Subramanian's ideas, graduate student Andrew Smith one day mixed indium oxide, manganese oxide, and yttrium oxide and heated the mixture in the oven. The resulting material, it turned out, didn't have any special magnetic or electric properties. It was just very blue. Subramanian's first thought was that Smith, who had recently switched from marine biology to chemistry, had made a mistake. His second thought was something that someone at Dupont had once told him: Blue is really hard to make. It's so hard, in fact, that Subramanian's new colour became a phenomenon. The New York Times called within days after his paper on YInMn blue, as he dubbed it, appeared in the Journal of the American Chemical Society. Shepherd Colour Company in Cheltenham, Australia, licensed the new pigment, which art historian Simon Schama has called "the bluest blue to date," and marketed it as a paint for artists. The new hue has inspired a music festival, and chip company AMD is using it to dye the housing of a series of graphics processors. "There is something about

Throughout history, making a blue pigment has taken hard work—or a stroke of luck

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the colour blue that just fascinates people," Subramanian says. Humans made pigments from red and yellow ochre and charcoal at least 100,000 years ago, but they didn't have blue. The Babylonians and Egyptians used bits of lapis lazuli, a blue semiprecious stone, in statuary and art, but the laborious process needed to turn it into the pigment ultramarine was only discovered in the sixth century B.C.E. (Recent evidence from a burial site in Turkey suggests people also ground the blue mineral azurite down to a fine powder 9000 years ago, possibly for cosmetics.) With natural blues scarce, people have tried to make their own. Ancient Egyptians mixed sand, plant ash, and copper to create Egyptian blue, the first synthetic pigment, about 5000 years ago. In the 19th century, chemists raced to create a synthetic ultramarine, and BASF spent an unprecedented 18 million gold marks, more than the company was worth at the time, to synthesize indigo, a deep blue dye from plants. These blues became some of the most sought-after products of the booming chemical industry. Yet blue pigments are still rare. Most blues in nature don't come from pigments that humans can co-opt. Animals such as the morpho butterfly and the blue jay appear blue not because of a pigment, but because their feathers or scales contain nanostructures that reflect light in a way that cancels out all but the blue wavelengths. To appear blue, a dye or a pigment needs to absorb red light, which usually happens when red photons boost electrons in the pigment molecule from one energy level to the next. Because red light has the lowest energy of any visible light, those two energy levels need to be very close together—and such closely spaced energy rungs are found only in complicated molecules that are hard for organisms to make. Plants have evolved many classes of pigments: Chlorophylls colour leaves green; carotenoids come in orange (carrots), red (tomatoes), and yellow (maize); and betalains produce the red colour of beetroot. But only one class of pigments is capable of producing blue: the anthocyanins. (The word literally means "blue flower.") And even most anthocyanins are not blue but red, because they naturally absorb blue light; only if the plant tacks on chemical groups can the molecule shift toward absorbing red. In minerals, too, blue is a special case. Subramanian discovered that YInMn 's colour is created by a manganese ion surrounded by five oxygen atoms in a structure resembling two three-sided pyramids glued together at the bottom, a geometry rarely seen in natural minerals. Designing materials from scratch to produce blue is difficult even today, Subramanian says. "So much chemistry has to come together," he says. Subtle changes in the arrangement of neighbouring atoms can throw off the energy levels of an atom's electrons, altering the colour it can absorb. The red of rubies and the green of emeralds both spring from chromium ions surrounded by six oxygen atoms; other atoms

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in the two stones cause the colour difference by altering the chromium's energy levels. Such effects are very hard to predict, Subramanian says: "If rubies and emeralds did not exist in nature, no one would know how to create them." But scientists have not given up hunting for new blues, continuing an age-old quest with 21st century tools. Although Subramanian's discovery came about by accident, other researchers are methodically using physics, chemistry, and genetics to find or create new blues for painters to dazzle with, edible colorants that make food more interesting, and blue flowers that, so far, only exist in artists' imaginations.

In 2004, Japanese researchers unveiled what they billed as the world's first blue rose. The only problem with the flower: It wasn't very blue. Although its petals did produce a blue pigment, the overall appearance of the flower was more mauve. Even Yoshikazu Tanaka, the scientist behind the work, admits that his first thought on seeing the flower was: "could be bluer." Fifteen years later, he is still trying to make that bluer rose. Tanaka works at the global research centre of Japanese beverage giant Suntory, which grew out of Japan's first whisky distillery, opened in 1923. (The brand was made famous by the movie *Lost in Translation*, in which an aging actor played by Bill Murray shoots a whisky commercial in Tokyo.) The company decided to branch out into the cut-flower market in the 1980s after a tax hike made Japanese liquor more expensive. Company legend has it that the idea was to paint the English rose the Scottish national colour, blue, as a kind of thank you for the invention of whisky, Tanaka says. More likely, it just seemed a good business idea. After all, blue flowers are rare, including among cut flowers. Chrysanthemums, carnations, tulips—none of them naturally comes in blue. Blue orchids have usually been artificially dyed. Decades of breeding have yielded roses in every shade of yellow, pink, and red, but never blue ones. Artists have long noted this rarity. In German romanticism, the blue flower became a symbol of longing and the unattainable. Rudyard Kipling dedicated a poem to someone tasked by his lover to find her a blue rose: "Half the world I wandered through/Seeking where such flowers grew." By the time he returns empty-handed, his love has died. Scientists got their first glimpse of the complexity behind blue flowers in 1913, when German researcher Richard Willstätter announced he had isolated the blue pigment from cornflowers. It was an anthocyanin he named cyanidin. Two years later, when he isolated the pigment of red roses, it turned out to be the exact same molecule. Anthocyanins can change colour depending on the acidity of a solution, so Willstätter proposed that roses had a different hue because the pH in their petals was lower than in cornflowers. It was the first scientific theory about blue flowers. And it was wrong. Over the following decades, a different story

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emerged, one that was finally confirmed by x-ray crystallography in 2005. Cyanidin itself does not produce a stable blue colour; instead, cornflowers combine six molecules of cyanidin with six molecules of a colourless copigment arranged around two metal ions—a huge molecular complex that stabilises the cyanidin molecules and allows one electron to make the right energy transition. “Flowers are doing crazy chemistry to generate that blue,” says Beverley Glover, a botanist at the University of Cambridge in the United Kingdom. Several other blue flowers have hit on the same trick, but most produce a different anthocyanin, called delphinidin, that can more easily be coaxed to appear blue. The only difference between cyanidin and delphinidin is that the latter has an extra oxygen atom on one of its rings, put there by an enzyme called flavonoid 3',5'-hydroxylase. The entire family of roses, which includes apples and pears, lacks the enzyme, which means that delphinidin-producing roses can't be produced through traditional breeding.

Tanaka is trying genetic engineering instead. By 1991, he and his colleagues had identified and patented the flavonoid 3',5'-hydroxylase gene in petunias. Transferring that gene into carnations coaxed them into producing delphinidin, turning them a purplish blue. But when the team shuttled the gene into roses, using the bacterium *Agrobacterium tumefaciens* as a courier, they didn't start to produce the blue pigment for some reason. It was the same gene from pansies that finally led to the delphinidin-making—but not very blue—rose unveiled in 2004. Apparently, producing delphinidin alone wasn't enough. Scientists had to do some crazy chemistry themselves. Since then, Tanaka's main strategy has been to transfer genes from bellflowers, pansies, and other blue flowers to “decorate” delphinidin chemically, hoping to hit a magic combination. Last year, he showed a visitor hundreds of tiny rose plants growing under fluorescent lights in his lab. “All of them are just to get a new blue colour,” he said. In the meantime, however, a collaboration between Tanaka and a group led by Naonobu Noda at the Institute of Vegetable and Floriculture Science in Tsukuba, Japan, has led to an indisputably blue flower: a blue chrysanthemum. In a 2017 *Science Advances* paper, the researchers reported that inserting the flavonoid 3',5'-hydroxylase gene from bellflowers into red chrysanthemums, along with a gene that adds a glucose molecule, resulted in “the most blueshifted flowers” ever genetically engineered. Their idea was that the glucose would allow the flower's natural enzymes to attach further chemical groups to delphinidin, creating a stronger blue. To their surprise, added groups weren't necessary; instead, the glucose helped delphinidin assemble with copigments naturally produced in the flower, shifting the

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colour to blue. Using the exact same strategy has not worked in roses, probably because they don't have the same copigments and have a lower pH. But Tanaka has not given up. He has tried to add genes from gentian that modify the delphinidin and genes from the genus *Torenia* that produce copigments. In a nod to Willstätter, he is even trying to change the pH in the rose petals. Tanaka is confident he will develop bluer roses before his retirement, only 5 years away, but almost 30 years of pursuing his quest have also taught him to be cautious: "It is hard to say how blue they will be."

Doughnuts to dye for

Scientists are looking for a natural pigment to turn food blue. At first, Cathie Martin was interested in the nutritional value of food pigments. Then, she became obsessed with blue food for its own sake. A decade ago, Martin, a scientist at the John Innes Centre here, genetically engineered tomatoes to produce anthocyanins in their fruits, so that other scientists could compare their dietary effects in humans with those of regular tomatoes. But the pigments also turned the vegetable a dark, purplish blue. And Martin began to wonder how to make other food blue. Few foods are naturally blue, but the colour has long been in demand as a food colorant. Synthetic ultramarine was once used to whiten cane sugar, which has a yellowish tinge. Blue food dyes are used to colour candy, coatings, or drinks. They are also mixed with other colours. "We must have blue to make all the colours of the spectrum," says Richard van Breemen, a chemist who investigates natural products at Oregon State University in Corvallis. Currently, there's not a lot to choose from. Two synthetic blue food dyes are approved in the United States: Brilliant blue, also named blue No. 1, was originally made from coal tar, like many synthetic dyes, and blue No. 2, or indigo karmine, is derived from synthetic indigo. Another synthetic blue colorant is available in the European Union: patent blue V, which gives blue curaçao liqueur its hue. Because consumers prefer natural ingredients, big companies such as Mars and Pepsi have invested in replacements for the synthetic colorants, with little success so far. "One of the big frustrations with the colour blue is that it is very, very difficult to reproduce the colours that you see in nature with compounds that can be used in the same way for colouring food," Martin says. The only natural blue colorant is a crude extract derived from spirulina algae that the U.S. Food and Drug Administration approved for use in confectionery and other food in 2014. But it is not very stable, Martin says—or very blue, for that matter. "It's a terrible blue," she says. "It's green really." And the colour may change or disappear when foods are baked or boiled or exposed to

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light on grocery shelves. Van Breemen has looked for better candidates in the microbial world. Reasoning that he was more likely to find stable blues in extreme conditions, he studied microbes from the hot springs at Yellowstone National Park, for instance; he also searched in marine bacteria. But none of the blue pigments he found was suitable. Many are chemical weapons, which the microbes release to fight other microbes, he says—making them more promising as antibiotics than as food colorants. Plants may be a better bet, and they offer many compounds to choose from. Although most blue flowers create pigments based on delphinidin, they vary the molecule by adding different chemical groups, and many of the intermediates in the chemical pathway leading to delphinidin are blue as well. Martin is hoping she'll find a safe, stable food dye in the butterfly pea, whose beautiful blue flowers give the Malay rice dish nasi kerabu its blue colour. (The flower's colour, however, was not what most struck the men who gave the genus its Latin name, *Clitoria*.)

Martin initially bought *Clitoria* blossoms online, from Amazon, but stocks soon ran out; more recently, she received three bulging bags of blossoms from Saudi Arabia, where a scientist who had visited her lab asked people to collect them in the wild. A mix of butterfly pea anthocyanins has worked well for some food applications, Martin says. Researchers in her lab have used it to make bluish frosting for cupcakes and doughnuts as well as blue ice cream. But these pigments, too, are fleeting. "Most blue anthocyanins have a half-life of about 24 hours. And we're talking about something that needs at least about 3 months," Martin says. So, her quest continues.

The deepest blue

A mineral created under immense pressure inspired the search for a new pigment. Geologist David Dobson of University College London (UCL) never realized that blue pigments are a big deal until he saw the excitement that a sample of the world's newest blue, Mas Subramanian's YInMn , created among colleagues at UCL's Slade School of Fine Art. "I thought: Hang on a minute," Dobson says. "I'm making blue all the time in my lab." Dobson studies the transition zone, the part of Earth's mantle that stretches from about 410 to 660 kilometres beneath our feet. In his lab, he squeezes mineral samples in a machine called a multianvil cell to replicate the gigantic pressure at those depths—about 200,000 times that at Earth's surface. Under those circumstances, the four elements that make up olivine, the most common mineral in the mantle—iron, magnesium, silicon, and oxygen—form a different mineral called ringwoodite, whose physical and chemical properties Dobson is studying. The millimetre-size

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crumbs of ringwoodite also happen to be a deep blue. Having seen the success of YInMn, Dobson decided to turn his deep-Earth blue into a new pigment. He expects it will find a market, if only because not everybody sees YInMn as the perfect blue. The rare earth element indium, one of its ingredients, makes it expensive; a 40-milliliter tube of the acrylic paint that made a splash at the Slade School, produced by a company named Derivan, sells for \$130 or more. And it “was actually a bit soupy,” says Jo Volley, a lecturer at the Slade School. First, Dobson had to understand where ringwoodite’s colour comes from. “Everyone was used to it being blue, and no one had really considered that much why,” he says. He found that the colour arises not from an energy transition within one atom, but from the exchange of an electron between two types of iron ions, Fe²⁺ and Fe³⁺. (The same mechanism accounts for the colour of Prussian blue, a pigment discovered by chance in 1706 when Berlin alchemists used contaminated potash in a recipe for a red pigment.) Ringwoodite’s structure, with the iron ions surrounded by four oxygen atoms in a tetrahedral coordination, creates the right conditions for the electron swap to absorb red light. But that arrangement is stable only at the huge pressure in Earth’s interior. At the surface, even simply grinding the mineral destroys the structure—and the colour. Dobson tried to create a similar structure that is stable at a pressure of 1 atmosphere by starting with zinc germanate, a mineral that also has metal ions—in this case zinc and germanium—surrounded by oxygen atoms. If enough iron replaces the zinc and germanium, the structure turns blue, Dobson says. He has already produced a sample of re-engineered zinc germanate in his lab, and it is blue—but he hopes to make the colour richer by adding more iron. Three centuries ago, Dutch painter Pieter van der Werff used newly discovered Prussian blue to colour the sky and Mary’s veil in a painting depicting the entombment of Christ. Subramanian’s wife Rajeevi—a solid state chemist as well as an artist—was the first to use YInMn; it proved perfect for a painting of Crater Lake, not far from the couple’s home, which is famous for its deep blue water. Dobson hopes to develop a pigment that is similarly appealing. As the first blue pigment to be designed from scratch, rather than accidentally discovered or borrowed from nature, it would open a new chapter in humanity’s love affair with blue.

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First Drone Survey of Chernobyl's 'Red Forest' Reveals Staggering Radioactive Hotspots

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It's been 33 years since the Chernobyl nuclear power plant tragically blew apart in a meltdown, spreading nuclear fallout across the land. A lot has changed, but the surroundings still contain some of the most radioactive patches of soil on the planet. Last month, researchers from the University of Bristol mapped that radioactivity in a comprehensive survey of a fraction of the exclusion zone, uncovering surprising hotspots local authorities had no idea existed. The team used two types of unmanned aerial vehicle (UAV) in an unprecedented fashion, mapping 15 square kilometres (5.8 square miles) of Chernobyl's 2,600 square kilometre (1,000 square miles) exclusion zone in 3D. They used the pulsed laser system known as LIDAR to measure contours in the landscape while recording radiation levels with a lightweight gamma-ray spectrometer. A rotary-wing UAV was used to get a closer look at anything that caught their eye. Over a period of 10 days the team sent a fixed-wing survey craft out on 50 sorties to sweep the area in a grid-pattern, starting near the relatively low-risk village of Buriakivka before making their way towards the zone's epicentre. One specific feature that held the researchers' interest was the 10-square-kilometre (4 square miles) Red Forest – a dense woodland of dead pine trees near the ruins of the old reactor. The forest weathered the brunt of the station's cloud of debris, and to this day contains some of the most intense patches of radioactivity you'll find anywhere on Earth's surface. Thanks to University of Bristol team's survey, we have a better idea of just what that means. Amid the rusting remains of an assortment of vehicles in an old depot, radiation levels surge magnitudes beyond anything found nearby, providing any daring visitor with a year's worth of sieverts in the space of a few hours. The hotspot's intensity might have been unexpected, but its location makes sense given the facility's role in separating contaminated soil during the disaster's clean-up. "It's mother nature doing her job here," project leader Tom Scott told ITV science reporter Tom Clarke. "Some of the radioactivity has died away, so the overall levels have dropped significantly. But there are certain radioisotopes present that have very long half-lives, and so they're going to be around for a long time." Knowing exactly which areas will remain dangerous for decades to come, and which are safe to visit, will be vital for future efforts to reclaim the area. Abandoned settlements like the nearby ghost town of Pripjat are unlikely to see new life any time soon, with Ukrainian authorities estimating it will be tens of thousands of years before the area could be declared safe for human habitation. But that doesn't put the entire

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area completely off limits. Chernobyl might not be everybody's idea of a holiday hotspot, but each year around 70,000 tourists enter the exclusion zone under the careful watch of a local guide. The site of the old station is being resurrected as a solar plant, outfitted with 3,800 photovoltaic panels to convert sunlight into a small but admirable megawatt of electricity to the local grid. Meanwhile life scientists are paying close attention to how biology responds to both the fading wash of radiation and the sudden absence of humans. Having highly detailed maps identifying the safest paths for entrants to follow would benefit any intrepid traveller or researcher interested in studying the aftermath of one of the biggest human-caused disasters in the modern age.

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Scientists Just Revealed a Brand New Type of Endlessly Recyclable Plastic

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In a perfect world, plastic would never be on a one-way trip into landfill - it's a vision we've strived to realise for decades. Unfortunately, some plastics just don't recycle as easily as others, limiting how well we can reuse them in new products. But a new kind of plastic might help change all that. Researchers at the US Department of Energy's Lawrence Berkeley National Laboratory have designed a new kind of plastic polymer that can be broken down and built up again with the simplicity of a molecular Lego brick. "Most plastics were never made to be recycled," says chemist Peter Christensen. "But we have discovered a new way to assemble plastics that takes recycling into consideration from a molecular perspective." All plastics are more or less repeating units - or monomers - of compounds derived from an organic substance like petroleum. That stringy web of molecules can be mixed with a wide variety of chemicals, giving plastics diverse properties that allow us to use them for just about anything from shopping bags to clothing, to straws, and furniture. To the eternal confusion of consumers everywhere, some of those plastics can be broken down into components and recycled relatively easily. But not all. We might be able to throw our polyethylene terephthalate (PET) drink bottles into the recycling bin, but not a tough, thermoset plastic toy or utensil. Many plastics suffer from those additives that cling to the molecular chains to colour, soften, or harden them, making for an unpredictable mess of ingredients to convert into a durable product we can easily afford. Researchers have made some headway on redesigning thermoset plastics

Researchers at the US Department of Energy's Lawrence Berkeley National Laboratory have designed a new kind of plastic polymer that can be broken down and built up again with the simplicity of a molecular Lego brick.

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to become recyclable, but to really solve our growing plastics crisis we need to make the process as efficient and simple as possible, and the new type of plastic developed at the Berkeley Lab has the potential to meet such demands. Its building block is a monomer called diketoenamine: a compound formed by sticking a triketone to an amine. Condensing these units into a long string forms a plastic called poly(diketoenamine) – or PDK – and the bonds can be dissolved with ease using nothing more than a 12-hour soak in a strong acid bath. “With PDKs, the immutable bonds of conventional plastics are replaced with reversible bonds that allow the plastic to be recycled more effectively,” says chemist and team leader Brett Helms. By breaking the polymers down easily, the plastic’s core units can be separated from any additives over and over again in what is described as a closed-loop cycle. The researchers tested the recovery process by contaminating PDK and acid solutions with other substances, including fibreglass and flame-retardant chemicals, finding the additives had little impact on their diketoenamine harvest. The end result is a plastic ingredient that can shake off any colours or strengthening agents in several easy steps to be turned back into another product. “We’re interested in the chemistry that redirects plastic lifecycles from linear to circular,” said Helms. “We see an opportunity to make a difference for where there are no recycling options.” Right now, most of our recycling efforts are abysmal. While some countries are doing all they can, countries like the US are barely managing to recycle a quarter of their PET waste. Governments can always do their bit to enforce action, but at the end of the day, money talks. Earlier this year, researchers showed how we might be able to turn plastic into a far more lucrative resource: fuel. Any methods we can find to make recycling easy for the consumer and appealing to the manufacturer are worth investigating. We’re of course a long way from sending our PDK forks to an acid tank at our local recycling plant. Further research is needed to test the polymer’s suitability for various applications. Nobody wants a bendy plastic knife or a brittle shopping bag, no matter how recyclable it is. But whatever the results, this is what the future of plastics looks like – and we need it urgently. This research was published in Nature Chemistry.

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Scientists Just Created a Bizarre Form of Ice That's Half as Hot as The Sun

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It has taken one of the most powerful lasers on the planet, but scientists have done it. They've confirmed the existence of 'superionic' hot ice - frozen water that can remain solid at thousands of degrees of heat. This bizarre form of ice is possible because of tremendous pressure, and the findings of the experiment could shed light on the interior structure of giant ice planets such as Uranus and Neptune. On Earth's surface, the boiling and freezing points of water vary only a little - generally boiling when it's very hot, and freezing when it's cold. But both these state changes are at the whim of pressure (that's why the boiling point of water is lower at higher altitudes). In the vacuum of space, water can't exist in its liquid form. It immediately boils and vaporises even at -270 degrees Celsius - the average temperature of the Universe - before desublimating into ice crystals. But it's been theorised that in extremely high-pressure environments, the opposite occurs: the water solidifies, even at extremely high temperatures. Scientists at Lawrence Livermore National Laboratory directly observed this for the first time just recently, detailed in a paper last year. They created Ice VII, which is the crystalline form of ice above 30,000 times Earth's atmospheric pressure, or 3 gigapascals, and blasted it with lasers. The resulting ice had a conductive flow of ions, rather than electrons, which is why it's called superionic ice. Now they've confirmed it with follow-up experiments. They have proposed the new form be named Ice XVIII. In the previous experiment, the team had only been able to observe general properties, such as energy and temperature; the finer details of the internal structure remained elusive. So, they designed an experiment using laser pulses and X-ray diffraction to reveal the ice's crystalline structure. "We wanted to determine the atomic structure of superionic water," said physicist Federica Coppari of the LLNL. "But given the extreme conditions at which this elusive state of matter is predicted to be stable, compressing water to such pressures and temperatures and simultaneously taking snapshots of the atomic structure was an extremely difficult task, which required an innovative experimental design." Here's that design. First, a thin layer of water is placed between two diamond anvils. Then six giant lasers are used to generate a series of shockwaves at progressively increasing intensity to compress the water at pressures up to 100-400 gigapascals, or 1 to 4 million times Earth's atmospheric pressure. At the same time, they produce temperatures between 1,650 and 2,760 degrees Celsius (the surface of the Sun is 5,505 degrees Celsius). This experiment was designed so that the water would freeze

It has taken one of the most powerful lasers on the planet, but scientists have done it.

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when compressed, but since the pressure and temperature conditions could only be maintained for a fraction of a second, the physicists were uncertain that the ice crystals would form and grow. So, they used lasers to blast a tiny piece of iron foil with 16 additional pulses, creating a wave of plasma that generated an X-ray flash at precisely the right time. These flashes diffracted off the crystals inside, showing the compressed water was indeed frozen and stable. "The X-ray diffraction patterns we measured are an unambiguous signature for dense ice crystals forming during the ultrafast shockwave compression demonstrating that nucleation of solid ice from liquid water is fast enough to be observed in the nanosecond timescale of the experiment," Coppari said. These X-rays showed a never-before-seen structure - cubic crystals with oxygen atoms at each corner, and an oxygen atom in the centre of each face. "Finding direct evidence for the existence of crystalline lattice of oxygen brings the last missing piece to the puzzle regarding the existence of superionic water ice," said physicist Marius Millot of the LLNL. "This gives additional strength to the evidence for the existence of superionic ice we collected last year." The result reveals a clue to how ice giants such as Neptune and Uranus could have such strange magnetic fields, tilted at bizarre angles, and with equators that don't circle the planet. Previously, it was thought that these planets had a fluid ocean of ionic water and ammonia in place of a mantle. But the team's research shows that these planets could have a solid mantle, like Earth, but made of hot superionic ice instead of hot rock. Because superionic ice is highly conductive, this could be influencing the planets' magnetic fields. "Because water ice at Uranus and Neptune's interior conditions has a crystalline lattice, we argue that superionic ice should not flow like a liquid such as the fluid iron outer core of the Earth. Rather, it's probably better to picture that superionic ice would flow similarly to the Earth's mantle, which is made of solid rock, yet flows and supports large-scale convective motions on the very long geological timescales," Millot said. "This can dramatically affect our understanding of the internal structure and the evolution of the icy giant planets, as well as all their numerous extrasolar cousins." The research has been published in Nature.

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Discovery illuminates how bacteria turn methane gas into liquid methanol

Methane-consuming bacteria could be the future of fuel

2019-05-14

Known for their ability to remove methane from the environment and convert it into a usable fuel, methanotrophic bacteria have long fascinated researchers. But how, exactly, these bacteria naturally perform such a complex reaction has been a mystery. Now an interdisciplinary team at Northwestern University has found that the enzyme responsible for the methane-methanol conversion catalyses this reaction at a site that contains just one copper ion. This finding could lead to newly designed, human-made catalysts that can convert methane -- a highly potent greenhouse gas -- to readily usable methanol with the same effortless mechanism. "The identity and structure of the metal ions responsible for catalysis have remained elusive for decades," said Northwestern's Amy C. Rosenzweig, co-senior author of the study. "Our study provides a major leap forward in understanding how bacteria methane-to-methanol conversion." "By identifying the type of copper centre involved, we have laid the foundation for determining how nature carries out one of its most challenging reactions," said Brian M. Hoffman, co-senior author. The study was published 10 May in the journal *Science*. Rosenzweig is the Weinberg Family Distinguished Professor of Life Sciences in Northwestern's Weinberg College of Arts and Sciences. Hoffman is the Charles E. and Emma H. Morrison Professor of Chemistry at Weinberg. By oxidising methane and converting it to methanol, methanotrophic bacteria (or "methanotrophs") can pack a one-two punch. Not only are they removing a harmful greenhouse gas from the environment, they are also generating a readily usable, sustainable fuel for automobiles, electricity and more. Current industrial processes to catalyse a methane-to-methanol reaction require tremendous pressure and extreme temperatures, reaching higher than 1,300 degrees Celsius. Methanotrophs, however, perform the reaction at room temperature and "for free." "While copper sites are known to catalyse methane-to-methanol conversion in human-made materials, methane-to-methanol catalysis at a monocopper site under ambient conditions is unprecedented," said Matthew O. Ross, a graduate student co-advised by Rosenzweig and Hoffman and the paper's first author. "If we can develop a complete understanding of how they perform this conversion at such mild conditions, we can optimise our own catalysts." The study, "Particulate methane monooxygenase contains only mononuclear copper centres," was supported by the National Institutes of Health (award numbers

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Viable, environmentally-friendly alternative to Styrofoam

2019-05-14

Washington State University researchers have developed an environmentally-friendly, plant-based material that for the first time works better than Styrofoam for insulation. The foam is mostly made from nanocrystals of cellulose, the most abundant plant material on earth. The researchers also developed an environmentally friendly and simple manufacturing process to make the foam, using water as a solvent instead of other harmful solvents. The work, led by Amir Ameli, assistant professor in the School of Mechanical and Materials Engineering, and Xiao Zhang, associate professor in the Gene and Linda School of Chemical Engineering and Bioengineering, is published in the journal *Carbohydrate Polymers*. Researchers have been working to develop an environmentally friendly replacement for polystyrene foam, or Styrofoam. The popular material, made from petroleum, is used in everything from coffee cups to materials for building and construction, transportation, and packaging industries. But it is made from toxic ingredients, depends on petroleum, doesn't degrade naturally, and creates pollution when it burns. While other researchers have created other cellulose-based foams, the plant-based versions haven't performed as well as Styrofoam. They are not as strong, don't insulate as well, and degraded at higher temperatures and in humidity. To make cellulose nanocrystals, researchers use acid hydrolysis, in which acid is used to cleave chemical bonds. In their work, the WSU team created a material that is made of about 75 percent cellulose nanocrystals from wood pulp. They added polyvinyl alcohol, another polymer that bonds with the nanocellulose crystals and makes the resultant foams more elastic. The material that they created contains a uniform cellular structure that means it is a good insulator. For the first time, the researchers report, the plant-based material surpassed the insulation capabilities of Styrofoam. It is also very lightweight and can support up to 200 times its weight without changing shape. It degrades well, and burning it doesn't produce polluting ash. "We have used an easy method to make high-performance, composite foams based on nanocrystalline cellulose with an excellent combination of

Researchers have developed an environmentally-friendly, plant-based material that for the first time works better than Styrofoam for insulation.

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thermal insulation capability and mechanical properties," Ameli said. "Our results demonstrate the potential of renewable materials, such as nanocellulose, for high-performance thermal insulation materials that can contribute to energy savings, less usage of petroleum-based materials, and reduction of adverse environmental impacts." "This is a fundamental demonstration of the potential of nanocrystalline cellulose as an important industrial material," Zhang said. "This promising material has many desirable properties, and to be able to transfer these properties to a bulk scale for the first time through this engineered approach is very exciting." The researchers are now developing formulations for stronger and more durable materials for practical applications. They are interested in incorporating low-cost feedstocks to make a commercially viable product and considering how to move from laboratory to a real-world manufacturing scale.

Science Daily, 9 May 2019

<http://www.sciencedaily.com>

Precise temperature measurements with invisible light

2019-05-14

Ordinarily, you won't encounter a radiation thermometer until somebody puts one in your ear at the doctor's office or you point one at your forehead when you're feeling feverish. But more sophisticated and highly calibrated research-grade "non-contact" thermometers--which measure the infrared (heat) radiation given off by objects without touching them--are critically important to many endeavours besides health care. However, even high-end conventional radiation thermometers have produced readings with worryingly large uncertainties. But now researchers at the National Institute of Standards and Technology (NIST) have invented a portable, remarkably stable standards-quality radiation thermometer about 60 centimetres (24 inches) long that is capable of measuring temperatures to a precision of within a few thousandths of a degree Celsius. NIST has a long history of studying radiation thermometers. The new prototype instrument, which builds on that work, can measure temperatures between -50 C (-58 F) to 150 C (302 F). The corresponding infrared wavelengths are from 8 to 14 micrometres (millionths of a metre), which is a sort of thermodynamic sweet spot. "All temperatures are equal, but some are more equal than others," said NIST physicist Howard Yoon, who created the thermometer design and directed the project, described in the journal *Optics Express*. "That 200-degree span covers nearly all naturally occurring temperatures on Earth. If you make a big

Novel infrared thermometer offers dramatically improved performance

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impact in measuring objects in that range, it really matters." In addition to clinical medicine, temperatures in that region are of urgent importance in applications where contact is not appropriate or feasible. For example, surgeons need to measure the temperature of organs prior to transplant. Modern farmers need accurate temperatures when handling, storing and processing food. Satellites require non-contact thermometers for measuring temperatures on land and the surface of the sea. Conventional radiation thermometers often contain little more than a lens for focusing the infrared radiation and a pyroelectric sensor, a device that converts heat energy into an electrical signal. Their measurements can be affected by temperature differences along the thermometer and by temperature outside the instrument. The NIST design, called the Ambient-Radiation Thermometer (ART), is fitted with a suite of interior thermometers that constantly gauge temperatures at different points in the instrument. Those readings are sent to a feedback loop system which keeps the 30-cm (12-inch) cylinder containing the detector assembly at a constant temperature of 23 C (72 F). It also features other design improvements, including a method for reducing errors from what is called the size-of-source effect, which results when radiation enters the instrument from areas outside its specified field of view. The ART's major advantage is its unprecedented stability. After it has been calibrated against standards-grade contact thermometers, the instrument can remain stable to within a few thousandths of a degree for months under continuous operation. That makes the system very promising for applications that involve remote sensing over long periods. "Imagine being able to take the NIST design out in the field as traveling radiation thermometers for accurately measuring variables such as land- and sea-surface temperatures," Yoon said. "It could serve as a trustworthy method of calibrating satellite IR sensors and validating the huge weather science programs that are used to predict, for example, the paths and strengths of hurricanes." Its lower range of -50 C (-58 F) makes it suitable for monitoring the temperature of ice over polar regions, typically in the range of -40 C (-40 F) to -10 C (14 F). There are several methods of making very high-accuracy temperature measurements, but few are well-suited to field work. Platinum resistance thermometers are fragile and need frequent recalibration. The standard temperature source for transferring that calibration to the ART involves a heat-source cavity inside about 42 litres (11 gallons) of liquid. "Those are the best sources we have," Yoon said. "But it is impractical to measure water temperature by putting a thermometer in the ocean at intervals, and you don't want to constantly calibrate your radiation thermometer using a calibration source like that on board a ship." Gerald Fraser, chief of NIST's Sensor Science Division, said that "Yoon's innovation makes

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non-contact thermometry competitive with the best commercial contact thermometers in accuracy and stability in a temperature range that humans experience daily. This enables many new opportunities in product inspection and quality control and in defence and security where conventional contact methods are impractical or too expensive."

EurekaAlert, 9 May 2019

<http://www.eurekaalert.org>

Discovery may lead to new materials for next-generation data storage

2019-05-14

Research funded in part by the U.S. Army identified properties in materials that could one day lead to applications such as more powerful data storage devices that continue to hold information even after a device has been powered off. A team of researchers led by Cornell University and the University of California Berkeley made a discovery that opens up a plethora of materials systems and physical phenomena that can now be explored. The scientists observed what's known as chirality for the first time in polar skyrmions in an exquisitely designed and synthesised artificial material with reversible electrical properties. Chirality is where two objects, like a pair of gloves, can be mirror images of each other but cannot be superimposed on one another. Polar skyrmions are textures made up of opposite electric charges known as dipoles. Researchers had always assumed that skyrmions would only appear in magnetic materials, where special interactions between magnetic spins of charged electrons stabilise the twisting chiral patterns of skyrmions. When the team discovered skyrmions in an electric material, they were astounded, they said. The combination of polar skyrmions and these electrical properties may allow for the development of novel devices that are of significant interest to the Army, especially using the chirality as a parameter that can be manipulated. "Now that we know that polar/electric skyrmions are chiral, we want to see if we can electrically manipulate them," said Dr. Ramamoorthy Ramesh, the co-principal investigator of this project. "If I apply an electric field, can I turn each one like a turnstile? Can I move each one, one at a time, like a checker on a checkerboard? If we can somehow move them, write them, and erase them for data storage, then that would be an amazing new technology." Researchers published their findings in the journal Nature. "This ground-breaking discovery can be used in the future to develop device structures that can be used to improve logic/memory, sensing, communications, and other applications for the Army as

Army-funded re-search demonstrates emergent chirality in polar skyrmions for the first time in oxide superlattices

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well as industry," said Dr. Pani (Chakrapani) Varanasi, chief of the Materials Science Division of the Army Research Office, an element of U.S. Army Combat Capabilities Command's Army Research Laboratory. When the team began the study in 2016, they had set out to find ways to control how heat moves through materials. They fabricated a special crystal structure called a superlattice from alternating layers of lead titanate (an electrically polar material, whereby one end is positively charged and the opposite end is negatively charged) and strontium titanate (an insulator, or a material that doesn't conduct electric current). The research team started to explore the synthesis of artificially designed and structured oxides, with the goal to explore emergent phenomena. Emergent phenomena are pervasive in nature - fish swimming in a school, birds flying in formation, the emergence of crowd and mobs are all examples of how interactions of discrete objects (fish, birds, humans) can lead to unexpected collective behaviour. Materials can also exhibit such emergent behaviour, especially when placed under constraints. When the scientists took scanning transmission electron microscopy measurements of the artificially engineered lead titanate/strontium titanate superlattice, they saw something strange that had nothing to do with heat: Bubble-like formations had cropped up all across the material. Lead titanate is a well-known ferroelectric material, while strontium titanate, its sister compound is not ferroelectric at room temperature. Ferroelectric are materials that have a spontaneous electric polarisation that can be reversed by the application of an external electric field. Those bubbles, it turns out, were polar skyrmions. While using sophisticated scanning transmission electron microscopy at Berkeley Lab's Molecular Foundry and at the Cornell Centre for Materials Research, David Muller of Cornell University took atomic snapshots of skyrmions' chirality at room temperature in real time. The researchers discovered that the forces placed on the polar lead titanate layer by the nonpolar strontium titanate layer generated the polar skyrmion bubbles in the lead titanate. "Materials are like people," Ramesh said. "When people get stressed, they respond in unpredictable ways. And that's what materials do too: In this case, by surrounding lead titanate by strontium titanate, lead titanate starts to go crazy - and one way that it goes crazy is to create polar textures like skyrmions instead of being uniformly polarised." "This work has enabled the discovery of a fundamentally new phenomena in oxide superlattices," Schlom said. "We now have a template based on epitaxy to create many other science universes. For example, we can start to look at spin-charge coupling in such superlattices; work on this is already underway." The researchers

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also plan to study the effects of applying an electric field on the polar skyrmions.

EurekAlert, 9 May 2019

<http://www.eurekalert.org>

Assessing battery performance: Compared to what?

2019-05-14

Scientists must often ask themselves, compared to what? How do the results we generate in the laboratory compare with those obtained by others? How do our theoretical calculations compare with experimental data? Answering such questions is especially crucial for researchers and developers of lithium-ion batteries. Invented four decades ago, lithium-ion batteries now power most portable electronics like laptops and power tools. They are also being developed to meet the high energy storage demands for powering electric vehicles and electric grids. New designs with different compositions of electrode and electrolyte—the two key battery components—are constantly coming online. Assessing whether an innovation in electrode or electrolyte material is actually an improvement requires comparing it to other test results. However, there is no “one size fits all” standard for battery testing. Methods for testing batteries can vary widely. Argonne battery researcher Ira Bloom notes, “Industrial engineers and researchers from governmental and academic labs often devise their own procedures for characterising lithium-ion batteries based on the battery technology’s intended application. This makes the comparison of any technological innovations extremely complicated.” A team from the U.S. Department of Energy’s (DOE) Argonne National Laboratory, University of Warwick, OVO Energy, Hawaii National Energy Institute, and Jaguar Land Rover has reviewed the literature on the various methods used around the world to characterise the performance of lithium-ion batteries in order to provide insight on best practices. Typically, battery researchers use three parameters to define electrochemical performance: capacity, open-circuit voltage, and resistance. Capacity is a measure of the total charge stored in a battery. The open-circuit voltage is the voltage available from a battery with no current flow. It represents the battery’s maximum voltage. The resistance is the degree to which the component materials impede the flow of electric current, resulting in a voltage drop. The problem is that, depending on battery application, researchers may measure these parameters under different test conditions (temperature, rate of discharge, state of charge, etc.), and thereby obtain a different battery operating life. Battery resistance, for example, can be measured

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with either a direct current or alternating current. "It's complicated," observes Anup Barai, a principal investigator and senior research fellow at the University of Warwick. "The appropriateness of a test depends on what the investigator is studying. Our review provides guidance on the most appropriate test method for a given situation." To that end, the team has produced an easy-to-use table comparing eight test methods, including the main equipment needed, the information generated, and the advantages and drawbacks for each. "Our hope," Bloom adds, "is that our results may one day lead to more reliably comparable methods for testing lithium-ion batteries tailored to different applications." The study, entitled "A comparison of methodologies for the non-invasive characterisation of commercial Li-ion cells," recently appeared in the online version of the journal *Progress in Energy and Combustion Science*.

Phys.org, 9 May 2019

<http://phys.org>

Reversible chemistry clears path for safer batteries

2019-05-14

Researchers at the University of Maryland (UMD) and US Army Research Lab (ARL) have taken a critical step on the path to high energy batteries by improving their water-in-salt battery with a new type of chemical transformation of the cathode that creates a reversible solid salt layer, a phenomenon yet unknown in the field of water-based batteries. Building on their previous discoveries of the water-in-salt electrolytes reported in *Science* in 2015, the researchers added a new cathode. This new cathode material, lacking transition metal, operates at an average potential of 4.2 volts with excellent cycling stability, and delivers an unprecedented energy density comparable, or perhaps higher than, non-aqueous Li-ion batteries. The authors report their work on May 9 in the journal *Nature*. "The University of Maryland and ARL research has produced the most creative new battery chemistry I have seen in at least 10 years," said Prof. Jeffrey Dahn of Dalhousie University in Canada, an expert in the field not affiliated with the research. "However, it remains to be seen if a practical device with long lifetime can be created." Leveraging the reversible halogens intercalation in graphite structures, enabled by a super-concentrated aqueous electrolyte, the team generated an energy density previously thought impossible. The researchers found that the superconcentrated solution of the water-in-salt battery, combined with graphite anode's ability to automatically build and re-form a protective layer within the battery, gave a stable and long-lasting battery with high

Researchers have taken a critical step on the path to high energy batteries by improving their water-in-salt battery with a new type of chemical transformation of the cathode that creates a reversible solid salt layer.

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energy. "This new cathode chemistry happens to be operating ideally in our previously-developed 'water-in-salt' aqueous electrolyte, which makes it even more unique—it combines high energy density of non-aqueous systems with high safety of aqueous systems," said a co-first author of the paper, Chongyin Yang, an assistant research scientist in the UMD department of chemical & biomolecular engineering. "This new 'Conversion-Intercalation' chemistry inherits the high energy of conversion-reaction and the excellent reversibility from intercalation of graphite," said Ji Chen, co-first author of the paper and a research associate in the department of chemical & biomolecular engineering. The team of researchers—led by Chunsheng Wang, ChBE Professor with a dual appointment in the Department of Chemistry and Biochemistry; Kang Xu, ARL Fellow; and Oleg Borodin, ARL scientist—have advanced the battery into a testable stage: the size of a small button, typically used as a test vehicle in research labs. More research is needed to scale it up into a practical, manufacturable battery. The energy output of the water-based battery reported in this study boasts 25% increased energy density of an ordinary cell phone battery based on flammable organic liquids, but is much safer. The new cathode is able to hold 240 milliamps per gram for an hour of operation, roughly twice that of a typical cathode currently found in cell phones and laptops. The water-in-salt battery could ultimately be used in applications involving large energies at kilowatt or megawatt levels, or where battery safety and toxicity are primary concerns, including non-flammable batteries for airplanes, naval vessels, or spaceships.

Phys.org, 9 May 2019

<http://phys.org>

Graphite coating makes perovskite solar cells waterproof

2019-05-14

A cheaper, cleaner and more sustainable way of making hydrogen fuel from water using sunlight is step closer thanks to new research from the University of Bath's Centre for Sustainable Chemical Technologies. With the pressure on global leaders to reduce carbon emissions significantly to solve a climate change emergency, there is an urgent need to develop cleaner energy alternatives to burning fossil fuels. Hydrogen is a zero-carbon emission fuel alternative that can be used to power cars, producing only water as a waste product. It can be made by splitting water into hydrogen and oxygen; however, the process requires large amounts of electricity. Most electricity is made by burning methane so researchers

Researchers used graphite film to coat perovskite solar cells and waterproof them.

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at the University of Bath are developing new solar cells that use light energy directly to split water. Most solar cells currently on the market are made of silicon, however they are expensive to make and require a lot of very pure silicon to manufacture. They are also quite thick and heavy, which limits their applications. Perovskite solar cells, using materials with the same 3-D structure as calcium titanium oxide, are cheaper to make, thinner and can be easily printed onto surfaces. They also work in low light conditions and can produce a higher voltage than silicon cells, meaning they could be used indoors to power devices without the need to plug into the mains. The downside is they are unstable in water which presents a huge obstacle in their development and also limits their use for the direct generation of clean hydrogen fuels. The team of scientists and chemical engineers, from the University of Bath's Centre for Sustainable Chemical Technologies, has solved this problem by using a waterproof coating from graphite, the material used in pencil leads. They tested the waterproofing by submerging the coated perovskite cells in water and using the harvested solar energy to split water into hydrogen and oxygen. The coated cells worked underwater for 30 hours—ten hours longer than the previous record. After this period, the glue sandwiching the coat to the cells failed; the scientists anticipate that using a stronger glue could stabilise the cells for even longer. Previously, alloys containing indium were used to protect the solar cells for water splitting, however indium is a rare metal and is therefore expensive and the mining process to obtain it is not sustainable. The Bath team instead used commercially available graphite, which is very cheap and much more sustainable than indium. Dr. Petra Cameron, Senior Lecturer in Chemistry, said: "Perovskite solar cell technology could make solar energy much more affordable for people and allow solar cells to be printed onto roof tiles. However, at the moment they are really unstable in water—solar cells are not much use if they dissolve in the rain!" "We've developed a coating that could effectively waterproof the cells for a range of applications. The most exciting thing about this is that we used commercially available graphite, which is much cheaper and more sustainable than the materials previously tried." Perovskite solar cells produce a higher voltage than silicon based cells, but still not enough needed to split water using solar cells alone. To solve this challenge, the team is adding catalysts to reduce the energy requirement needed to drive the reaction. Isabella Poli, Marie Curie FIRE Fellow and Ph.D. student from the Centre for Sustainable Chemical Technologies, said: "Currently hydrogen fuel is made by burning methane, which is neither clean nor sustainable." "But we hope that in the future we can create clean hydrogen

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and oxygen fuels from solar energy using perovskite cells."The study is published in the open access journal Nature Communications.

Phys.org, 8 May 2019

<http://phys.org>

Researchers create 'force field' for super materials

2019-05-14

Researchers have developed a revolutionary method to intricately grow and protect some of the world's most exciting nanomaterials -- graphene and carbon nanotubes (CNT). When curved and rolled into cylinders, thin graphene layers form CNT structures. These rolled sheets of carbon can be a thousandth of the diameter of human hair and possess extraordinary properties such as extreme electrical conduction, or 100 times the strength of high tensile steel. Although widely regarded as the key to developing future batteries and supercapacitor technologies, CNTs are plagued with environmental 'poisoning' which causes the materials to lose their catalyst properties. In a paper published by the journal Carbon, researchers from the University of Surrey detail their new method for covering the CNTs' catalyst by using a protective layer that is configured to allow carbon diffusion and thus can be used to protect the catalyst from environmental contamination. The technique allows the catalyst to be transported, stored or accurately calibrated for future use. Professor Ravi Silva, Director of Advanced Technology Institute, said: "The protective catalyst technique provides a breakthrough in terms of usability and industrial applicability of carbon nanomaterials. For example, the poisoning of the catalyst by environmental contamination such as oxidation and unwanted etching of the thin catalyst film during reactive ion etching or wet-etching can now be prevented." Lead author of the study, Dr Muhammad Ahmad from the University of Surrey, said: "The age-old problem of poor attachment of the nano-carbon materials to the substrate has now been solved using this unique technique. By fine tuning the thickness of the protective layer, accurate control of the carbon supply to the catalyst is achieved to grow selected numbers of graphene layers or precise CNT films." "We hope that our research will free fellow scientists to unlock the incredible potential of carbon nanomaterials and I would not be surprised to see advances in areas such as sensor, battery and supercapacitor technologies."

Researchers have developed a revolutionary method to intricately grow and protect some of the world's most exciting nanomaterials -- graphene and carbon nanotubes (CNT).

Science Daily, 9 May 2019

<http://www.sciencedaily.com>

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The secrets of secretion: Isolating eucalyptus genes for oils, biofuel

2019-05-14

What is the genetic basis for eucalyptus trees to produce that fragrant oil many of us associate with trips to the spa? Carsten Külheim, associate professor in Michigan Technological University's School of Forest Resources and Environmental Science, has spent the past 10 years of his career studying eucalyptus. They are diverse, fast-growing species that includes scrubby bushes and 300-foot-tall flowering trees -- mostly indigenous to Australia, but also New Guinea and Indonesia. In particular, Külheim studies terpenes, organic compounds found in the plant's leaves. Terpenes enable certain species (mostly plants, but also some insects) that produce them to give off strong odours that deter pests or attract pollinators. For example, hops, a primary ingredient in beer, contain terpenes, which gives the hops their piney smell. Certain varieties of eucalyptus and tea tree produce great quantities of just the right terpenes, which can be used for essential oils or biofuel distillation. It is said that Australia's Blue Mountains take their name from the smog-like mist eucalyptus trees emit, particularly on hot days; this mist is composed of terpenes vaporising in the heat. Külheim and his fellow researchers want to know what, at the genetic level, causes production of about 50 different terpenes so they can crank it up to use the oil as a renewable fuel. In the article "High marker density GWAS provides novel insights into the genomic architecture of terpene oil yield in Eucalyptus" in the journal *New Phytologist* (DOI: <https://doi.org/10.1111/nph.15887>), Külheim and his co-authors investigate the genetic basis of variation in oil yield in blue mallee, a eucalyptus native to Australia. This will allow for a faster and more efficient domestication, making the production of renewable fuels from eucalypt plantations more feasible. One reason for the interest in eucalyptus oil is because bioethanol (typically made from corn) and biodiesel (typically made with vegetable and soybean oils) do not have sufficient energy density to be useful for the aviation industry. Eucalyptus oil, however, can be converted into high-energy biofuel that can be used for jet fuel and even tactical missile fuel (JP-10). However, many eucalypts currently have not been domesticated and vary greatly in their oil yield. Using genome-wide association studies (GWAS), Külheim has identified the genes that produce the components of eucalyptus oil that may be used for jet fuel, and the aspects that may be used for the production of biodiesel. "This enables us to select for trees that mostly produce useful oil components for our purposes; we can use biotechnology to remove the genes for unwanted components or enhance the desired

What is the genetic basis for eucalyptus trees to produce that fragrant oil many of us associate with trips to the spa? Carsten Külheim, associate professor in Michigan Technological University's School of Forest Resources and Environmental Science, has spent the past 10 years of his career studying eucalyptus.

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ones," Külheim said. "We hope to provide eucalyptus farmers with genetic marker information to select trees at an earlier stage in their growth for higher terpene production. By choosing to cultivate new trees from power terpene producers, farmers are able to create new generations of the plants that naturally produce more oils." But beyond the promise of eucalyptus oil for biofuels and the beauty and wellness industries, the species could also prove an excellent cash crop for farmers in arid regions. The trees grow well in hot, dry regions, don't need to be irrigated, and thus do not compete with food production on arable land.

Science Daily, 8 May 2019

<http://www.sciencedaily.com>

Soaking up pharmaceuticals and personal care products from water

2019-05-14

Medications excreted in the urine or dumped into the toilet can end up in the water supply, just like lotions or cosmetics that wash off the body and go down the sink or shower drain. Unfortunately, conventional wastewater treatment cannot completely remove pharmaceuticals and personal care products (PPCPs). Now, researchers reporting in ACS Applied Materials & Interfaces have developed an adsorbent membrane that they say could be used to purify water contaminated with PPCPs. With rising standards of living worldwide, PPCP use has increased. Consequently, these substances are being detected in surface water, groundwater and even the tissues of fish and vegetables. Some PPCPs are endocrine disruptors or could otherwise negatively affect human health or the environment. Scientists have shown that materials called porous aromatic frameworks (PAFs) can remove pollutants from water. But because PAFs are in powder form and don't dissolve in most solvents, they are difficult to handle and recycle. Guangshan Zhu and colleagues from Northeast Normal University wondered if they could make an adsorbent material for PPCP removal by coating the surfaces of electrospun fibre membranes with PAFs. The researchers electrospun a polymer called polyacrylonitrile into a fibrous membrane, which they coated with polyaniline to help attach PAFs to the surface. Then, they added biphenyl molecules and reacted them to grow PAF-45 on the polyaniline-coated fibres. The modified membrane adsorbed three model PPCPs -- ibuprofen, chloroxylenol and diethyl-meta-toluamide (DEET) -- with capacities higher than most other reported adsorbents. In addition, the membrane was recyclable: The team removed

Researchers have developed an adsorbent membrane that they say could be used to purify water contaminated with PPCPs.

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the adsorbed PPCPs with ethanol and reused the membrane for 10 adsorption-desorption cycles, with only a slight decrease in capacity.

EurekaAlert, 8 May 2019

<http://www.eurekaalert.org>

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Healthy plant-based diet (but not plant-based junk food) may protect kidneys

2019-05-15

Researchers examined data on eating habits and kidney function for 14,686 middle-aged adults, following half of them for at least 24 years. Overall, 4,343 participants developed chronic kidney disease. People who most closely adhered to a diet of healthy plant-based foods were 14 percent less likely to develop kidney disease than individuals who rarely ate these foods, the study found. At the same time, participants who consumed the greatest amount of unhealthy vegetarian foods were 11 percent more likely to develop kidney disease than people who ate the smallest amounts of these foods. "Relatively higher intakes of healthful plant foods and relatively lower intakes of less healthful plant foods and animal foods are associated with favourable kidney outcomes," said senior study author Casey Rebholz of the Johns Hopkins Bloomberg School of Public Health in Baltimore. "We believe that healthful plant foods played an important role because higher consumption of healthful plant foods were associated with a lower risk of kidney disease and slower decline in kidney function when the consumption of less healthful plant foods and animal foods were held constant," Rebholz said by email. A healthy plant-based diet includes whole grain foods; fruits like apples, pears, and oranges; veggies like dark, leafy greens, sweet potatoes, and broccoli; nuts and natural peanut butter; and legumes like string beans and lentils. Study participants who had the healthiest plant-based diets consumed an average of nine to ten servings a day of these foods. These individuals were more likely to be women, white, older, high school graduates, and physically active. An unhealthy plant-based diet may limit meat but load up on potatoes. This type of diet might also include juice instead of whole fruit, sodas and sugary drinks, and lots of candy, cake and chocolate. Participants who had the least healthy plant-based diets consumed an average of seven servings a day of these foods. They were more likely to be men, younger, sedentary, and drink more alcohol. The association between plant-based diets and chronic kidney risk was especially pronounced for people with a normal weight at the start of the study, researchers report in the *Clinical Journal of the American Society of Nephrology*. The study wasn't a controlled experiment designed to prove that certain eating patterns directly contribute to kidney disease. One limitation of the study is that researchers relied on participants to accurately recall what they ate and drank, which can lead to measurement errors, the study authors note. Researchers also may not have had a complete picture of long-term eating habits. Still, it's possible eating more fruits and vegetables may make it

While a healthy-plant based diet is tied to a lower risk of kidney disease, people who fill their plates with starchy, sugary vegetarian fare may actually increase their risk of kidney damage, a new study suggests.

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easier for the kidneys to rid the body of toxins, said Dr. Michal Melamed of Albert Einstein College of Medicine and Montefiore Medical Centre in Bronx, New York. Fruits and vegetables have less acid, putting less demand on the kidneys than meats which have a lot of acid. "It could also be that the people who eat more fruits and vegetables also do other things, such as exercise more, get more sleep, or in general have a healthier lifestyle and that is the reason why this association is seen," Melamed, who wasn't involved in the study, said by email. "In general, multiple studies have shown that eating a lot of processed meats and red meats is probably not good for people, not just for their kidney health but also for the heart."

Reuters Health, 4 May 2019

<http://www.reuters.com/news/health>

Study finds lifestyle factors that could harden arteries

2019-05-15

A new study from the University of Georgia pinpoints lifestyle factors that could lead to hardened arteries. One of the largest of its kind, the study performed an untargeted metabolomics profile of over 1,200 participants of the Bogalusa Heart Study to identify metabolites linked to the hardening of arteries. Hardening arteries, or arterial stiffness, is an independent risk factor for heart disease and death, and the mechanisms that contribute to arterial stiffening are not well understood. That's where metabolomics can help pull back the curtain on how and when arterial stiffness begins to occur. Metabolomics is the study of metabolites, which are created each time there is a transfer of energy in the body. Metabolites play a key role in maintaining the body's normal function, and changes in metabolite levels can reflect how environmental factors, like smoking, diet or pollutants, influence health. "Metabolomics can accurately measure the amount of exposures entering the body," said study author Changwei Li. "In this study, we identified many metabolites related to coffee drinking, alcohol drinking, Southern foods, dietary supplements, and even pesticides," said Li, an assistant professor of epidemiology and biostatistics at UGA's College of Public Health. Using the most up-to-date panel of metabolites, Li and his colleagues ran an analysis on participant blood samples, looking for environmental exposures that had an impact on measures of arterial stiffness. The study found 27 new metabolites associated with arterial stiffness. "We were able to identify some environmental and lifestyle related-metabolites, build metabolite networks to shown how the body reacts to the environmental exposures, and more importantly, tested the effect of those metabolites on arterial

A new study from the University of Georgia pinpoints lifestyle factors that could lead to hardened arteries.

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stiffness," said Li. The majority of these were associated with other known risk factors of arterial stiffness like high blood pressure, high cholesterol or diabetes. But some of these metabolites are food additives and cooking ingredients found in many U.S. kitchens. For example, the team identified two peptides—gamma-glutamylvaline and gamma-glutamylisoleucine—that are commonly used to enhance the savory taste of chicken broth. "Our study raised possibility that those additives may cause arterial stiffness. Given the wide usage of those additives, future studies are warranted to investigate their role in arterial stiffness." To be clear, said Li, the current study is a snapshot of metabolites. The relationship between some of the metabolites and arterial stiffness over time is unclear, and he has plans to run this study again using longitudinal data. The full report of the findings can be found in the current issue of the American Journal of Hypertension.

Medical Xpress, 6 May 2019

<http://medicalxpress.com>

Avoid smoky environments to protect your heart

2019-05-15

If a room or car is smoky, stay away until it has cleared. That's the main message of research presented at EuroHeartCare 2019, a scientific congress of the European Society of Cardiology (ESC). "Avoid exposure to secondhand smoke regardless of whether the smoker is still in the room," said study author Professor Byung Jin Kim, of Sungkyunkwan University, Seoul, Republic of Korea. "Our study in non-smokers shows that the risk of high blood pressure (hypertension) is higher with longer duration of passive smoking -- but even the lowest amounts are dangerous." Passive smoking at home or work was linked with a 13% increased risk of hypertension. Living with a smoker after age 20 was associated with a 15% greater risk. Exposure to passive smoking for ten years or more was related to a 17% increased risk of hypertension. Men and women were equally affected. Participants with hypertension were significantly more likely to be exposed to secondhand smoke at home or work (27.9%) than those with normal blood pressure (22.6%). Hypertension was significantly more common in people exposed to passive smoke at home or work (7.2%) compared to no exposure (5.5%). High blood pressure is the leading global cause of premature death, accounting for almost ten million deaths in 2015, and those affected are advised to quit smoking. Previous research has suggested a link between passive smoking and hypertension in non-smokers. But most studies were small, restricted to women, and used self-reported questionnaires in which respondents typically over-report never-

If a room or car is smoky, stay away until it has cleared. That's the main message of new research.

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smoking. This is the first large study to assess the association between secondhand smoke and hypertension in never-smokers verified by urinary levels of cotinine, the principal metabolite of nicotine. It included 131,739 never-smokers, one-third men, and an average age of 35 years. "The results suggest that it is necessary to keep completely away from secondhand smoke, not just reduce exposure, to protect against hypertension," said Professor Kim. "While efforts have been made around the world to minimise the dangers of passive smoking by expanding no smoking areas in public places, our study shows that more than one in five never-smokers are still exposed to secondhand smoke. Stricter smoking bans are needed, together with more help for smokers to kick the habit. Knowing that family members suffer should be extra motivation for smokers to quit," he said.

Science Daily, 3 May 2019

<http://www.sciencedaily.com>

Tupperware seeks plastic circularity

2019-05-15

Tupperware plans to incorporate Sabic's circular polymers in its products. Sabic has been working with the UK-based start-up Plastic Energy, which has a technology for making pyrolysis oil from plastic waste. Sabic will take that liquid and process it into polyethylene and polypropylene. The two firms anticipate having a commercial-scale plant running in the Netherlands next year. The first products Tupperware hopes to make with the recycled plastics are a reusable straw and an on-the-go coffee cup.

Chemical & Engineering News, 4 May 2019

<http://pubs.acs.org/cen/news>

Tupperware plans to incorporate Sabic's circular polymers in its products.

FDA: Ambien Is Making People Kill Themselves While Asleep

2019-05-15

Sleep medications including Ambien have become infamous for prompting people to act bizarrely in a semi-sleeping stupor — but now the U.S. Food and Drug Administration (FDA) will require sleeping pill manufacturers to post warnings on labels, according to The New York Times. Harrowing incidents related to sleeping pills have included "accidental overdoses, falls, burns, near drowning, exposure to extreme cold temperatures leading to loss of limb, carbon monoxide poisoning, drowning, hypothermia, motor vehicle collisions with the patient driving,

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and self-injuries such as gunshot wounds and apparent suicide attempts," according to FDA research. "Patients usually did not remember these events," the agency wrote. In other words, the FDA is done pulling its punches about sleeping meds.

Open Secret

The FDA recently announced that a prominent warning would be required on all medication guides for Ambien, Lunesta, Sonata, and the generic version of Ambien, which is called zolpidem. The FDA also mandates a separate warning against prescribing the drugs to anyone with a history of sleepwalking. But this isn't the first time the FDA has stepped in to warn against sleeping pills. The NYT reports that the government agency first issued a public warning against bizarre sleeping behaviour over 12 years ago — meaning that this week's new warning merely ups the ante. "I am surprised to see this warning come out now," University of Pennsylvania physician Ilene Rosen told The NYT. "This is something I've been telling my patients for the last 15 years, and in the sleep community this is well known. And I'd like to think we've done a good job putting the news out there, that these drugs have some risks."

Futurism, 1 May 2019

<https://futurism.com>

A Couple in Mongolia Has Died of The Plague After Eating Raw Animal Innards

2019-05-15

For days, the dusty roads of a small town in Mongolia's westernmost province were largely deserted. "After the quarantine [was announced], not many people - even locals - were in the streets for fear of catching the disease," Sebastian Pique, an American Peace Corps volunteer who has lived in the remote mountainous region for two years, told Agence France-Presse. The illness that sparked widespread alarm among the town's roughly 1,400 residents and visitors, and left them isolated for six days? The plague. The town of Tsagaannuur, located near the border between Mongolia and Russia, was recently sealed off following the deaths of a local couple who contracted the plague from eating the raw meat and organs of an infected marmot, Ariuntuya Ochirpurev with the World Health Organization in Ulaanbaatar, told The Washington Post. Some Mongolians believe eating the rodent's uncooked innards to be "very good for health," Ochirpurev said. The husband and wife reportedly ate the

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kidney, gall bladder and stomach of the creature, a type of large squirrel found in the region. In this case, however, Ochirpurev said consuming the marmot raw resulted in what was probably an agonising death. The 38-year-old man, who worked as a border agent, and his wife, 37, died of multiple organ failure caused by septicaemic plague, Ochirpurev said. According to the Centres for Disease Control and Prevention, septicaemic plague causes “fever, chills, extreme weakness, abdominal pain, shock, and possibly bleeding into the skin and other organs.” A person’s skin and other tissues can also turn black and die. It began late last month when the man came down with a fever, Ochirpurev said. In less than a week, he was dead and his wife were hospitalised in the intensive care unit vomiting blood and suffering from severe headaches. She died on 1 May from toxic shock. That evening, lab results confirmed the pair had the plague, prompting the declaration of a quarantine, Ochirpurev said. The couple left behind four children ranging in age from 9 months to 14 years old. The decision to impose the quarantine came after officials became worried that the husband and wife had developed pneumonic plague, which can be swiftly passed to other people through airborne droplets, Ochirpurev said. Pneumonic plague is the “most serious form of the disease” and the only type that can spread from person to person, according to the CDC. If left untreated, cases of the plague have a 30 to 100 percent fatality rate, the WHO said. A total of 118 people, which included residents of the town and health-care workers who were believed to have had “close contact” with the couple, were isolated and given preventive antibiotics, Ochirpurev said. An additional 28 people, several of whom were foreign tourists from Switzerland, Sweden, Kazakhstan and South Korea, were quarantined at the border where the man worked, she said. The rest of the roughly 1,300 residents were limited in their movements in and out of the town. After no new plague cases were reported, Ochirpurev said the quarantine was lifted on Monday. The minister of health is still monitoring the situation, she said. Deaths caused by the plague - a disease carried by small rodents that was responsible for wiping out about 60 percent of Europe’s population nearly 700 years ago and killing millions in China, Hong Kong and nearby port cities in the late 1800s - are much more rare in modern times because of antibiotics, according to the CDC. But reports of people getting infected have continued to pop up around the world, including in the United States, William L. Gosnell, a program director with the University of Hawaii at Manoa’s department of tropical medicine, medical microbiology and pharmacology, told The Post. “The bacteria maintains itself out in the wild in these animal populations,” said Gosnell, who is affiliated with the university’s John A. Burns School of Medicine. The plague is most commonly transmitted to humans by fleas that become

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infected from biting rodents carrying the yersinia pestis bacteria, which causes the disease. From 2010 to 2015, there were more than 3,200 cases reported worldwide, including 584 deaths, the WHO reported. In recent decades, the United States has had an average of seven cases per year, usually occurring in rural or semirural regions, the CDC said. The areas most affected include northern New Mexico, northern Arizona, southern Colorado, California, southern Oregon and far western Nevada. Gosnell said he has never heard of a person getting the plague from eating raw rodent meat, but added that "it wouldn't be surprising." "Any time you eat something raw, there's always a chance for picking up all sorts of different pathogens," he said. "There are so many other zoonotic infections they could have picked up, unfortunately due to the locale, it just happened to be plague." Throughout Mongolia, where the plague is an endemic disease, the most common source of infection for people is "contact with and consumption of the marmot," according to a 2011 article published in the journal of Emerging Infectious Diseases. In the province where the couple lived, there have been nine reported cases with three deaths between 1989 and 2010, Ochirpurev said, but she noted all the victims had confirmed exposure to marmots. It was likely that the couple's decision to not cook the rodent before eating its organs made them more susceptible to becoming sick, Gosnell said. "If you have some of these mildly pathogenic bacterial infections, they tend to be somewhat concentrated in the spleen, the liver and the kidneys," he said. "A lot of the time, viruses that are found in the blood, that's where they get trapped." A "thorough cooking" is recommended before eating any type of wild rodent, Gosnell said. "If you cook it, the bacteria is dead. You don't got a problem," he said. "Some things you don't eat raw."

Science Daily, 9 May 2019

<http://www.sciencedaily.com>

Here's Why The Latest Fad of Drinking a Morning 'Salt Juice' Is Not That Smart

2019-05-15

Twitter CEO Jack Dorsey likes to advertise his many regimented health habits, which are at times both questionable and sensible. He practices intermittent fasting (specifically, eating one meal per day and nothing on weekends) and walking to work every day, for example. Recently, he's mentioned that he starts his mornings with "salt juice," a concoction of water, Himalayan salt, and lemon. Dorsey loves the drink so much, it is reportedly available at Twitter offices around the world, according to a

Twitter CEO Jack Dorsey likes to advertise his many regimented health habits, which are at times both questionable and sensible.

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recent New York Times profile of the tech executive. Most people don't need to consume extra salt to stay healthy. With the exception of athletes, people who spend long periods of time in the heat, have low blood pressure, or are malnourished, the average human doesn't need a special salt-filled drink to keep their nutrition in check. "Salt is something that you do not make in the body, so we need to get it from outside sources," Wendy Bazilian, a registered dietitian with a doctorate in public health, told Business Insider. "When we eat a regular diet or multiple meals, there's virtually no question that you will get the requisite approximately 1/4 teaspoon a day (500 mg) most of us need to meet our basic biological needs." Even if a person has an intense workout where they sweat a lot, a post-exercise meal is usually enough to replenish lost salt, according to registered dietitian and author of *Eating in Colour*, Frances Largeman-Roth. If a person is fasting or severely limiting their food intake, however, a salt drink could help them maintain the body's physiological functions, like controlling blood volume and flow and maintaining nerve and muscle function. Himalayan salt is also known for having more minerals and being less processed than table salt. That doesn't mean a salty drink can replace a balanced and regular diet. "In our typical scenario and society, breakfast is the time and meal where the most nutritional quality usually happens, so not taking advantage of that or building that into the day can be a potential problem for energy or long-term health overtime if not addressed," Bazilian said. Plus, if a person doesn't drink water during a food fast it could result in dehydration, even if they do drink salt water pre-fast. "Sodium does help you hang onto water, so his salt juice habit may help him feel better while he's fasting," Largeman-Roth told INSIDER. "Still, I wouldn't recommend this diet to anyone." The lemon in Dorsey's beverage could offer some benefits. "Lemon water provides hydration and vitamin C at its most basic level," Bazilian said. Vitamin C supports the immune system, promotes healthy skin, and helps with iron absorption into the body. Water also provides hydration, and Bazilian said it is arguably the most important substance we put into our bodies. "I consider it essential like a nutrient. We would die within days if we didn't have a water source, although you can live for weeks without food," Bazilian said. While salt juice may not be that useful, she noted some people start their mornings with lemon water as an alternative to caffeinated coffee, which could help prevent a midday sugar or caffeine crash. "Plus, rituals and routines are often helpful to maintain focus," Bazilian said.

Science Alert, 7 May 2019

<http://www.sciencealert.com.au>

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Watch Concrete Explode As Scientists Probe Weird Phenomenon

2019-05-15

In a new study, researchers from Empa, the Swiss Federal Laboratories for Materials Science and Technology, heated concrete up to 600 degrees Celsius (1,112 degrees Fahrenheit) and watched it go kaboom. The reason for the explosions, the researchers found, was the way tiny amounts of moisture locked inside the concrete vaporized and moved when heated. Concrete explosions can be particularly dangerous results of fires that affect bridges or tunnels, according to a statement. In March 2017, a bridge on Interstate 85 in Atlanta partially collapsed after a fire in a storage unit under the bridge damaged the structure's concrete and steel. In 2003, a fire caused the collapse of a reinforced-concrete building in Hengyang, China, and the incident killed 20 firefighters. Concrete, in its simplest form, is made of cement, sand and water. But major construction projects such as bridges, tunnels and skyscrapers use high-performance concretes, which have additional ingredients or use special drying methods to improve their durability and strength. But heat them to over 392 F (200 C), and high-performance concretes become vulnerable. They can even explode, sending chunks of concrete shooting away from the main block. To find out why, Empa researchers joined scientists at the University of Grenoble in France and the Laue-Langevin Institute in Grenoble to watch concrete get hot. The researchers tracked the interior of the heated concrete in real time using neutron tomography, which relies on the absorption of neutrons to create a 3D image.

Under pressure

The images revealed that high-performance concrete explodes because of the same properties that make it strong: It has very few pores, and those pores are tiny. When heated, water locked up in the concrete moves away from the source of heat and vaporizes. Because the concrete is so dense and impermeable, the water and steam get stuck. With no way to vent the build-up of pressure, parts of the block blow off. Even when the source of heat is removed, the researchers found, the explosions can still occur until the internal pressure falls. In one experiment, a chunk of concrete flew toward the scientists' recording equipment after the heat was turned off, knocking over an innocent timer. The results should help scientists

**Little known fact:
Concrete can
explode. And now
scientists know why.**

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understand how moisture moves during catastrophic fires, the researchers wrote last year in the journal *Cement and Concrete Research*.

Live Science, 6 May 2019

<http://www.livescience.com>

Are heat-not-burn tobacco products a safer alternative to cigarettes?

2019-05-15

First there were smokers. Then there were vapers. Now there is a tribe of nicotine users so new that they don't have a name yet. Maybe we'll call them heaters or smoulders. But if the tobacco industry gets its way, they will become a familiar sight. The new tribe are converts to what are called heated tobacco products (HTPs) or heat-not-burn (HNB) devices. Instead of incinerating tobacco they warm it up, releasing an aerosol of nicotine and other compounds that the user inhales. They have been described as a hybrid of a cigarette and a vape. These devices have been on sale for years, but tobacco firms have begun a major PR offensive in the belief that the time is right to win over more consumers. "They're very busy all over the world. It's a massive campaign," says Anna Gilmore of the Tobacco Control Research Group at the University of Bath, UK. Take Philip Morris International (PMI), which makes the leading product on the global market, IQOS (I Quit Ordinary Smoking). Last week, the US Food and Drug Administration (FDA) approved it for sale. PMI says the device, which is already available in 41 other countries and territories, is used by 10.4 million people, the vast majority of them ex-smokers. The company also recently launched a campaign encouraging people to switch from cigarettes. If efforts like these succeed, we can expect a rerun of the health debates that have raged over the e-cigarettes used by vapers. Are HTPs safer than smoking? Do they encourage people to quit, or to start? What are the long-term risks? The answers matter because the tobacco industry is aiming HTPs at smokers, who might otherwise quit or shift to vaping. The idea of heating rather than burning tobacco is actually nothing new. The first HTP was launched in 1988 by the R. J. Reynolds Tobacco Company, but flopped commercially and was withdrawn the following year. The industry launched numerous devices after this, but smokers consistently rejected them. These early products were marketed at smokers worried about smell, ash and second-hand smoke. But now the industry has hit on a new idea: to sell the devices as being safer. The logic is that because the majority of dangerous compounds in cigarettes are generated by burning tobacco, ditching the combustion should mean HTPs are less

The rise of vaping has seen tobacco firms revisit an old cigarette alternative, but the health benefits are far from clear

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toxic, while still delivering nicotine and a cigarette-like taste. The reason the industry thinks the time is ripe is due to the success of e-cigarettes, says Theodore Caputi, a health economist at Harvard University. These have popularised the idea of safer, smokeless alternatives, but have failed to satisfy many smokers. They often lack the “throat hit” – the sensation of smoke striking the back of the throat – that many smokers enjoy. PMI confirms that vaping’s partial success has created an opportunity. “E-cigarettes have changed smokers’ thinking,” says Moira Gilchrist, head of scientific and public communications at PMI. “But the rate of people switching from smoking to vaping has actually slowed down, so there’s an opportunity to provide other alternatives.” PMI admits that heated tobacco doesn’t eliminate the dangers of smoking. “IQOS is not risk free,” says Gilchrist. “The best thing a smoker can do is quit.” But the firm insists it is less harmful to use a HTP than to smoke. “It is safer,” says Gilchrist. This claim largely rests on PMI research showing that heating rather than burning tobacco generates significantly lower levels of harmful chemicals. It examined 58 compounds found in smoke that are known to be harmful or potentially harmful. Averaged across the 58, levels in IQOS aerosols are 90 per cent lower. An independent literature review by Erikas Simonavicius at King’s College London and his colleagues found broad agreement with this figure. But 10 of the 11 studies on aerosol composition they looked at were industry funded, says Simonavicius. “The research findings from the tobacco industry support the tobacco industry’s claims,” he says. “Are heated tobacco products safer than smoking? Do they encourage people to quit, or to start? What are the long-term risks?” Indeed, most of the published research on HNB has been carried out by or funded by the industry. This raises concerns, says Stanton Glantz at the University of California, San Francisco, because “tobacco companies have a record of publishing incomplete or manipulated information”. For example, in 2001, PMI released research – dubbed “project MIX” – showing that including additives such as menthol in cigarettes didn’t boost toxicity. In 2011, Glantz analysed internal company documents released through legal action. He concluded that the data had been massaged to conceal the fact that additives did increase toxicity. Responding to the analysis, PMI’s then chief scientist, Ruth Dempsey, said, “I am of the opinion that their concerns on project MIX are unfounded.” Even if PMI’s claim about HNB’s altered chemical make-up is true, studies of aerosol composition are a smokescreen, says Glantz. What matters is the biological effect of inhalation. He says that studies he and others have done, both on PMI data and independently generated results, show that, by this measure, IQOS and other HNB products are little, if any, safer than cigarettes.

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Another concern is that the aerosol may contain harmful chemicals that aren't in cigarette smoke because burning breaks them down. "It is possible that HTPs deliver to their users a unique chemical mixture with a distinct toxicity profile," says Irina Stepanov at the University of Minnesota. This means HTPs could lead to diseases not caused by smoking, says Glantz. PMI accepts that it isn't sufficient to simply know the aerosol composition, but disputes that the fumes are equally toxic. "We've also completed toxicology studies," says Gilchrist. "All show a significant reduction of toxicity." Up to now, however, PMI has failed to persuade the FDA of the validity of its health claims. Companies wishing to market "safer" smokes in the US have to apply for FDA recognition as a "modified risk tobacco product". PMI has filed such an application for IQOS, but in January 2018 the FDA's Tobacco Products Scientific Advisory Committee decided it didn't reach the required standard. PMI submitted an updated approval last summer. Gilchrist says it is still under review and that the firm doesn't know when to expect the verdict – the FDA approval last week was to sell the device without making any health claims. In the meantime, independent evidence has begun to pile up. In a review of the literature on heated tobacco published this year, Bertrand Dautzenberg at the Sorbonne University, Paris, and Marie-Dominique Dautzenberg of pressure group Paris Without Tobacco analysed the health claims. "Heated tobacco produces less smoke than traditional cigarettes, but the risk reduction is not demonstrated," says Bertrand Dautzenberg. The pair also found evidence that non-smokers taking up HNB outnumber smokers using it to quit and that 69 per cent of users continue to smoke as well. Both fly in the face of industry claims that these devices help people to quit. It is still too early to deliver a verdict on the health impacts of HTPs, let alone wider questions such as whether they help smokers quit, but industry observers are sceptical. "Tobacco sales are declining globally," says Gilmore. "Their long-term business model is under threat. They have to do this."

New Scientist. 8 May 2019

<http://www.newscientist.com/>

California jury links RoundUp to cancer, awards couple \$2 billion

2019-05-15

A jury ruled against chemical giant Monsanto recently, awarding a California couple \$2 billion in damages after determining their cancer was caused by the weedkiller RoundUp. The decision in Alameda County Superior Court comes on the heels of a recent Environmental Protection

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Agency (EPA) statement that said there were no serious public health risks associated with glyphosate, the active ingredient in RoundUp. But a growing number of juries disagree with the EPA's position. The ruling marks the third case since August in which a jury found that glyphosate caused cancer. More than 13,000 similar lawsuits have been filed against Monsanto or its parent company Bayer. Many of those suits were spurred by a 2015 World Health Organization analysis that said glyphosate is "probably carcinogenic in humans." Alva and Alberta Pilliod, the plaintiffs in the California case, argued they developed non-Hodgkin lymphoma following decades of using the weedkiller. Bayer relied heavily on EPA's assessment of glyphosate's safety in responding to the verdict, arguing the Pilliods had existing risk factors for that type of cancer. "Bayer is disappointed with the jury's decision and will appeal the verdict in this case, which conflicts directly with the U.S. Environmental Protection Agency's interim registration review decision released just last month," the company said in a statement. "The consensus among leading health regulators worldwide that glyphosate-based products can be used safely and that glyphosate is not carcinogenic." Bayer said the verdict would be unlikely to impact future cases and trials, as each one has its own factual and legal circumstances. Glyphosate is the most heavily used weedkiller in the country, and its use has been spreading year after year, according to analysis by the Environmental Working Group. The EPA earlier this month proposed new rules that would "help farmers target pesticide sprays on the intended pest, protect pollinators, and reduce the problem of weeds becoming resistant to glyphosate." "EPA has found no risks to public health from the current registered uses of glyphosate," Administrator Andrew Wheeler said in a statement. The U.S. Department of Agriculture has argued that the herbicide is necessary. "If we are going to feed 10 billion people by 2050, we are going to need all the tools at our disposal, which includes the use the glyphosate," Secretary of Agriculture Sonny Perdue said in a statement when EPA announced its proposed rules. But a number of communities have banned the use of glyphosate due to health concerns. More than 50 other cities and counties, including Los Angeles County, have prohibited its use.

The Hill, 13 May 2019

<https://thehill.com>

Medical devices are often exempt from bans on harmful chemicals.

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Plastics that save us may also hurt us

2019-05-16

Hiding in plain sight, in every hospital in the world, is a product that embodies both the extraordinary benefits and the unsettling risks that plastics can pose to human health. Introduced in 1950, as the United States was about to enter the Korean War, the plastic blood bag was a life-saving solution to a medical problem. Doctors had been collecting blood and performing transfusions since World War I, but the process was just beginning to be scaled up. The glass bottles used to hold blood were far from ideal. Not only did they break easily; they were hard to keep sterile, and air bubbles trapped in the rigid containers could complicate transfusions. The new bags, invented by two American scientists, had a host of advantages: They were lightweight, cheap, couldn't shatter and took up about half the space in a refrigerator as a bottle holding the same amount of blood. They could also be easily made and kept sterile and thrown away after a single use. Later, their popularity was boosted by a serendipitous discovery. It turns out that a chemical used to soften the plastic — di(2-ethylhexyl) phthalate, or DEHP — had a conservatory effect on red blood cells, meaning the blood could be stored longer. It was only a matter of time before plastic blood bags could be found in clinics, hospitals and blood banks across the globe. "The discovery of plastics revolutionised blood storage and transport," Ole Grøndahl Hansen, project manager at PVCMed Alliance, a consortium of leading companies from the medical PVC sector, wrote of the discovery. It saved "the lives of millions of people around the world."

Blood chemicals

Plastics had a similar effect across the health care industry. Shatter-proof, cheap, disposable and hypo-allergenic, the material has become indispensable, used for everything from intravenous (IV) tubes to artificial hearts. But lately, experts are warning that the widespread use of plastics in medical devices can also pose a risk to their users. Because plastic is so crucial to the industry, medical devices have received waivers from regulations banning chemicals as potentially dangerous to human health, despite their intimate association with the body.

Politico, 10 May 2019

<https://www.politico.eu>

Yale researchers have pinpointed a key reason why people are more likely to get sick and even die from flu during winter months: low humidity.

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Flu virus' best friend: Low humidity

2019-05-16

Yale researchers have pinpointed a key reason why people are more likely to get sick and even die from flu during winter months: low humidity. While experts know that cold temperatures and low humidity promote transmission of the flu virus, less is understood about the effect of decreased humidity on the immune system's defences against flu infection. The Yale research team, led by Akiko Iwasaki, the Waldemar Von Zedtwitz Professor of Immunobiology, explored the question using mice genetically modified to resist viral infection as humans do. The mice were all housed in chambers at the same temperature, but with either low or normal humidity. They were then exposed to the influenza A virus. The researchers found that low humidity hindered the immune response of the animals in three ways. It prevented cilia, which are hair-like structures in airways cells, from removing viral particles and mucus. It also reduced the ability of airway cells to repair damage caused by the virus in the lungs. The third mechanism involved interferons, or signalling proteins released by virus-infected cells to alert neighbouring cells to the viral threat. In the low-humidity environment, this innate immune defence system failed. The study offers insight into why the flu is more prevalent when the air is dry. "It's well known that where humidity drops, a spike in flu incidence and mortality occurs. If our findings in mice hold up in humans, our study provides a possible mechanism underlying this seasonal nature of flu disease," said Iwasaki. While the researchers emphasised that humidity is not the only factor in flu outbreaks, it is an important one that should be considered during the winter season. Increasing water vapor in the air with humidifiers at home, school, work, and even hospital environments is a potential strategy to reduce flu symptoms and speed recovery, they said.

Medical Xpress, 13 May 2019

<http://medicalxpress.com>

Common food additive E171 found to affect gut microbiota

2019-05-16

University of Sydney research provides new evidence that nanoparticles, which are present in many food items, may have a substantial and harmful influence on human health. The study investigated the health impacts of food additive E171 (titanium dioxide nanoparticles) which is commonly used in high quantities in foods and some medicines as a whitening

University of Sydney research provides new evidence that nanoparticles, which are present in many food items, may have a substantial and harmful influence on human health.

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agent. Found in more than 900 food products such as chewing gum and mayonnaise, E171 is consumed in high proportion everyday by the general population. Published in *Frontiers in Nutrition*, the mice study found that consumption of food containing E171 has an impact on the gut microbiota (defined by the trillions of bacteria that inhabit the gut) which could trigger diseases such as inflammatory bowel diseases and colorectal cancer. Co-lead author Associate Professor Wojciech Chrzanowski said the study added substantially to a body of work on nanoparticle toxicity and safety and their impact on health and environment. "The aim of this research is to stimulate discussions on new standards and regulations to ensure safe use of nanoparticles in Australia and globally," he said. While nanoparticles have been commonly used in medicines, foods, clothing, and other applications, the possible impacts of nanoparticles, especially their long-term effects, are still poorly understood. Titanium dioxide consumption has considerably increased in the last decade and has already been linked to several medical conditions, and although it is approved in food, there is insufficient evidence about its safety. Increasing rates of dementia, auto-immune diseases, cancer metastasis, eczema, asthma, and autism are among a growing list of diseases that have been linked to soaring exposure to nanoparticles. "It is well established that dietary composition has an impact on physiology and health, yet the role of food additives is poorly understood," said Associate Professor Chrzanowski, a nanotoxicology expert from the University of Sydney's School of Pharmacy and Sydney Nano Institute. "There is increasing evidence that continuous exposure to nanoparticles has an impact on gut microbiota composition, and since gut microbiota is a gate keeper of our health, any changes to its function have an influence on overall health." "This study presents pivotal evidence that consumption of food containing food additive E171 (titanium dioxide) affects gut microbiota as well as inflammation in the gut, which could lead to diseases such as inflammatory bowel diseases and colorectal cancer," he said. Co-lead author Associate Professor Laurence Macia from the University of Sydney said: "Our research showed that titanium dioxide interacts with bacteria in the gut and impairs some of their functions which may result in the development of diseases. We are saying that its consumption should be better regulated by food authorities." "This study investigated effects of titanium dioxide on gut health in mice and found that titanium dioxide did not change the composition of gut microbiota, but instead it affected bacteria activity and promoted their growth in a form of undesired biofilm. Biofilms are bacteria that stick together and the formation of biofilm has been reported in diseases such as colorectal cancer," said Associate Professor Macia, who is an immunologist expert on the impacts of the gut

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and gut microbiota on health from the Faculty of Medicine and Health and the Charles Perkins Centre.

Medical Xpress, 13 May 2019

<http://medicalxpress.com>

Sales of opioid painkiller codeine have halved in Australia

2019-05-16

Sales of codeine have halved in Australia since it became a prescription-only drug, and fears that the change would drive people toward stronger opioids appear to be unfounded. The decision to ban over-the-counter sales of the opiate painkiller came amid a growing concern about the opioid epidemic sweeping through the US. Similar problems were emerging in Australia as codeine-related deaths had more than doubled in the decade to 2009. Before February 2018, Australians could buy low-dose codeine in combination with other painkillers such as paracetamol and ibuprofen without a prescription. But codeine, like other opioids, can lead to dependence and tolerance. Consuming large amounts of codeine in these formulations also puts people at risk of harms from the other ingredients, including liver and gastrointestinal damage, blood potassium imbalances and heart attack. While the ban was popular among doctor groups, critics warned it would put pressure on addiction services and lead to an uptick in demand for high-strength opioids.

Decreasing sales

Now an analysis of codeine sales by Australia's Therapeutic Goods Administration has found that Australians only bought half as many packets of codeine-containing products once they became prescription-only, from an average of 35 million per year between 2014 and 2017, down to 17 million in 2018. This is equivalent to 7000 kilograms of codeine less than would have been expected without the ban. Nevertheless, sales of the higher strength, 30 milligram packets remained similar. "Our analysis does not support the assertion that many patients were switched from low- to high-strength codeine medicines after up-scheduling," the Therapeutic Goods Administration said in a statement. Suzanne Nielsen at Monash University, Australia, says her recent analysis of prescription data found no increase in other opioids being prescribed in the year following the ban compared to the two years prior either. Codeine-based medications currently require prescriptions in countries such as the US,

Sales of codeine have halved in Australia since it became a prescription-only drug, and fears that the change would drive people toward stronger opioids appear to be unfounded.

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Germany and Japan, but can be purchased over-the-counter in the UK. Aside from safety concerns, one of the reasons the Australian regulator gave for its decision was that evidence indicated low-dose codeine was no more effective than other available painkillers.

New Scientist, 30 April 2019

<http://www.newscientist.com/>

Without heart disease, daily aspirin may be too risky

2019-05-16

For people without heart disease, taking a daily aspirin to prevent heart attacks and strokes may increase the risk of severe brain bleeding to the point where it outweighs any potential benefit, a research review suggests. U.S. doctors have long advised adults who haven't had a heart attack or stroke but are at high risk for these events to take a daily aspirin pill, an approach known as primary prevention. Even though there's clear evidence aspirin works for this purpose, many physicians and patients have been reluctant to follow the recommendations because of the risk of rare but potentially lethal internal bleeding. For the current study, researchers examined data from 13 clinical trials testing the effects of aspirin against a placebo or no treatment in more than 134,000 adults. The risk of intracranial haemorrhage, or brain bleeds, was rare: taking aspirin was associated with two additional cases of this type of internal bleeding for every 1,000 people, the study found. But the bleeding risk was still 37 percent higher for people taking aspirin than for people who didn't take this drug. "Intracranial haemorrhage is a special concern because it is strongly associated with a high risk of death and poorer health over a lifetime," said study co-author Dr. Meng Lee of Chang Gung University College of Medicine in Taiwan. "These findings suggest caution regarding using low-dose aspirin in individuals without symptomatic cardiovascular disease," Lee said by email. For people who have already had a heart attack or stroke, the benefit of low-dose aspirin to prevent another major cardiac event is well established, researchers note in JAMA Neurology. But the value of aspirin is less clear for healthier people, for whom bleeding risks may outweigh any benefit, the study team writes. Already, guidelines on aspirin for primary prevention of heart disease in the U.S., Europe and Australia have incorporated a need to balance the potential benefits against the risk of bleeding. For elderly people, who have a greater risk of bleeding than younger adults, the risks may be too great to recommend aspirin. For adults ages 50 to 59 considering aspirin to prevent heart attacks and strokes, for example, the U.S Preventive Services

For people without heart disease, taking a daily aspirin to prevent heart attacks and strokes may increase the risk of severe brain bleeding to the point where it outweighs any potential benefit, a research review suggests.

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Task Force (USPSTF) recommends the pill only for people who have at least a 10 percent risk of having a heart attack or stroke over the next decade and who don't have a higher-than-average risk of bleeding. (The American College of Cardiology provides an online risk calculator here: bit.ly/2VxbuAK.) One limitation of the analysis is that the smaller clinical trials examined a variety of aspirin doses up to 100 milligrams daily. The analysis also only focused on brain bleeds, and not on other types of internal bleeding associated with aspirin. "We have long known that aspirin can precipitate bleeding, most commonly in the gastrointestinal tract, but most devastatingly in the brain," said Dr. Samuel Wann, a cardiologist at Ascension Healthcare in Milwaukee, Wisconsin, who wasn't involved in the study. Despite the benefits for preventing heart attacks, the consensus on aspirin has changed over time, particularly for people without heart disease or hardening and narrowing of the arteries (atherosclerosis). "We have previously recommended aspirin to prevent platelets from sticking to the inside of an individual's arteries, but the benefit, while real, turns out to be small compared to the rare but devastating incidence of brain haemorrhage," Wann said by email. "We no longer recommend routine use of aspirin in individuals who have no demonstrable cardiovascular disease or atherosclerosis."

Reuters Health, 14 May 2019

<http://www.reuters.com/news/health>

Arsenic exposure linked to heart thickening

2019-05-16

Drinking water that is contaminated with even moderate levels of arsenic may lead to harmful thickening of the heart's main chamber walls, a new U.S. study suggests. Researchers who analysed arsenic levels from more than 1,000 adults under the age of 50 found the risk of heart thickening over the next roughly five years was significantly higher in those with the highest exposure to the toxin, according to the report published in *Circulation*. "It's important for the general public to be aware that arsenic can be a risk factor for cardiovascular disease," said the study's lead author, Dr. Gernot Pichler, a medical specialist in internal medicine in the department of cardiology at Hospital Hietzing/Heart Centre Clinic Floridsdorf in Vienna. "Potential sources of exposure need to be considered, in particular for people drinking water from private wells. Private wells are currently not regulated and people using private wells, including children and young adults, are not protected." "Testing of those wells is a critical first step in order to take action and prevent arsenic

Drinking water that is contaminated with even moderate levels of arsenic may lead to harmful thickening of the heart's main chamber walls, a new U.S.

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exposure," Pichler said in an email. To take a closer look at the impact of arsenic on the heart, Pichler and his colleagues turned to data from the Strong Heart Family Study, a long-term study of cardiovascular risk factors among Native Americans. The new report included 1,337 adults in Arizona, Oklahoma, North Dakota and South Dakota whose average age was just under 31 when their arsenic levels were measured. At the outset, none of the study participants had diabetes or heart disease. The researchers evaluated the shape, size and function of the study participants' hearts using echocardiography, a type of ultrasound imaging. Arsenic exposure was evaluated in urine samples. Arsenic exposure in the participants overall was found to be higher than in the general U.S. population, but lower than what is found in Mexico and Bangladesh, the study authors note. After following participants for up to about seven years, the researchers found that those with higher levels of arsenic were more likely to have thickening of the left ventricle. Indeed, a two-fold higher level of arsenic was associated with a 47 percent increased risk of a participant having left ventricular thickening, known as hypertrophy. Among participants with higher blood pressure levels – above 120/80 - or those using blood-pressure lowering drugs, the impact of arsenic appeared to be stronger: higher levels of arsenic were linked to a 58 percent greater chance of developing left ventricular hypertrophy in this group. Pichler suspects that individuals with high blood pressure might be more susceptible to the deleterious effects of arsenic. For those with arsenic-contaminated drinking water, Pichler suggests water treatment. "The best treatment systems are at the point of entry," he said. "Some states, such as New Jersey, help families to treat their water. Simple water filters, heating or boiling water do not remove arsenic. The use of bottled water is an option but treatment will be cheaper in the long run." The first thing, for people whose water comes from wells, "is to have water tested," said Jessica Wilson, a clinical dietician affiliated with Magee-Womens Hospital in Pittsburgh, Pennsylvania, who wasn't involved in the study. "You want to see if it's safe and OK to drink." The new study highlights a big problem, said Dr. Omar Ali, director of the cardiac catheterisation lab at Detroit Medical Centre's Heart Hospital in Michigan, who also wasn't involved in the study. "The World Health Organization estimates that more than 800 million people worldwide are being exposed to high concentrations of arsenic," Ali said. "And in the U.S., statistics from the (Centres for Disease Control and Prevention) and the (U.S. Geological Survey) show that 45 million Americans are drinking well water and 2.1 million are drinking water from wells with high concentrations of arsenic." This isn't the first paper to show that arsenic can lead to cardiovascular disease, Ali said. Others have linked the toxin to stroke and to accelerated atherosclerosis.

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The new findings should spur doctors to find out where patients get their drinking water from, Ali said. "We need to increase awareness of this potential problem and to investigate it more," he added. "In communities where people rely solely on well water, we need to be extra vigilant."

Reuters Health, 8 May 2019

<http://www.reuters.com/news/health>

Stopping inflammation in its tracks: A leap forward for new anti-inflammatory drugs

2019-05-16

Treatments for chronic inflammatory diseases are one step closer as University of Queensland researchers discover a way to stop inflammation in its tracks. Associate Professor Kate Schroder and Dr. Rebecca Coll from UQ's Institute for Molecular Bioscience and Professor Avril Robertson from UQ's School of Chemistry and Molecular Biosciences led the study, which will inform the design of new drugs to stop the formation of a protein complex, called the inflammasome, which drives inflammation. Dr. Coll, who is now a Lecturer at the Wellcome-Wolfson Institute for Experimental Medicine at Queen's University Belfast, said the inflammasome was important in protecting our bodies from infection, but is also a key driver of unhealthy inflammation. "Inflammation helps our bodies heal following infection, but when the inflammasome is not switched off, inflammation becomes damaging. "Uncontrolled inflammation results in chronic diseases, such as Parkinson's disease, Alzheimer's disease and respiratory diseases such as asthma," she said. Associate Professor Schroder said the team's exciting discovery gave new insight into how to stop inflammation at the molecular level. "We previously identified a small molecule, MCC950, that inhibits the inflammasome to block inflammation in disease but, until now, we did not understand how it worked," she said. "We discovered that MCC950 binds directly to the inflammasome and inactivates it, turning off inflammation. "Now that we understand how a small molecule can inhibit the inflammasome, we are very excited about the potential of inflammasome inhibitors as anti-inflammatory drugs. Professor Robertson said "UQ start-up Inflazome Ltd, which is developing targeted therapies for inflammatory diseases, had announced its plans to commence clinical trials of their inflammasome inhibitors in 2019, and other companies are competing in this space. "We are keen to see results of these trials and hope that our discovery can lead to the efficient design of new molecules

Associate Professor Kate Schroder and Dr. Rebecca Coll from UQ's Institute for Molecular Bioscience are working towards the anti-inflammatory drugs of the future.

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as anti-inflammatory drugs of the future," she said. The research was published in the scientific journal *Nature Chemical Biology*.

Medical Xpress, 13 May 2019

<http://medicalxpress.com>

Is high-fructose corn syrup worse than regular sugar?

2019-05-16

High-fructose corn syrup has been a scapegoat for American obesity for the past decade and a half, so you might be surprised to learn that sugar and honey both have more fructose than high-fructose corn syrup. Let's break down the numbers here. Despite its misleading name, the most commonly used form of HFCS only has 42 percent fructose in comparison to table sugar's 50 percent. Honey, the beloved natural sweetener, has 49 percent. Standard corn syrup doesn't have any fructose because it's 100 percent glucose, which explains how HFCS got its name: it was a kind of corn syrup with more fructose than normal. This is true for every form of natural sugar you see advertised on organic food because sucrose, the molecule you know as sugar, is made up of one fructose molecule and one glucose molecule. Honey is a bit different, as its fructose and glucose molecules aren't bound together, but instead are free-floating—much more like HFCS. "People say you should use honey, but what's interesting about honey is that because the sucrose is split apart [into glucose and fructose], you can fit a lot more of those molecules into a tablespoon," says Andrea Giancoli, a registered dietician and consulting expert on dietary policy. "A tablespoon of honey has more calories than a tablespoon of table sugar." Now, it is true that your body metabolises fructose differently from glucose, and products made with only fructose can cause metabolic issues as well as digestive problems. Pure fructose more directly impacts blood sugar, and eventually can lead to decreased insulin sensitivity and high triglycerides. But as a 2008 review of HFCS notes, those differences are irrelevant when talking about the health impacts of any of these commonly used sugars: "Sucrose, HFCS, invert sugar, honey, and many fruits and juices deliver the same sugars in the same ratios to the same tissues within the same time frame to the same metabolic pathways." Maybe the most confusing thing about the whole HFCS controversy is that there isn't actually much scientific debate. Though there are still some questions as to how the body might process different types of sugar in distinct ways, the research thus far shows that the metabolic effects are exactly the same. The confusion stems from a 2004 study that correlated HFCS consumption with obesity rates in the U.S., which at the time were

Many of us believe some kinds of sugar are somehow healthier.

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fairly closely aligned. More and more food companies were using table sugar's syrupy cousin because it has properties that make it ideal for making processed foods like soda and candy. Around the same time, Americans were growing fatter. The researchers were careful to note that, as always, correlation doesn't imply causation. Perhaps the rise of HFCS coincided with an increase in processed food consumption or simply in total calories consumed, and the shift in sugar use had nothing to do with it. But that didn't stop other people, both scientists and journalists, from drawing much broader conclusions. Many parties took the paper to mean that there was something unique about HFCS that contributed to obesity. But the study never claimed to prove that, and subsequent research has shown exactly the opposite. As a 2014 review in the journal *Diabetes Care* put it: "the belief that sucrose is metabolised differently than HFCS is a myth. No study has shown any difference between the two when each is given [in the same caloric values], nor is there any difference in sweetness or caloric value." In the time since that study, sugar consumption overall (including that of HFCS) has declined, even as obesity rates have continued to climb. Of course, this is not to say that you should feel fine eating food with HFCS in it. Just remember that it's the nature of those products—the fact that they're often sugary drinks and processed foods—that make them bad for you. An equivalent product made with real cane sugar is just as bad. In fact, one review paper points out that soda's acidity actually causes sucrose to split apart into its constituent molecules, meaning the can starts out containing common sugar but looks quite different, at the molecular level, by the time you drink it. The authors note, "It is a sweet irony that purists who must have their sucrose-sweetened sodas end up drinking a sweetener composition more similar to HFCS and have been doing so since the first cola was formulated in the 1880s." The message here is that you should absolutely avoid HFCS. But you should also be avoiding all forms of sugar equally. You should really only be getting six to nine teaspoons a day at a maximum, according to federal guidelines, but Americans consume close to 20 on average. If we all focused on sugar as one lump category rather than "natural" versus "unnatural," we'd be better at making healthy choices. Even the sugar found in fruits is unhealthy if you eat too much of it. Go ahead and drizzle some honey on your toast because you like the taste—but don't fool yourself into thinking the natural sources of sugar don't count as sweet treats.

Popular Science, 14 May 2019

<http://www.popsci.com>

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City life damages mental health in ways we're just starting to understand

2019-05-16

We've long known that the environments we live and work in impact our physical health—and that we can be harmed by things we may not even realise we're being exposed to, like lead or air pollution. It's also not a new idea that our physical surroundings may weigh on our mental health as well. Back in the 1930s, two sociologists noticed a striking pattern amongst the people being admitted to Chicago's asylums. Rates of schizophrenia, they reported, were unusually high in those born to inner-city neighbourhoods. Since then, researchers have discovered that mental illnesses of all kinds are more common in densely populated cities than in greener and more rural areas. In fact, the Centre for Urban Design and Mental Health estimates that city dwellers face a nearly 40 percent higher risk of depression, 20 percent higher chance of anxiety, and double the risk of schizophrenia than people living in rural areas. Some of the burden on city dwellers' mental health can be traced to social problems such as loneliness and the stress of living cheek-by-jowl with thousands or even millions of other people. But there's something about the physical nature of cities that also seems to put a strain on the emotional wellbeing of their inhabitants. City life means dealing with stressors like air and noise pollution stemming from traffic, construction, or your neighbours. However, it's only in recent years that scientists have begun to seriously study the mechanisms through which exposure to various environmental stressors could be wounding our mental health, says Andreas Meyer-Lindenberg, director of the Central Institute of Mental Health in Mannheim, Germany. "It's an emerging field," he says. Meyer-Lindenberg and his research partner Matilda van den Bosch, an environmental health researcher at the University of British Columbia in Vancouver, recently reviewed the scientific evidence for these and a number of other physical stressors to find out whether they contribute to depression. The pair searched for studies concerning a wide range of substances and situations that people might run across in everyday life. They discovered that while many of these factors were particularly abundant in cities, they weren't limited to urban environments. For example, air pollution isn't only found within city borders. Another potential danger was pesticides, which farm workers in particular come into contact with. Still, a key part of improving our collective mental health will be making our cities more liveable, says Meyer-Lindenberg, who published the findings this year in the journal *Annual Review of Public Health*. More than half the world's population already lives in cities and this number is expected to rise to nearly 70

Urban dwellers are particularly at risk from the impacts of air pollution and other hazards on mental health.

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percent by 2050. "Globally we are becoming more and more increasingly urban, so neighbourhoods are opening up and changing," points out Marianthi-Anna Kioumourtzoglou, an assistant professor of environmental health sciences at the Mailman School of Public Health at Columbia University who has studied the impacts of air pollution on mental health. "We should consciously try and do that in a way that will promote mental wellbeing."

The risks around us

In their review, Meyer-Lindenberg and van den Bosch found that some potential threats had been examined more thoroughly than others. For some, including pollen, there wasn't enough information yet to show a convincing link to depression. However, the team did find a number of studies suggesting that heavy metals like lead, pesticides, common chemicals like bisphenol A (BPA), and noise pollution may contribute to depression, although further research is still needed to confirm that this is the case. Even more compelling was the evidence condemning air pollution. In addition to causing respiratory and cardiovascular problems that kill millions of people each year, this particular menace raises our risk for a number of psychiatric problems. Poor air quality has been associated with depression, anxiety, and psychotic experiences such as paranoia and hearing voices. In the United States, emissions for many common pollutants have decreased sharply in the decades since the Clean Air Act took effect. However, "just the fact that levels have been going down does not mean they are safe," says Kioumourtzoglou. "We all breathe, so we are all involuntarily exposed." She and her colleagues have found that women who live in highly polluted neighbourhoods are more likely than others to report symptoms of anxiety and take antidepressants. Meyer-Lindenberg and van den Bosch also delved into the potential connection between city living and depression. "Cities are an interesting case," Meyer-Lindenberg says. On average, city dwellers have access to better healthcare and education than other people. "So, cities are good for most aspects of human life... it's just that mental health shows the flip side of cities." Urban areas, he believes, are harmful both because of the lack of greenery and the presence of particularly high amounts of toxic exposures such as air pollution. This doesn't mean that if you live next to a highway or above a bar, you're doomed to develop depression or anxiety. Many people thrive in cities. And mental illnesses are caused by a complex tangle of genetics and life circumstances; it's rarely possible to pick out a single issue and name it as the culprit, Meyer-Lindenberg says. Rather, hazards like air pollution raise a person's overall risk, especially for those who are already

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vulnerable for other reasons. How strongly our physical surroundings affect this risk is something scientists have not yet figured out. For people in poor communities, though, the impact is likely especially potent; not only does financial stress contribute to depression, but low-income neighbourhoods face disproportionately high levels of air and noise pollution and lead exposure. How exactly these things prime the brain for depression is not entirely clear. Some issues, such as noise pollution and possibly pollen, are aggravating enough that they may contribute to depression by constantly wearing down our mood. Our surroundings also harm us in ways we aren't consciously aware of, perhaps by damaging our neurons or altering the abundance of chemical messengers like serotonin, according to Meyer-Lindenberg. Air pollution and other substances may prompt an inflammatory response that over time takes a toll on the brain, Meyer-Lindenberg says. In children, exposure to these hazards may also prevent the brain from developing normally. The idea that so many things we encounter in everyday life could be threatening our mental wellbeing is an alarming one. But our physical environments can also nourish our mental health. There's plenty of research showing that our risk for depression and other psychiatric disorders is lowered by—you guessed it—contact with nature. People are more physically active while in nature and the sights, sounds, and smells of greenery and oceans soothe us and give our mood a boost. In one experiment, scientists discovered that after a stroll in nature people are less prone to rumination, the tendency to obsess over one's mistakes and troubles that is a common feature of disorders like depression and anxiety. The nature walk also calmed activity in several brain regions involved in rumination and responding to threats to our sense of belonging or feelings that we've made a social misstep. One of these brain areas—known as the perigenual anterior cingulate cortex, which is involved in regulating our emotions—may be key to understanding how our environments can harm or help our mental health, Meyer-Lindenberg believes. "A lot of the risk factors that we've been looking at tend to hit the same brain system," he says. He and his colleagues have found that this part of the brain responds particularly strongly to socially stressful situations in people who were raised in cities. This area also seems to be influenced by a number of genes that have been linked to susceptibility towards depression and other psychiatric illnesses, suggesting it may be important to our mental health.

Fighting back

Nearly one in five adults in the United States live with a mental illness, while depression is considered the leading cause of disability worldwide

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by the World Health Organization. This makes it vitally important for us to learn more about how the world around us is shaping our mental health, van den Bosch says. She hopes this information will give policymakers incentives to further tighten restrictions on air pollution and other noxious products of human industry. "We know that many of these things are bad, and do we really need more evidence? It seems like the answer is yes," says van den Bosch. Even if the effect on our overall risk for mental illness turns out to be small, she says, "It will still have a huge impact on population health." Kioumourtzoglou also hopes to see research probing whether exercise, time in nature, or other actions could offset the risks that air pollution and other hazards pose to our mental health. Whatever these steps are, they likely won't be easy or practical for everyone. That's why it's also important to inject greenery into our cities, where many hazards are most concentrated. Not only do parks and street trees give city dwellers a revitalising dose of nature, they also help us by muffling noise and absorbing pollutants. We can't just flatten our cities and rebuild them into forested utopias, Kioumourtzoglou admits. But we can keep environmental health in mind when planning new neighbourhoods and refurbishing existing ones. "Sometimes it takes a while for new and more protective regulations to kick in—and we need to know what we can do in the meantime to protect ourselves," she says.

Popular Science, 14 May 2019

<http://www.popsci.com>

Technical Notes

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

ENVIRONMENTAL RESEARCH

Development of triflumizole ionic liquids containing anions of natural origin for improving the utilisation and minimising the adverse impacts on aquatic ecosystems

Proximity to chemical equilibria among air, water, soil, and sediment as varied with partition coefficients: A case study of polychlorinated dibenzodioxins/furans, polybrominated diphenyl ethers, phthalates, and polycyclic aromatic hydrocarbons

Uptake and biodegradation of emerging contaminant sulfamethoxazole from aqueous phase using *Ipomoea aquatica*

Volatiles from Different Instars of Honeybee Worker Larvae and Their Food

Antibiotics in corals of the South China Sea: Occurrence, distribution, bioaccumulation, and considerable role of coral mucus

MEDICAL RESEARCH

Multi-walled carbon nanotubes induce stronger migration of inflammatory cells in vitro than asbestos or granular particles but a similar pattern of inflammatory mediators

Therapeutic Targeting of Nuclear Receptors, LXR and RXR, for Alzheimer's Disease

Prenatal toxicity and maternal-foetal distribution of 1,3,5,8-tetrachloronaphthalene (1,3,5,8-TeCN) in Wistar rats

Adverse Maternal, Foetal, and Postnatal Effects of Hexafluoropropylene Oxide Dimer Acid (GenX) from Oral Gestational Exposure in Sprague-Dawley Rats

OCCUPATIONAL RESEARCH

Animal production, insecticide use and self-reported symptoms and diagnoses of COPD, including chronic bronchitis, in the Agricultural Health Study

Toxicogenomics - What added Value Do These Approaches Provide for Carcinogen Risk Assessment?

Technical Notes

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Bioaccessibility of nickel and cobalt in powders and massive forms of stainless steel, nickel- or cobalt-based alloys, and nickel and cobalt metals in artificial sweat

Occupational exposure to solvents and lung function decline: A population-based study

Low-dose computed tomography screening for lung cancer in people with workplace exposure to asbestos

PUBLIC HEALTH RESEARCH

Role of cadmium and arsenic as endocrine disruptors in the metabolism of carbohydrates: Inserting the association into perspectives

Harmonised methodology to assess chronic dietary exposure to residues from compounds used as pesticide and veterinary drug

Biological exposure limits caused by co exposure to fluoride and arsenic based on Wnt signalling pathway

Mercury levels in blood, urine and hair in a nation-wide sample of Spanish adults

Pathway analysis of a genome-wide gene by air pollution interaction study in asthmatic children