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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

New Agricultural Active Constituent and New Chemical Products DALMAZIN containing d-cloprostenol

2019-06-21

The Australian Pesticides and Veterinary Medicines Authority (APVMA) has before it an application for the approval of a new active constituent, d-cloprostenol, and an application for registration of a new product DALMAZIN containing the new active constituent. The product is indicated for the induction of oestrus, synchronisation of oestrus and induction of parturition in cows, sows and mares.

Particulars of the active constituents

- Common Name: d-cloprostenol
- IUPAC Name: (5Z)-7-[(1R,2R,3R,5S)-2-[(1E,3R)-4-(3-chlorophenoxy)-3-hydroxybut-1-en-1-yl]-3,5-dihydroxycyclopentyl]-hept-5-enoic acid
- Chemical Abstracts Name: 5-Heptenoic acid, 7-[(1R,2R,3R,5S)-2-[(1E,3R)-4-(3-chlorophenoxy)-3-hydroxy-1-buten-1-yl]-3,5-dihydroxycyclopentyl]-, (5Z)-
- Manufacturer's Code: SUPE008
- Molecular Formula: C₂₂H₂₉ClO₆
- Molecular Weight: 424.9 g/mol
- Chemical Family: F2α prostaglandin synthetic analogue
- Mode of Action: It is a potent luteolytic agent; within hours of administration, it causes the corpus luteum to stop production of progesterone, and to reduce in size over several days. This effect is used in animals to induce oestrus and/or to cause abortion.

Summary of the APVMA's evaluation D-Cloprostenol active constituent

The APVMA has evaluated the chemistry aspects of d-cloprostenol (physico-chemical properties, spectroscopic identification, manufacturing process, quality control procedures, specifications, batch analysis results and analytical methods) and found them to be acceptable. There is no pharmacopeia monograph for d-cloprostenol. The APVMA has considered the toxicological aspects of d-cloprostenol, and concluded that there are no toxicological concerns to the approval of this active constituent. An Acceptable Daily Intake (ADI) has been established at 0.075 µg/kg bw/d. An Acute Reference Dose (ARfD) was considered to be unnecessary due to its low acute toxicity. d-cloprostenol is covered by the existing entry for

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cloprostenol in Schedule 4 of the Standard for the Uniform Scheduling of Medicines and Poisons (SUSMP). A reference to a substance in the SUSMP includes every stereoisomer of the substance, and therefore the Schedule 4 listing is applicable for d-cloprostenol. The APVMA is satisfied that the proposed importation and use of d-cloprostenol would not be an undue toxicological hazard to the safety of people exposed to it during its handling and use.

Particulars Of The Product

Proposed product name(s): DALMAZIN

Applicant company: ETHICAL AGENTS AUSTRALIA PTY LTD

Name of active constituent: d-cloprostenol

Signal heading: Schedule 4 Summary of proposed use: For use in the induction of oestrus in mares, synchronisation or induction of oestrus in cows and induction of parturition in cows and sows. The product is also indicated for the expulsion of mummified foetus, induction of abortion, ovarian dysfunction (persistent corpus luteum, luteal cyst) treatment, endometritis/pyometra and delayed uterine involution treatment in cows. Dosage and route of administration: The proposed dose of DALMAZIN is 2 mL given intramuscularly in cows and 1 mL given intramuscularly in sows and mares. For synchronisation of oestrus in cows, up to 2 intramuscular (IM) doses will be being given 11 days apart, and for the induction of farrowing in pigs 2 IM doses will be given 6 hours apart. DALMAZIN is also proposed for various therapeutic reproductive indications in cows, with dosing frequency ranging from a single dose to up to 3 doses given on consecutive days.

Pack sizes: 20 mL vial, 100 mL bag

Withholding period: CATTLE & PIGS MEAT: DO NOT USE less than 1 day before slaughter for human consumption. MILK: Zero (0) days. HORSES: DO NOT USE in horses that may be used for human consumption Side effects: When used in cows for induction of parturition and dependent on the time of treatment relative to the date of conception, the incidence of retained placenta may be increased. Behavioural changes seen after treatment for induction of farrowing are similar to those changes associated with natural farrowing and usually cease within one hour. Occurrence of anaerobic infection is likely if anaerobic bacteria penetrate the tissue of the injection site. Typical local reactions due to anaerobic infection are swelling and crepitus at the injection site.

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Summary Of The APVMA's Evaluation of Dalmazin In Accordance With The Requirements Of Section 14(1)(C) Of The Agricultural And Veterinary Chemicals Code Act 1994

The APVMA has evaluated the proposed product DALMAZIN and is satisfied that the proposed chemical product meets the safety (s 5A), efficacy (s 5B) and the trade (s 5D) criteria if used according to label instructions. 1. The APVMA has evaluated the application and in its assessment in relation to whether the safety criteria has been met in accordance with the definition set out in section 5A of the Agvet Code, and proposes to determine that: (i) The APVMA is satisfied that the proposed use of DALMAZIN would not be an undue hazard to the safety of people exposed to it during its handling and use. The APVMA has conducted a risk assessment for the product and in conjunction with the estimated hazard profile, determined whether the proposed use of the product would not be an undue health hazard to humans. The APVMA estimated the acute toxicity of DALMAZIN based on information provided by the applicant. The acute toxicity of the proposed product was ascertained from toxicological studies in laboratory animals using the active constituent and the product formulation. Based on the findings of the acute toxicological studies, the active constituent, d-cloprostenol, and the product present a low acute oral and dermal toxicity. On genotoxicity, d-cloprostenol is unlikely to be genotoxic in vivo. The active was also not found to have reproductive and developmental toxicity. The APVMA recommends the following first aid statement (a) – If poison occurs, contact a doctor or Poisons Information Centre. Phone Australia 13 11 26. The APVMA also recommends the following safety directions: Repeated exposure may cause allergic disorders. Wash hands after use. The first aid instruction and safety directions will be included on the product label. (ii) The APVMA is satisfied that the proposed use of DALMAZIN will not be an undue hazard to the safety of people using anything containing their residues. d-cloprostenol is rapidly eliminated from pigs and cattle and that animals are unlikely to be sent for slaughter immediately after treatment with indications for reproduction. Coverage of the proposed uses in the APVMA Maximum Residue Limits (MRL) Standard as a Table 5 entry was considered appropriate. Table 5 lists uses of substances where MRLs are not necessary. MRLs are not necessary in situations where residues do not or should not occur in foods or animal feeds; or where the residues are identical to or indistinguishable from natural food components; or otherwise are of no toxicological significance. (iii) The APVMA is satisfied that the proposed use of DALMAZIN containing the active constituent d-cloprostenol is not likely to be harmful to human

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beings if used according to the product label directions. d-cloprostenol is listed in Schedule 4 of the Australian Standard for Uniform Scheduling of Medicines and Poisons (SUSMP). The Schedule 4 signal heading is PRESCRIPTION ANIMAL REMEDY. The product will be administered principally by veterinarians, although it is expected that the product will also be used by dairy, pig and equine farmers/operators. If the latter is the case, it would be expected that these operators would also be experienced in the handling of veterinary drugs. (iv) The APVMA is satisfied that the proposed use of DALMAZIN is not likely to have an unintended effect that is harmful to animals, plants or the environment if used according to the product label directions. The environmental assessment applied the standard VICH GL6 guidance for a Phase 1 assessment which applies the total residue approach. The total residue approach assumes 100% of d-cloprostenol administered to the animal is excreted in the waste matrices. The assessment considered both intensively reared animals and pasture animals. Two days of treatment were assumed for cows and sows, while one day of treatment was assumed for mares. The environmental risks of the proposed use of DALMAZIN were determined to be acceptable. The results of the target animal safety studies indicated that, at the proposed label dose rate of 0.15 mg d-cloprostenol (2 mL DALMAZIN) per animal in cattle and 0.075 mg d-cloprostenol (1 mL DALMAZIN) in pigs and mares, DALMAZIN is unlikely to cause serious adverse reactions in cattle, pigs and horses. The following contraindications: non-use in gestating and dystocic animals, non-use in animals suffering from cardiovascular, respiratory and gastrointestinal tract disease are listed in the proposed label. The APVMA will approve the following side effects to be listed on the DALMAZIN label: occurrence of anaerobic infection and typical reactions at injection sites, increase in the incidence of retained placentas when used in cattle, and behavioural changes when used during farrowing in sows. An increased mortality in piglets when the product is used for the induction of parturition in sows before the 112th day of gestation is listed as a precaution. 2. The APVMA has evaluated the applications and in its assessment in relation to whether the efficacy criteria have been met in accordance with the definition set out in section 5B of the Agvet Code, and proposes to determine that: (i) In relation to its assessment of efficacy under section 5B (2)(a), the APVMA is satisfied that data from trials supporting the efficacy of the products adequately demonstrate that if used according to the product label directions, the product is effective for the proposed uses. The efficacy data submitted included dose determination, dose confirmation and field studies. The trial designs, treatment group sizes, ages and types of animal used, experimental conditions, administration of test and reference products, sample

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collection and analysis of data were generally appropriate for establishing the efficacy of the test product under normal use conditions for various reproductive indications in cattle, pigs and horses. The proposed dose of 2 mL DALMAZIN given intramuscularly in cows, and 1 mL given intramuscularly in sows and mares demonstrated efficacy in all the trials that were submitted. 3. The APVMA has evaluated the application and in its assessment in relation to whether the trade criteria have been met in accordance with the definition set out in section 5C of the Agvet Code, and proposes to determine that: (i) DALMAZIN residues are not expected in cattle meat, offal or milk or pig meat and offal following the proposed use. It is considered that the risk to international trade associated with the proposed use in cattle and pigs with the withholding periods is low.

Making A Submission

In accordance with section 12 of the Agvet Code, the APVMA invites any person to submit a relevant written submission as to whether the active constituent d-cloprostenol should be approved. Submissions should relate only to matters that are considered in determining whether the safety criteria set out in section 5A of the Agvet Code have been met. Submissions should state the grounds on which they are based. In accordance with section 13 of the Agvet Code, the APVMA invites any person to submit a relevant written submission as to whether DALMAZIN should be registered. Submissions should relate only to matters that are required by the APVMA to be taken into consideration in determining whether the safety, efficacy or trade criteria have been met. Submissions should state the grounds on which they are based. Submissions must be received by the APVMA within 28 days of the date of this notice and be directed to the contact listed below. All submissions to the APVMA will be acknowledged in writing via email or by post. Relevant comments will be taken into account by the APVMA in deciding whether the product should be registered and in determining appropriate conditions of registration and product labelling.

When making a submission please include:

- contact name
- company or group name (if relevant)
- email or postal address
- the date you made the submission.

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All personal and confidential commercial information (CCI) material contained in submissions will be treated confidentially.

APVMA Chemical Gazette, 18 June 2019

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

Guidance on Therapeutic Goods (Conformity Assessment Standard for Quality Management Systems) Order 2019

2019-06-21

Two key requirements of the conformity assessment procedures for medical devices are that a manufacturer must implement:

- a Quality Management System (QMS) for the design, production, packaging, labelling and final inspection of a device, and
- inspection and quality assurance techniques that are to be applied during the production of a device

The *Therapeutic Goods (Conformity Assessment Standard for Quality Management Systems) Order 2019* specifies relevant medical device standards for quality management systems and medical devices intended to be supplied in a sterile state. The Order ensures that if a manufacturer's QMS, or inspection and quality assurance techniques, comply with the relevant standards specified in the Order, the TGA will treat the QMS, or the inspection and quality assurance techniques, as if they comply with the parts of the conformity assessment procedures specified in the Order. Apart from ISO13485:2016 for QMS, this order also identifies a number of other ISO standards, or parts of ISO standards, referred to in the former Order that have been updated by ISO since that order was first introduced. For example:

ISO 11137-2:2006 Sterilization of health care products Radiation Part 2: Establishing the sterilization dose, has been revised by ISO 11137-2:2013 Sterilization of health care products Radiation Part 2: Establishing the sterilization dose; and ISO 13408-1:1998 Aseptic processing of health care products Part 1: General requirements, has been revised by ISO 13408-1:2008 Aseptic processing of health care products Part 1: General requirements.

ISO standards are often adopted by regional or national standards organisations. Where a regionally or nationally adopted version of an ISO standard has been applied and the adopted version of the standard is

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identical to the original parent publication of the ISO standard, the TGA treats these standards as being interchangeable with the original parent ISO standard. For example, the standard *ISO 13485:2016 - Medical Devices - Quality management Systems- Requirements for regulatory purposes* has been adopted as an identical regional or national standard in several jurisdictions:

- EN ISO 13485:2016 (also I.S. EN ISO, DIN EN ISO, BS EN ISO, NSAI ISO etc.) in Europe,
- ANSI/AAMI/ISO 13485:2016 in the USA, and
- AS ISO13485:2017 in Australia.

While the Order only specifies the parent ISO 13485:2016 standard, where a manufacturer has met the requirements of an identical regional/national adopted standard the TGA considers that the requirements of ISO 13485:2016 have also been met.

TGA, 19 June 2019

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

New rules enforced in New Zealand from 1 June for hazard substances

2019-06-21

New rules have been enforced in New Zealand as of 1 June for hazard substances in class 6 (toxic) and class 8 (corrosive) and for handling of hazardous waste.

Class 6 and 8 substances

For these substances you have to establish a hazardous substance location (HSL), which must meet specific requirements for capacity and storage. The HSL must be notified to WorkSafe, the New Zealand authority on hazardous substances. From 1 December 2019 a location compliance certificate will also be mandatory. Read more on [WorkSafes hjemmeside](#), including a quick guide to class 6 and 8 substances.

Hazardous waste

As of 1 June, hazardous waste is subject to most of the rules for the safe use, handling and storage of hazardous substances. This means that you need to include any hazardous waste used or stored at your site in your

New rules have been enforced in New Zealand as of 1 June for hazard substances in class 6 (toxic) and class 8 (corrosive) and for handling of hazardous waste.

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inventory and label any containers that hold hazardous waste. Further information is available [here](#).

DHI Newsletter, June 2019

<http://www.dhigroup.com>

AMERICA

Trump nominates new member to US Chemical Safety Board

2019-06-21

President Donald J. Trump has nominated Katherine Andrea Lemos to be a member of the US Chemical Safety and Hazard Investigation Board for a five-year term. Lemos has previously served in the Federal Aviation Administration and the National Transportation Safety Board, according to the announcement. She is currently the director of autonomous systems for Northrop Grumman's aerospace sector. According to the announcement, she has a background in system safety, accident investigation, human factors, and advanced technology research and integration. The independent board investigates chemically related industrial accidents and has been operating for 20 years. Nominations to the CSB must be confirmed by the Senate. Lemos's nomination comes as a surprise because Trump has three times tried to eliminate funding for the board. The board currently has only three of its five member positions filled; the current members' terms expire in December, February 2020, and August 2020. The board has been operating with an interim chair for the past year after the previous chair resigned. Despite the president's request to eliminate the CSB, Congress has continued funding support. Several members of Congress and industry representatives have urged the president to nominate new members. "Given the President's previous attempts to zero out the board, it's interesting that he has decided to nominate a new board member," says Michael Wright, director of health, safety, and environment for the United Steelworkers union. "We hope this signals that he now sees CSB's value. The nominee has an impressive résumé and if confirmed, we look forward, as a stakeholder, to her service."

Chemical & Engineering News, 14 June 2019

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

Trump has nominated Katherine Andrea Lemos to be a member of the US Chemical Safety and Hazard Investigation Board for a five-year term.

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Notice of Adoption – Section 25704 Exposures to Listed Chemicals in Coffee Posing No Significant Risk

2019-06-20

On 3 June 2019, the Office of Administrative Law approved the adoption of Title 27, California Code of Regulations, section 25704, Exposures to Listed Chemicals in Coffee Posing No Significant Risk. The regulation will be effective on 1 October 2019. Section 25704 states, "Exposures to chemicals in coffee, listed on or before 15 March 2019 as known to the state to cause cancer, that are created by and inherent in the processes of roasting coffee beans or brewing coffee do not pose a significant risk of cancer." The regulatory text and the supporting rulemaking documents are available at the following links:

- [Notice of Modified Text – Exposures to Listed Chemicals in Coffee Posing No Significant Risk](#)
- [Final Statement of Reasons - Exposures to Listed Chemicals in Coffee Posing No Significant Risk](#)
- [Regulation Text - Exposures to Listed Chemicals in Coffee Posing No Significant Risk](#)
- [Stamped Form 400 - Exposures to Listed Chemicals in Coffee Posing No Significant Risk](#)

OEHHA, 7 June 2019

<http://www.oehha.ca.gov>

New York Delays Enforcement of Household Cleansing Product Information Disclosure Program

2019-06-21

On 12 June 2019, the New York State Department of Environmental Conservation (NYSDEC) announced that it will delay enforcement of the Household Cleansing Product Information Disclosure Program (Disclosure Program) from 1 July 2019, to 1 January 2020. NYSDEC states in the 12 June 2019, Environmental Notice Bulletin that it will begin enforcing any violations of the required disclosure as of 2 January 2020. According to the notice, NYSDEC "will continue to work with any manufacturers on the design of their websites, or entertain any questions regarding compliance with website design or safety data sheets." NYSDEC "remains committed to working with the manufacture[r]s to implement this program in the best manner possible." On 9 January 2019, NYSDEC previously delayed enforcement of its Disclosure Program. The Disclosure Program sets forth

On 3 June 2019, the Office of Administrative Law approved the adoption of Title 27, California Code of Regulations, section 25704, Exposures to Listed Chemicals in Coffee Posing No Significant Risk.

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extensive requirements for manufacturers of certain consumer cleaning products to disclose information regarding the ingredients in those products.

National Law Review, 18 June 2019

<http://www.natlawreview.com>

EUROPE

Draft Guidelines on the quality requirements for medical devices in drug-device combinations

2019-06-21

The European Medicines Agency (EMA) has released a draft guideline on the quality requirements for medical devices in drug-device combinations for public consultation. Drug-device combinations are medical devices in human medicines that include a device for the administration, dosing or use of the medicine. The guideline addresses the new obligations in the EU Medical Devices Regulation (MDR 2017/745), in particular the requirements under Article 117. Article 117 foresees that a marketing authorisation application will include a CE certificate or declaration of conformity for the device or, in certain cases, an opinion from a notified body. In the draft guideline it is specified which information about the device that needs to be submitted as part of an initial marketing authorisation application. Comments on the public consultation must be submitted by 31 August 2019. Further information is available at: [Draft guideline: Quality requirements for drug-device combinations](#).

The European Medicines Agency (EMA) has released a draft guideline on the quality requirements for medical devices in drug-device combinations for public consultation.

DHI Newsletter, June 2019

<http://www.dhigroup.com>

EFSA approves recycling process of post-consumer poly(ethylene terephthalate)

2019-06-21

The European Food Safety Authority, EFSA, has approved a recycling process of post-consumer poly(ethylene terephthalate) (PET) flakes for use in food contact materials (FCM). The PET flakes originate from materials and articles manufactured in accordance with the EU legislation on FCM and contains no more than 5% of PET from non-food consumer applications. The PET flakes have been evaluated and approved not to be a

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risk to human health when used for contact with foodstuffs for long-term storage at room temperature, with or without hot-fill. Articles made of this recycled PET are not intended to be used in microwave and conventional ovens. The approved recycling process is based on the EREMA Multi-Purpose Reactor (MPR) technology and was submitted by the Italian company Alimpet S.r.L. In the EU, recycling processes must be evaluated and authorised before the recycled plastic materials or articles are placed on the market for food contact.

DHI Newsletter, June 2019

<http://www.dhigroup.com>

Austrian Academy of Sciences Publishes NanoTrust Dossier on the Safe-By-Design Concept

2019-06-21

The Institute of Technology Assessment of the Austrian Academy of Sciences has published a NanoTrust Dossier entitled "Safe-by-Design — The Early Integration of Safety Aspects in Innovation Processes." The Dossier presents an overview of the concepts behind the idea of integrating health or environmental safety considerations in the design of materials, products, or processes, focusing on the nano-specific Safe-by-Design (SbD) concept. SbD aims to take account of safety issues early on and throughout the entire product development process. According to the Dossier, the nano-specific concepts of SbD are intended to address prevailing uncertainties about potential risks to the environment and human health at the beginning stages in the development of new nanomaterials and products. The Dossier states that the basic assumption of the SbD concept is that risks can be reduced through the choice of materials, products, tools, and technologies, making them as safe as possible. Particular attention is paid to the product development stage, when it is still possible to intervene to control the selection of these factors. In line with the precautionary principle, the early integration of safety in the innovation process is generally seen as desirable. In recent years, according to the Dossier, many projects have been dedicated to the SbD concept and its practical implementation in industry. Alongside the strengths of the concept, such as the early focus on safety-relevant issues, a number of challenges concerning practical applicability have been identified. The Dossier notes that the voluntary nature of the use of SbD increases the users' outlay in money and time without any visible added benefit for the enterprise. Currently, therefore, "the nano-specific SbD concept must be considered as difficult to implement, although the effort

The Dossier presents an overview of the concepts behind the idea of integrating health or environmental safety considerations in the design of materials, products, or processes, focusing on the nano-specific Safe-by-Design (SbD) concept.

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to include safety as early as possible in the innovation process is generally very positively received." The Dossier includes a summary of projects at the European Union (EU) and national levels that have addressed or are addressing SbD in the nano-context.

Nano & Other Emerging Technologies, 12 June 2019

<http://nanotech.lawbc.com>

UK accused of 'silently eroding' EU pesticide rules in Brexit laws

2019-06-21

The UK has been accused of "silently eroding" key environmental and human health protections in the Brexit-inspired rush to convert thousands of pages of European Union pesticide policy into British law. Despite government claims the process would be little more than a technical exercise, analysis by the University of Sussex's UK Trade Policy Observatory (UKTPO) has uncovered significant departures from EU regulations, including the removal of a blanket ban on hormone-disrupting chemicals, which are known to cause adverse health effects such as cancer, birth defects and immune disorders. The UK legislation removes the EU system of checks and balances to give a handful of ministers the power to create, amend and revoke pesticide legislation. It also appears to weaken the existing "precautionary principle" approach, which requires scientific evidence from an independent body that a pesticide is safe to use. Instead, UK ministers are given the option to obtain and consider such evidence at their own discretion. The changes could lead to the widespread use in the UK of harmful and carcinogenic pesticides, the researchers warn. But because the laws are being drawn up so quickly and at such a high volume, there has been little scrutiny of the process, said Emily Lydgate, a UKTPO fellow and senior lecturer at the university. "The creation of over 10,000 pages of new legislation, which effectively convert EU law into UK rulebooks, is one of the most intensive and significant efforts that the government has made to prepare for Brexit," she said. "You'd normally think this would be so significant that it would justify primary legislation but because it's a conversion, it's undergone a very minimal parliamentary process." The EU provides up to 80% of the UK's environmental laws, which include regulations on pesticides, landfills, recycling and climate heating. Under the new regulations, however, power to make, amend and revoke pesticide legislation will be devolved to each of the national territories and consolidated to a secretary of state in England, relevant ministers in Scotland and Wales, and the competent authority in Northern Ireland.

Analysis finds changes such as removal of blanket ban on hormone-disrupting chemicals

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Ffion Thomas, a master's student from the sustainability charity the Centre for Alternative Technology who was involved in the analysis, said the devolution of power could spell disaster for trade within the UK. "Each territory could set their own regulations on pesticides, so after exit day you could find that chemicals are approved [in one territory but not others] that have been proven harmful to human and animal health and the environment," said Thomas. Hormone-disrupting chemicals are permitted for use in Canada and the US, and both countries have criticised the EU ban. Whether the UK government's decision to remove the ban was an invitation to open trade talks with North America was as yet unclear, said Lydgate. "But the US and Canada have complained about [the ban] for a long time and it would certainly be on the table in a trade deal," she added. Josie Cohen, the head of policy and campaigns at the Pesticide Action Network UK charity, warned the overall legislative changes could give ministers the power to open the door to further pesticide deregulation and potentially make them vulnerable to lobbying. "Despite the government commitment to uphold UK standards, these legal instruments threaten to eliminate crucial checks and balances and leave us woefully under-resourced to protect human health and environment from pesticides," she said. "Before EU exit, the government must invest in creating a UK standalone regime which is fit for purpose. Otherwise we will end up with larger quantities of increasingly harmful chemicals being allowed in our food and farms." The Department for Environment, Food and Rural Affairs said: "We will maintain the robust regulation of pesticides as we leave the EU, prioritising the protection of people and the environment. As always, we will continue to make all decisions on pesticides based on the best scientific evidence, following advice from the independent expert committee on pesticides."

The Guardian, 12 June 2019

<http://www.guardian.com>

REACH Update

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Public consultation on harmonised classification and labelling

2019-06-21

The European Chemicals Agency (ECHA) is looking for comments on the harmonised classification and labelling proposals for: quinochloramine (ISO); 2-amino-3-chloro-1,4-naphthoquinone (EC 220-529-2, CAS 2797-51-5). Please note that a combined format including the draft (renewal) assessment report prepared according to the Plant Protection Products Regulation and the proposal for harmonised classification and labelling (CLH Report) according to the CLP Regulation has been used. For additional information, consult the Commission's Guidelines on Active Substances and Plant Protection Products; tellurium (EC 236-813-4, CAS 13494-80-9); and tellurium dioxide (EC 231-193-1, CAS 7446-07-3). The deadline for comments is 16 August 2019. Further information is available at:

- CLH consultations
- Commission's guidelines on active substances and plant protection products

ECHA News, 19 June 2019

<http://echa.europa.eu>

New intention to harmonise classification and labelling

2019-06-21

The European Chemicals Agency (ECHA) has received one proposal to harmonise the classification and labelling for bis(4-methylbenzoyl) peroxide from Germany. The proposal to harmonise the classification and labelling was received for bis(4-methylbenzoyl)peroxide (EC 407-950-9, CAS 895-85-2) can be viewed at: Registry of CLH intentions

ECHA News, 19 June 2019

<http://echa.europa.eu>

Want to keep using these substances in preservatives?

2019-06-21

Companies have withdrawn their interest to get the following active substance and product-type combinations approved in the biocides review program:

The European Chemicals Agency (ECHA) has received one proposal to harmonise the classification and labelling for bis(4-methylbenzoyl)peroxide from Germany.

REACH Update

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- metam-sodium (EC 205-293-0, CAS 137-42-8) for use in preservatives for fibre, leather, rubber and polymerised materials (product-type 9) and for liquid-cooling and processing systems (product-type 11); and
- thiram (EC 205-286-2, CAS 137-26-8) for use in preservatives for fibre, leather, rubber and polymerised materials (product-type 9).

Notify ECHA by 12 June 2020 to keep these substances in the approval process. Further information is available at: Upcoming deadlines

ECHA News, 19 June 2019

<http://echa.europa.eu>

Union authorisation deadlines in 2020

2019-06-21

The European Chemicals Agency has advised to check its website for the deadlines to apply for Union authorisation for your biocidal product. In 2020, there are currently three substances with application deadlines:

- Cyphenothrin (EC 39515-40-7, CAS 254-484-5): apply by 1 February 2020;
- Acetamiprid (EC -, CAS 135410-20-7): apply by 1 February 2020; and
- Cypermethrin (EC 257-842-9, CAS 52315-07-8): apply by 1 June 2020.

Union authorisation allows you to place a biocidal product on the market throughout the EU without the need for specific national authorisation. Further information is available at:

- Applications deadlines for Union authorisation
- Practical guide on Union authorisation

ECHA News, 19 June 2019

<http://echa.europa.eu>

The European Chemicals Agency has advised to check its website for the deadlines to apply for Union authorisation for your biocidal product.

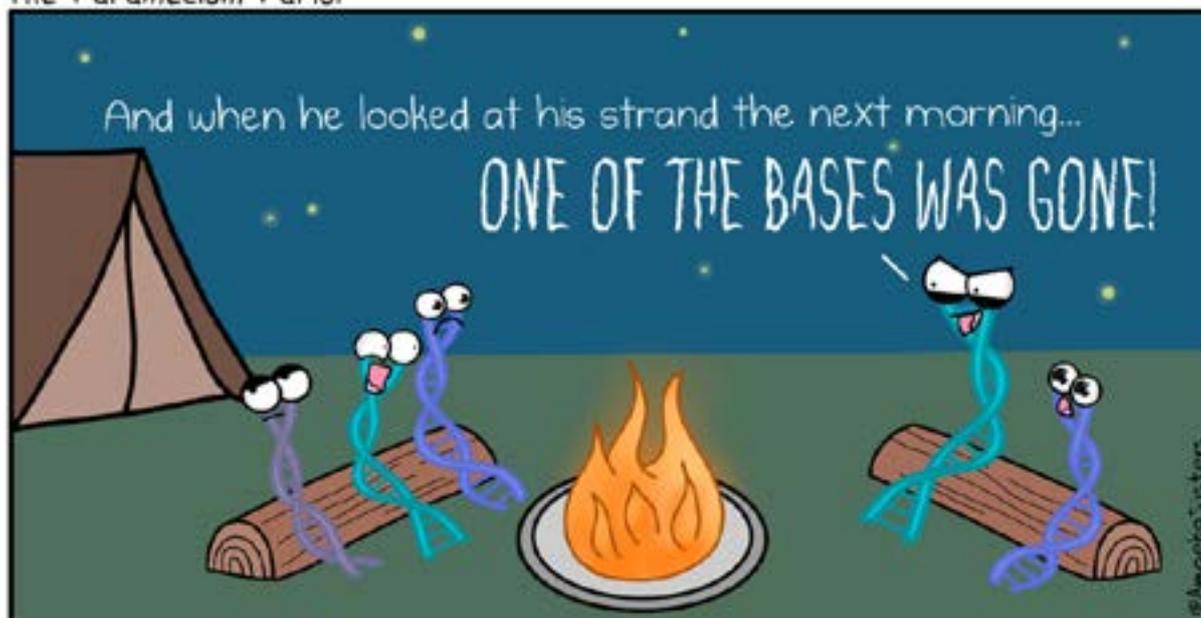
Janet's Corner

CHEMWATCH

Mutation Stories

2019-06-14

The Paramecium Parlor



Sharing mutation stories was a DNA camping tradition.

Hazard Alert

CHEMWATCH

Bromoform

2019-06-10

Bromoform (CHBr_3) is a pale yellowish liquid with a sweet odour similar to chloroform. It is soluble in about 800 parts water and is miscible with alcohol, benzene, chloroform, ether, petroleum ether, acetone, and oils. It is also non-flammable and readily evaporates into the air. Bromoform is produced naturally by phytoplankton and seaweeds in the ocean and this is thought to be the predominant source to the environment. However, locally significant amounts of bromoform enter the environment formed as disinfection by-products known as the trihalomethanes when chlorine is added to drinking water to kill bacteria. [1,2]

USES [3]

Bromoform is used as an intermediate in geological assaying and as a solvent for waxes, greases, and oils. It is also used in shipbuilding, aircraft, and aerospace industries and as an ingredient in fire-resistant chemicals and gauge fluid. Traces of bromoform are likely to be present in swimming pools, municipal waters, and wastes as a result of chlorination in the presence of naturally occurring bromide ions and humic substances. It is hypothesised that bromoform may be formed by the haloform reaction which occurs during the chlorination of water.

SOURCES & ROUTES OF EXPOSURE [2, 4]

Studies have indicated that bromoform can easily enter the body after swallowing them in water or breathing them in air. In addition, they can enter the body through the skin (for example, by washing or showering in water containing these chemicals). Some portion of bromoform entering the body may be broken down to other compounds. Bromoform and its breakdown products can be removed from the body by being exhaled from the lungs. These chemicals leave the body fairly rapidly. Bromoform does not tend to build up in the body; 50-90% of the amount that enters the body is removed within 8 hours. The principal route of human exposure to bromoform is from drinking water that has been disinfected with chlorine, bromine, or bromine compounds. Bromoform has been detected in swimming pools that have been disinfected with bromine or bromine compounds; therefore, exposure to low levels could occur from inhalation of bromoform that has evaporated into the air or through the skin from bromoform in the water. In addition, exposure could also occur from inhalation of ambient air near factories or laboratories that

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use bromoform. Another place for exposure is near a chemical waste site where bromoform leaked into water or soil.

HEALTH EFFECTS [2]

Acute Effects

Human exposure to large amounts of bromoform through inhalation and oral exposure can result in unconsciousness. Animal studies, combined with limited observations in humans, indicate that the principal adverse health effects associated with short-term inhalation or oral exposure to high levels of bromoform are CNS depression, resulting in the slowing down of normal brain activities, sedation, narcosis, and sleep, and liver and kidney injury.

Chronic Effects

The long-term effects of exposure to bromoform in humans have not been studied. Animal studies indicate effects on the liver, kidney, and CNS from chronic oral exposure to bromoform. The Reference Dose (RfD) for bromoform is 0.02 milligrams per kilogram body weight per day (mg/kg/d) based on hepatic lesions in rats. The United States Environmental Protection Agency has determined that there are insufficient data to calculate a Reference Concentration (RfC) for bromoform.

Cancer Risk

The only available human cancer study suggested a positive correlation between levels of bromoform in drinking water and the incidence of several tumour types. However, this study was considered to be incomplete and preliminary because the study design did not permit consideration of variables such as personal habits, residential histories, and past exposures. Animal studies have demonstrated an increase in the incidences of liver and intestinal tumours following oral exposure to bromoform. EPA considers bromoform to be a probable human carcinogen and has ranked it in EPA's Group B2.

SAFETY [5]

First Aid Measures

- Eye Contact: Check for and remove any contact lenses. Immediately flush eyes with running water for at least 15 minutes, keeping eyelids

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open. Cold water may be used. WARM water MUST be used. Get medical attention.

- Skin Contact: In case of contact, immediately flush skin with plenty of water. Cover the irritated skin with an emollient. Remove contaminated clothing and shoes. Wash clothing before reuse. Thoroughly clean shoes before reuse. Get medical attention.
- Serious Skin Contact: Wash with a disinfectant soap and cover the contaminated skin with an anti-bacterial cream. Seek immediate medical attention.
- Inhalation: If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical attention.
- Serious Inhalation: Evacuate the victim to a safe area as soon as possible. Loosen tight clothing such as a collar, tie, belt or waistband. If breathing is difficult, administer oxygen. If the victim is not breathing, perform mouth-to-mouth resuscitation. Seek medical attention.
- Ingestion: Do NOT induce vomiting unless directed to do so by medical personnel. Never give anything by mouth to an unconscious person. If large quantities of this material are swallowed, call a physician immediately. Loosen tight clothing such as a collar, tie, belt or waistband.

Exposure Control & Personal Protection

Engineering Controls

Provide exhaust ventilation or other engineering controls to keep the airborne concentrations of vapours below their respective threshold limit value.

Personal Protection Equipment

- Splash goggles;
- Lab coat;
- Vapour respirator - Be sure to use an approved/certified respirator or equivalent;
- Gloves;

Personal Protection in Case of a Large Spill:

- Splash goggles;
- Full suit;
- Vapour respirator (A self contained breathing apparatus should be used to avoid inhalation of the product);

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- Boots;
- Gloves;

Please note: Suggested protective clothing might not be sufficient; consult a specialist BEFORE handling this product.

REGULATION

United States

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

- General Industry: 29 CFR 1910.1000 Table Z-1 - 0.5 ppm, 5 mg/m³ TWA; Skin
- Construction Industry: 29 CFR 1926.55 Appendix A - 0.5 ppm, 5 mg/m³ TWA; Skin
- Maritime: 29 CFR 1915.1000 Table Z-Shipyards - 0.5 ppm, 5 mg/m³ TWA; Skin

ACGIH: American Conference of Governmental Industrial Hygienists has set a Threshold Limit Value (TLV) for bromoform of 0.5 ppm, 5.2 mg/m³ TWA; Skin; Appendix A3 - Confirmed Animal Carcinogen with Unknown Relevance to Humans

NIOSH: The National Institute for Occupational Safety and Health has set a Recommended Exposure Limit (REL) for bromoform of 0.5 ppm, 5.2 mg/m³ TWA; Skin

Australia [7]

Safe Work Australia: Safe Work Australia has set a time weighted average concentration (TWA) for bromoform of 0.5ppm or 5.2mg/m³ for a 40 hour work week.

REFERENCES

1. <http://en.wikipedia.org/wiki/Bromoform>
2. <http://www.epa.gov/ttn/atw/hlthef/bromoform.html>
3. <http://scorecard.goodguide.com/chemical-profiles/html/bromoform.html>
4. <http://www.atsdr.cdc.gov/phs/phs.asp?id=711&tid=128>
5. <http://www.sciencelab.com/msds.php?msdsId=9927109>
6. https://www.osha.gov/dts/chemicalsampling/data/CH_222000.html

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7. <http://www.safeworkaustralia.gov.au/sites/SWA/about/Publications/Documents/772/Workplace-exposure-standards-airborne-contaminants.pdf>

Gossip

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New textile dyeing method drastically reduces water needed and toxic dye discharge

2019-06-11

Anuradhi Liyanapathirana is passionate about sustainability and protecting the environment through science. A University of Georgia doctoral student in the College of Family and Consumer Sciences' department of textiles, merchandising and interiors, the Sri Lanka native is researching and helping develop an environmentally friendly textile dyeing method. Traditional dyeing methods involve a dye bath that requires massive amounts of water, much of it released as toxic wastewater that can damage the environment and be costly to treat. Liyanapathirana, along with FACS faculty members Sergiy Minko and Suraj Sharma, is researching a better approach using nanocellulose as a carrier of textile dyes that significantly reduces the amount of wastewater and toxic chemicals. Through a process of homogenisation, cellulose, a readily available natural polymer found in the cell wall of green plants, is converted into a hydrogel consisting of nanocellulose fibres. In this method, researchers dye the nanocellulose hydrogel instead of dyeing the fabric. Compared to cotton fibres, nanocellulose fibres have more surface area with high reactivity, allowing for more efficient attachment of dye molecules. "My aspiration in life is to make social transformation through science," Liyanapathirana said. "Over the past decades, the development of material science has contributed to advances in electronics, nanotechnology and sustainable technologies. I've embraced research that enables advancing sustainable materials and sustainable technologies for industry." Using this technique, UGA researchers have been able to reduce the water needed to dye 1 kilogram of cotton from 19 litres to just 1.9 litres. Recent analysis also indicates a 60% reduction of dye discharge. Liyanapathirana and the FACS team said they're excited about the potential impact the research can have on the textile industry. They are now looking at ways to upscale the technology to make it applicable to the industrial production process. UGA is the ideal place to make it happen, Liyanapathirana said, based on its reputation for ground-breaking research bringing new products to market. "With the emerging trends on environmental pollution and population growth, sustainable technologies are the key to accomplishing viable socio-economic development," she said. "I'm confident that our research projects will have a direct contribution to sustainable development, and that we

Researchers are investigating a better approach using nanocellulose as a carrier of textile dyes that significantly reduces the amount of wastewater and toxic chemicals.

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will able to make a remarkable impact on the world with our innovations and discoveries.”

Phys.org, 31 May 2019

<http://phys.org>

New technique for studying rusting of steel benefits mining industry

2019-06-11

University of Saskatchewan (USask) Ph.D. student Arthur Situm has developed a new non-invasive technique to study the rusting of steel, research that may help with the safety of potash mining and construction of buildings, roads and bridges. At the Canadian Light Source (CLS) synchrotron, a national research facility of USask, Situm has been studying how the protective coatings of rebar—the steel reinforcing bars used to strengthen concrete —withstand rusting (corrosion). He did his research with the potash mining industry especially in mind. Salt from potash mining seeps through the porous concrete and may cause rebar to rust faster, which could require more frequent replacements. The world’s largest reserves of potash, mainly used for crop fertilizer, are in Saskatchewan and the industry is integral to the provincial economy, making up nearly 30 percent of the mineral’s worldwide production in 2017. “Concrete usually holds up pretty well even when the rebar is somewhat rusted, but the method I developed helps you determine at which point the protective coatings of the rebars fail, so that researchers can develop better coatings,” said Situm. Unlike other methods used to study corrosion, Situm’s new synchrotron technique, which stems from a combination of X-rays, a microscope and the CLS particle accelerator, shows how effective the coatings are without removing them from the rebar. Normally, coating removal damages samples by making them unusable for future testing and may interfere with the corrosion of the coating itself. The project is funded by: the federal agency NSERC; the International Minerals Innovation Institute (IMII); potash companies Nutrien, BHP and Mosaic; and Mitacs, a national not-for-profit organization that fosters growth and innovation for business and academia in Canada. “We work closely with these companies to better understand what their needs are in terms of rebar, and we regularly share our results with them and IMII,” said chemistry professor Andrew Grosvenor, Situm’s supervisor. “We hope that by the end of the project our work will be useful for them to further improve the safety of constructions in the potash industry.” Situm has simulated different conditions for multiple types of protective

**University of
Saskatchewan (US-
ask) Ph.D.**

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coatings in the lab to understand how the materials and surface chemicals can respond. His results show that a well-known and more expensive coating called “fusion-bonded epoxy” is able to withstand corrosion better than other types of coatings tested. “It’s not just the work we do in the lab that can tell us to choose a particular coating. A material performance can change greatly based on the lifetime of the material and environmental exposure, so we are not recommending one coating over others,” said Grosvenor. “Arthur was more interested in finding new ways to study corrosion.” Situm’s technique ‘maps’ how the chemical elements of a material are placed across its surface, and how they may change in response to corrosion or aging. His results are published in the journals *Corrosion Science* and *Surface and Interface Analysis*. “Much like a map of a city, which tells you where parks and buildings are, and how big, my map shows a very accurate distribution of chemicals in a material,” he said. Situm plans to extend the applications of his technique to study the stability of the ceramics used to store nuclear waste, using a simulated nuclear fuel.

Phys.org, 28 May 2019

<http://phys.org>

New method to evaluate comfort of smart and functional textiles

2019-06-11

Until now, user-friendliness has been the focus of the development of smart and functional textiles. Now it is time to address comfort when wearing these textiles—a quality factor that should be of interest to the industry. The development of smart and functional e-textiles has gone at a rapid pace, not least when it comes to desired properties such as being lightweight, flexible, being elastic, and the possibility of integrating them into garments. User-friendliness has been the top priority, but when it comes to comfort, how the textiles actually feel on the skin, development has not come so far. This may explain why the market share of these textiles falls behind even though demand is high. Doctoral student Melkie Tadesse has, in his research project, developed a method for assessing this, which should be of great interest for the industry when it comes to quality evaluation of these kinds of textiles. “So far, the research has sought to produce a material that is perceived as an ordinary textile, but without succeeding in finding a method for evaluating the feeling, the comfort, of the material against the skin,” he explains. The aim also extends to being able to predict tactile comfort.

Until now, user-friendliness has been the focus of the development of smart and functional textiles. Now it is time to address comfort when wearing these textiles—a quality factor that should be of interest to the industry.

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Sample material collection

In his project, he has set up a sample material collection by developing and collecting various smart and functional textiles, using 3-D printing, coating, inkjet printing, screen printing on the textile substrate and smart fibres integrated in the knitting process itself. The functional textile materials have different properties such as being thermochromic (they are activated by heat), electrically conductive (activated by an electric current), photochromic (activated when exposed to light), and electroluminescent (they emit light when an electric current passes through it).

Verification by an expert panel

Various characterisation methods such as durability against washing and mechanical actions, electrical conductivity and surface properties were analysed. Then he examined how the different functional fabrics were experienced in skin contact based on physiological and psychological aspects. Various experiments with visual and blind subjective evaluations were carried out. "We used an expert panel to verify the results. The participants touched and squeezed functional fabric materials and evaluated them based on different bipolar attributes, that is, words and their opposite words, e.g. rough-smooth, that are directly or indirectly related to tactile comfort, i.e. different ways to put words to the experience of touch." Objective data (low-stress mechanical properties) was collected through a measuring system for textiles, the Kawabata Evaluation System, where the physical properties of the textile material are measured under low load conditions, such as how it behaves in regards to, for example, tensile and pressure, bending, surface friction and shearing on contact with the skin, in which the result showed that low stress mechanical properties are directly related to the tactile comfort of fabrics when in contact with the skin. By using different statistical methods, he produced an interpretable result from the collected data. The result shows that it is possible to use visual tests as well as blind tests to evaluate the comfort properties of smart and functional textiles.

Environmental friendly technologies and chemicals

The project has been framed by a comprehensive approach to sustainable development. "In the project, we have used completely environmentally friendly, resource-efficient and cost-effective techniques and chemicals,

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not least when it comes to inkjet printing, when we have developed and collected the various textile materials.”

Phys.org, 28 May 2019

<http://phys.org>

Earth recycles ocean floor into diamonds

2019-06-11

Traces of salt trapped in many diamonds show the stones are formed from ancient seabeds that became buried deep beneath the Earth's crust, according to new research led by Macquarie University geoscientists in Sydney, Australia. Most diamonds found at the Earth's surface are formed this way; others are created by crystallization of melts deep in the mantle. In experiments recreating the extreme pressures and temperatures found 200 kilometres underground, Dr Michael Förster, Professor Stephen Foley, Dr Olivier Alard, and colleagues at Goethe Universität and Johannes Gutenberg Universität in Germany, have demonstrated that seawater in sediment from the bottom of the ocean reacts in the right way to produce the balance of salts found in diamond. The study, published in *Science Advances*, settles a long-standing question about the formation of diamonds. “There was a theory that the salts trapped inside diamonds came from marine seawater, but couldn't be tested,” says lead author Michael. “Our research showed that they came from marine sediment.” Diamonds are crystals of carbon that form beneath the Earth's crust in very old parts of the mantle. They are brought to the surface in volcanic eruptions of a special kind of magma called kimberlite. While gem diamonds are usually made of pure carbon, so-called fibrous diamonds, which are cloudy and less appealing to jewellers, often include small traces of sodium, potassium and other minerals that reveal information about the environment where they formed. These fibrous diamonds are commonly ground down and used in technical applications like drill bits. Fibrous diamonds grow more quickly than gem diamonds, which means they trap tiny samples of fluids around them while they form. “We knew that some sort of salty fluid must be around while the diamonds are growing, and now we have confirmed that marine sediment fits the bill,” says Michael. For this process to occur, a large slab of sea floor would have to slip down to a depth of more than 200 kilometres below the surface quite rapidly, in a process known as subduction in which one tectonic plate slides beneath another. The rapid descent is required because the sediment must be compressed to more than four gigapascals (40,000 times atmospheric pressure) before it begins to melt in the temperatures

The diamond on your finger is most likely made of recycled seabed cooked deep in the Earth.

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of more than 800°C found in the ancient mantle. To test the idea, team members at the Johannes Gutenberg Universität Mainz and Goethe Universität Frankfurt in Germany carried out a series of high-pressure, high-temperature experiments. They placed marine sediment samples in a vessel with a rock called peridotite that is the most common kind of rock found in the part of the mantle where diamonds form. Then they turned up the pressure and the heat, giving the samples time to react with one another in conditions like those found at different places in the mantle. At pressures between four and six gigapascals and temperatures between 800°C and 1100°C, corresponding to depths of between 120 and 180 kilometres below the surface, they found salts formed with a balance of sodium and potassium that closely matches the small traces found in diamonds. "We demonstrated that the processes that lead to diamond growth are driven by the recycling of oceanic sediments in subduction zones," says Michael. "The products of our experiments also resulted in the formation of minerals that are necessary ingredients for the formation of kimberlite magmas, which transport diamonds to the Earth's surface."

EurekAlert, 29 May 2019

<http://www.eurekalert.org>

New metamaterial can improve MRI quality and reduce scan time

2019-06-11

Could a small ringlike structure made of plastic and copper amplify the already powerful imaging capabilities of a magnetic resonance imaging (MRI) machine? Xin Zhang, Stephan Anderson, and their team at the Boston University Photonics Centre can clearly picture such a feat. With their combined expertise in engineering, materials science, and medical imaging, Zhang and Anderson, along with Guangwu Duan and Xiaoguang Zhao, designed a new magnetic metamaterial, reported in *Communications Physics*, that can improve MRI quality and cut scan time in half. Zhang and Anderson say that their magnetic metamaterial could be used as an additive technology to increase the imaging power of lower-strength MRI machines, increasing the number of patients seen by clinics and decreasing associated costs, without any of the risks that come with using higher-strength magnetic fields. They even envision the metamaterial being used with ultra-low field MRI, which uses magnetic fields that are thousands of times lower than the standard machines currently in use. This would open the door for MRI technology to become widely available around the world. "This [magnetic metamaterial] creates

New magnetic metamaterial could be used as an additive technology to increase the imaging power of lower-strength MRI machines, increasing the number of patients seen by clinics and decreasing associated costs, without any of the risks that come with using higher-strength magnetic fields.

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a clearer image that may be produced at more than double the speed” of a current MRI scan, says Anderson, a School of Medicine professor of radiology and vice chairman of research in Boston Medical Centre’s radiology department. MRI uses magnetic fields and radio waves to create images of organs and tissues in the human body, helping doctors diagnose potential problems or diseases. Doctors use MRI to identify abnormalities or diseases in vital organs, as well as many other types of body tissue, including the spinal cord and joints. “[MRI] is one of the most complex systems invented by human beings,” says Zhang, a College of Engineering professor of mechanical engineering, electrical and computer engineering, biomedical engineering, materials science and engineering, and a professor at the Photonics Centre. Depending on what part of the body is being analysed and how many images are required, an MRI scan can take up to an hour or more. Patients can face long wait times when scheduling an examination and, for the healthcare system, operating the machines is time-consuming and costly. Strengthening MRI from 1.5 T (the symbol for tesla, the measurement for magnetic field strength) to 7.0 T can definitely “turn up the volume” of images, as Anderson and Zhang describe. But although higher-power MRIs can be done using stronger magnetic fields, they come with a host of safety risks and even higher costs to medical clinics. The magnetic field of an MRI machine is so strong that chairs and objects from across the room can be sucked toward the machine -- posing dangers to operators and patients alike. The magnetic metamaterial designed by the Boston University researchers is made up of an array of units called helical resonators -- three-centimetre-tall structures created from 3-D-printed plastic and coils of thin copper wire -- materials that aren’t too fancy on their own. But put together, helical resonators can be grouped in a flexible array, pliable enough to cover a person’s kneecap, abdomen, head, or any part of the body in need of imaging. When the array is placed near the body, the resonators interact with the magnetic field of the machine, boosting the signal-to-noise ratio (SNR) of the MRI, “turning up the volume of the image” as Anderson says. “A lot of people are surprised by its simplicity,” says Zhang. “It’s not some magic material. The ‘magical’ part is the design and the idea.” To test the magnetic array, the team scanned chicken legs, tomatoes, and grapes using a 1.5 T machine. They found that the magnetic metamaterial yielded a 4.2-fold increase in the SNR, a radical improvement, which could mean that lower magnetic fields could be used to take clearer images than currently possible. Now, Zhang and Anderson hope to partner with industry collaborators so that their magnetic metamaterial can be smoothly adapted for real-world clinical applications. “If you are able to deliver something that can increase SNR by a significant margin, we can start to think about possibilities that

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didn't exist before," says Anderson, such as the possibility of having MRI near battlefields or in other remote locations. "Being able to simplify this advanced technology is very appealing," he says. This work was supported by the National Institutes of Health, the Boston University College of Engineering Dean's Catalyst Award, the Boston University Wallace H. Coulter Translational Research Partnership Award, and the Boston University Ignition Award.

Science Daily, 10 June 2019

<http://www.sciencedaily.com>

Oozing white mucus from giant salamanders makes excellent medical glue

2019-06-11

Chinese giant salamanders, the largest and longest-living amphibians in the world, excrete a goo from their skin that can be used to seal wounds – and it is better than most medical adhesives available today. When giant salamanders are threatened or injured, their skin oozes a protein-rich mucus. Shrike Zhang at Harvard Medical School and his colleagues used this mucus to make glue for sticking skin back together after surgeries. With the medical adhesives currently on the market, there is an important trade-off. Synthetic adhesives are very strong, but not very flexible and give off heat as they bond with the skin that can be damaging, while natural adhesives are more flexible and biocompatible, but not nearly as strong. To make their glue, Zhang and his colleagues gently scratched the backs of Chinese giant salamanders to trigger mucus secretion. They then collected the white material and freeze-dried into a powder for later use by mixing with water to rehydrate. "I think if you happened to have a giant salamander by your side, putting the mucus right on should probably work too," says Zhang. "If you happened to have salamanders surrounding you all the time that might be something to try." The salamanders are critically endangered in the wild, though millions live in commercial farms. They tested the strength of the goo on pig skin and found that it was slightly weaker than chemical adhesive but far stronger than the natural kind, while retaining the same flexibility as natural medical adhesive. In live rats, sealing a small wound with salamander adhesive left almost no scar and allowed the hair to regrow almost immediately. It also did not cause significant inflammation and degraded safely in the body. Not only does this glue seem to be safe and effective, it's renewable. "You don't have to kill any animals, you just once in a while very gently scratch their

Chinese giant salamanders, the largest and longest-living amphibians in the world, excrete a goo from their skin that can be used to seal wounds – and it is better than most medical adhesives available today.

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skins to harvest the mucus," says Zhang. "It's very sustainable, and you can obtain this adhesive for a long time."

New Scientist, 6 June 2019

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

After 40 Years of Searching, Scientists Identify The Key Flaw in Solar Panel Efficiency

2019-06-11

Solar panels are fantastic pieces of technology, but we need to work out how to make them even more efficient – and scientists just solved a 40-year-old mystery around one of the key obstacles to increased efficiency. A new study outlines a material defect in silicon used to produce solar cells that has previously gone undetected. It could be responsible for the 2 percent efficiency drop that solar cells can see in the first hours of use: Light Induced Degradation (LID). Multiplied by the increasing number of panels installed at solar farms around the world, that drop equals a significant cost in gigawatts that non-renewable energy sources have to make up for. In fact, the estimated loss in efficiency worldwide from LID is estimated to equate to more energy than can be generated by the UK's 15 nuclear power plants. The new discovery could help scientists make up some of that shortfall. "Because of the environmental and financial impact solar panel 'efficiency degradation' has been the topic of much scientific and engineering interest in the last four decades," says one of the researchers, Tony Peaker from the University of Manchester in the UK. "However, despite some of the best minds in the business working on it, the problem has steadfastly resisted resolution until now." To find what 270 research papers across four decades had previously been unable to determine, the latest study used an electrical and optical technique called deep-level transient spectroscopy (DLTS) to find weaknesses in the silicon. Here's what the DLTS analysis found: As the electronic charge in the solar cells gets transformed from sunlight, the flow of electrons gets trapped; in turn, that reduces the level of electrical power that can be produced. This defect lies dormant until the solar panel gets heated, the team found. "We've proved the defect exists, it's now an engineering fix that is needed," says one of the researchers, Iain Crowe from the University of Manchester. The researchers also found that higher quality silicon had charge carriers (electrons which carry the photon energy) with a longer 'lifetime', which backs up the idea that these traps are linked to the efficiency degradation. What's more, heating the material in the dark, a process often used to remove traps from silicon,

A new study outlines a material defect in silicon used to produce solar cells that has previously gone undetected.

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seems to reverse the degradation. The work to push solar panel efficiency rates higher continues, with breakthroughs continuing to happen in the lab, and nature offering up plenty of efficiency tips as well. Now that the Light Induced Degradation mystery has been solved, solar farms across the globe should benefit. "An absolute drop of 2 percent in efficiency may not seem like a big deal, but when you consider that these solar panels are now responsible for delivering a large and exponentially growing fraction of the world's total energy needs, it's a significant loss of electricity generating capacity," says Peaker. The research has been published in the *Journal of Applied Physics*.

Science Alert, 8 June 2019

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

To Clean Up Heavy Metals, Give Soil A Chemical 'Bath'

2019-06-11

A new way to wash heavy metals from contaminated soils uses a chemical process that's a bit like brewing coffee. When poisonous heavy metals like lead and cadmium escape from factories or mines, they can pollute the nearby soil. With no easy ways to remove these contaminants, fields must be cordoned off to prevent these toxins from entering the food chain where they threaten human and animal health. According to the Environmental Protection Agency, heavy metals have been found at thousands of locations nationwide. While some have been cleaned up through a combination of federal, state, and private efforts, the need remains for new technologies to address heavy metal contamination. As researchers from Stanford University describe in *Nature Communications*, they started by rinsing contaminated soil with a mixture of water and a chemical that attracts heavy metals. When that mixture percolates through the soil, the chemical pulls heavy metals loose. The team members then collected this toxic brew and ran it through an electrochemical filter that captured the heavy metals out of the water. In this way they cleansed the soil of heavy metals and recycled the water and chemical mixture to percolate through more contaminated ground. "This is a new approach to soil clean-up," says Yi Cui, who is a professor of materials science and engineering and photon science. "Our next step is a pilot test to make sure that what works in the lab is practical in the field, and to figure out how much this process will cost." So far, his team has cleansed soils contaminated with lead and cadmium—two prevalent and dangerous toxins—as well as with copper, which is only dangerous in high concentrations. Cui believes this process of chemical cleansing and

A new way to wash heavy metals from contaminated soils uses a chemical process that's a bit like brewing coffee.

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electrochemical filtering will work with other dangerous heavy metals like mercury and chromium, but further lab experiments will need to demonstrate that.

Washing Contaminated Soil

Cui says the project began two years ago when he and graduate student Jinwei Xu brainstormed about how to solve the basic problem: Heavy metals bind to the soil and become virtually inextricable. Today, Cui says, clean-up may involve digging up contaminated soils and sequestering them somewhere. Agricultural researchers have also developed phytoremediation techniques—growing sacrificial plants in contaminated soil to absorb heavy metals, then harvesting these crops and taking them to an extraction and disposal facility. But phytoremediation can take many years of repeated harvests. Seeking a quick, cost-effective way to extract heavy metals from contaminated fields, the researchers tried washing toxic soil samples with plain water. They soon realised that plain water couldn't break the chemical bond between the heavy metals and the soil. They needed some additive to pry the contaminants loose. They found the answer in a common chemical known by its initials: EDTA. In retrospect, EDTA was the obvious choice because this same chemical is used to treat patients with lead or mercury poisoning. Negatively charged EDTA bonds so strongly to positively charged heavy metal particles that it pulls the lead or mercury from the patient's tissues. The researchers reasoned that, when dissolved in water, EDTA's negative hooks would rip heavy metals loose from soils. Experiments bore this out. When EDTA-treated water percolated through contaminated soil, it carried the heavy metals away. But the team's job was only half done. The soil was clean, but the treated water was still toxic. They needed a way to separate the EDTA from the heavy metals in the rinse water and capture those toxins once and for all.

Heavy Metal Rinse Water

The scientists knew that EDTA remained strongly negative even after it captured a positively charged metal particle. So, the researchers built a sieve with the electrical and chemical properties to pull the negatively charged EDTA and positively charged heavy metals apart. The result was isolated heavy metals and a mixture of water and EDTA ready to purify more soil. In addition to lead and cadmium, the researchers tested the process on copper, which is only dangerous in high concentrations. Next Cui would like to run the experiment on other heavy metals like mercury, which are so toxic they require special handling to protect the researchers. But he thinks the chemistry is so sound that he is confident of success in

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the lab. The bigger question is whether the process can be scaled up to treat tons of contaminated soil. The researchers have sought to patent the process through the Stanford Office of Technology Licensing and would like to find an opportunity to run a pilot project in a contaminated field. "We really have no good remediation technology for heavy metals," Cui says. "If this proves practical on a large scale it will be a significant advance."

Futurity, 10 June 2019

<http://www.futurity.org>

Polar bears inspire strong, elastic, heat-insulating aerogel

2019-06-11

A polar bear's shaggy coat provides exceptional defence against icy, Arctic conditions. Each hollow strand of fur traps heat, collectively forming a waterproof mat that keeps the animals warm and dry. Inspired by this structure, researchers have made a strong, insulating aerogel that is also elastic and waterproof (Chem 2019, DOI: 10.1016/j.chempr.2019.04.025). Materials that mimic polar bear hair could be used for thermal and sound insulation in buildings and airplanes, but they tend to be weak and not very pliable, limiting applications. So, Shu-Hong Yu, a chemist at the University of Science and Technology of China, turned to tough carbon tubes, which are thicker than common nanotubes. Working with Yong Ni, Jian-Wei Liu, and colleagues, Yu soaked 35 nm wide, 5 μm long tellurium nanowires in a glucose solution and heated them, creating a mesh of interconnected wires with a smooth carbon shell. The group then heated the material in an inert atmosphere to remove the nanowires, yielding a carbon-based aerogel. The product is lighter and traps heat better than most aerogels and commercial insulators, Yu says. It also bounces back and does not lose its insulating nature when squished more than 10,000 times to 10% of its volume. The team aims to cut production costs by finding an inexpensive substitute for the tellurium nanowire template.

Chemical & Engineering News, 9 June 2019

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

Made of hollow carbon tubes, the durable insulator outperforms most aerogels

Extreme pressure alters element properties

2019-06-11

Material properties change at high pressure. Scientists can generate pressures millions of times above ambient pressure and, in doing so, have found near-room-temperature superconductors, polymeric nitrogen, and other surprises. To better understand how elements behave under pressure, Martin Rahm of Chalmers University of Technology and colleagues predicted the electronegativity and electron configuration of individual atoms of elements 1 through 96—except for thorium, uranium, and neptunium, which they could not calculate—in a nonreactive environment up to 300 GPa (J. Am. Chem. Soc. 2019, DOI: 10.1021/jacs.9b02634).

Chemical & Engineering News, 9 June 2019

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

Chemists could make 'smart glass' smarter by manipulating it at the nanoscale

2019-06-11

"Smart glass," an energy-efficiency product found in newer windows of cars, buildings and airplanes, slowly changes between transparent and tinted at the flip of a switch. "Slowly" is the operative word; typical smart glass takes several minutes to reach its darkened state, and many cycles between light and dark tend to degrade the tinting quality over time. Colorado State University chemists have devised a potentially major improvement to both the speed and durability of smart glass by providing a better understanding of how the glass works at the nanoscale. They offer an alternative nanoscale design for smart glass in new research published June 3 in Proceedings of the National Academy of Sciences. The project started as a grant-writing exercise for graduate student and first author R. Colby Evans, whose idea -- and passion for the chemistry of colour-changing materials -- turned into an experiment involving two types of microscopy and enlisting several collaborators. Evans is advised by Justin Sambur, assistant professor in the Department of Chemistry, who is the paper's senior author. The smart glass that Evans and colleagues studied is "electrochromic," which works by using a voltage to drive lithium ions into and out of thin, clear films of a material called tungsten oxide. "You can think of it as a battery you can see through," Evans said. Typical tungsten-oxide smart glass panels take 7-12 minutes to transition between clear and tinted. The researchers specifically studied electrochromic tungsten-oxide

Chemists have devised a potentially major improvement to both the speed and durability of smart glass by providing a better understanding of how the glass works at the nanoscale.

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nanoparticles, which are 100 times smaller than the width of a human hair. Their experiments revealed that single nanoparticles, by themselves, tint four times faster than films of the same nanoparticles. That's because interfaces between nanoparticles trap lithium ions, slowing down tinting behaviour. Over time, these ion traps also degrade the material's performance. To support their claims, the researchers used bright field transmission microscopy to observe how tungsten-oxide nanoparticles absorb and scatter light. Making sample "smart glass," they varied how much nanoparticle material they placed in their samples and watched how the tinting behaviours changed as more and more nanoparticles came into contact with each other. They then used scanning electron microscopy to obtain higher-resolution images of the length, width and spacing of the nanoparticles, so they could tell, for example, how many particles were clustered together, and how many were spread apart. Based on their experimental findings, the authors proposed that the performance of smart glass could be improved by making a nanoparticle-based material with optimally spaced particles, to avoid ion-trapping interfaces. Their imaging technique offers a new method for correlating nanoparticle structure and electrochromic properties; improvement of smart window performance is just one application that could result. Their approach could also guide applied research in batteries, fuel cells, capacitors and sensors. "Thanks to Colby's work, we have developed a new way to study chemical reactions in nanoparticles, and I expect that we will leverage this new tool to study underlying processes in a wide range of important energy technologies," Sambur said. The paper's co-authors include Austin Ellingworth, a former Research Experience for Undergraduates student from Winona State University; Christina Cashen, a CSU chemistry graduate student; and Christopher R. Weinberger, a professor in CSU's Department of Mechanical Engineering

Science Daily, 6 June 2019

<http://www.sciencedaily.com>

Fertiliser plants emit 100 times more methane than reported

2019-06-11

Emissions of methane from the industrial sector have been vastly underestimated, researchers from Cornell University and Environmental Defence Fund have found. Using a Google Street View car equipped with a high-precision methane sensor, the researchers discovered that methane emissions from ammonia fertiliser plants were 100 times higher than the

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fertiliser industry's self-reported estimate. They also were substantially higher than the Environmental Protection Agency (EPA) estimate for all industrial processes in the United States. "We took one small industry that most people have never heard of and found that its methane emissions were three times higher than the EPA assumed was emitted by all industrial production in the United States," said John Albertson, co-author and professor of civil and environmental engineering. "It shows us that there's a huge gap between a priori estimates and real-world measurements." The researchers' findings are reported in "Estimation of Methane Emissions From the U.S. Ammonia Fertiliser Industry Using a Mobile Sensing Approach," published in *Elementa*. The use of natural gas has grown in recent years, bolstered by improved efficiency in shale gas extraction and the perception that natural gas is a less dirty fossil fuel. "But natural gas is largely methane, which molecule-per-molecule has a stronger global warming potential than carbon dioxide," Albertson said. "The presence of substantial emissions or leaks anywhere along the supply chain could make natural gas a more significant contributor to climate change than previously thought." To evaluate methane emissions from downstream industrial sources, the researchers focused on the fertiliser industry, which uses natural gas both as the fuel and one of the main ingredients for ammonia and urea products. Ammonia fertilizer is produced at only a couple dozen plants in the U.S.; factories are often located near public roadways, where emissions carried downwind can be detected -- in this case by mobile sensors. For this study, the Google Street View vehicle travelled public roads near six representative fertiliser plants in the country's midsection to quantify "fugitive methane emissions" -- defined as inadvertent losses of methane to the atmosphere, likely due to incomplete chemical reactions during fertiliser production, incomplete fuel combustion or leaks. The team discovered that, on average, 0.34 percent of the gas used in the plants is emitted to the atmosphere. Scaling this emission rate from the six plants to the entire industry suggests total annual methane emissions of 28 gigagrams -- 100 times higher than the fertilizer industry's self-reported estimate of 0.2 gigagrams per year. In addition, this figure far exceeds the EPA's estimate that all industrial processes in the United States produce only 8 gigagrams of methane emissions per year. "Even though a small percentage is being leaked, the fact that methane is such a powerful greenhouse gas makes the small leaks very important," said Joseph Rudek, co-author and lead

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senior scientist at Environmental Defence Fund. "In a 20-year timeframe, methane's global warming potential is 84 times that of carbon dioxide."

Science Daily, 6 June 2019

<http://www.sciencedaily.com>

Molecular bait can help hydrogels heal wounds

2019-06-11

Like fishermen, Rice University bioengineers are angling for their daily catch. But their bait, biomolecules in a hydrogel scaffold, lures microscopic stem cells instead of fish. These, they say, will seed the growth of new tissue to heal wounds. The team led by Brown School of Engineering bioengineer Antonios Mikos and graduate student Jason Guo have developed modular, injectable hydrogels enhanced by bioactive molecules anchored in the chemical crosslinkers that give the gels structure. Hydrogels for healing have until now been biologically inert and require growth factors and other biocompatible molecules to be added to the mix. The new process makes these essential molecules part of the hydrogel itself, specifically the crosslinkers that allow the material to keep its structure when swollen with water. Their work, reported in *Science Advances*, is intended to help repair bone, cartilage and other tissues able to regenerate themselves. Best of all, the Rice lab's customised, active hydrogels can be mixed at room temperature for immediate application, Mikos said. "This is important not only for the ease of preparation and synthesis, but also because these molecules may lose their biological activity when they're heated," he said. "This is the biggest problem with the development of biomaterials that rely on high temperatures or the use of organic solvents." Experiments with cartilage and bone biomolecules showed how crosslinkers made of a soluble polymer can bond small peptides or large molecules, like tissue-specific extracellular matrix components, simply by mixing them together in water with a catalyst. As the injected gel swells to fill the space left by a tissue defect, the embedded molecules can interact with the body's mesenchymal stem cells, drawing them in to seed new growth. As native tissue populates the area, the hydrogel can degrade and eventually disappear. "With our previous hydrogels, we typically needed to have a secondary system to deliver the biomolecules to effectively produce tissue repair," Guo said. "In this case, our big advantage is that we directly incorporate those biomolecules for the specific tissue right into the crosslinker itself. Then once we inject the hydrogel, the biomolecules are right where they need to be." To make the reaction work, the researchers depended on

The hydrogels can be mixed at room temperature and customised to help heal a variety of wounds.

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a variant of click chemistry, which facilitates the assembly of molecular modules. Click chemistry catalysts don't usually work in water. But with the helpful guidance of Rice chemist and co-author Paul Engel, they settled on a biocompatible and soluble ruthenium-based catalyst. "There's one specific ruthenium-based catalyst we can use," Guo said. "Others are often cytotoxic, or they're inactive under aqueous conditions, or they might not work with the specific kind of alkyne on the polymer. "This particular catalyst works under all those conditions -- namely, conditions that are very mild, aqueous and favourable to biomolecules," he said. "But it had not been used for biomolecules yet."

Science Daily, 5 June 2019

<http://www.sciencedaily.com>

For hydrogen power, mundane materials might be almost as good as pricey platinum

2019-06-11

As anyone who has purchased jewellery can attest, platinum is expensive. That's tough for consumers but also a serious hurdle for a promising source of electricity for vehicles: the hydrogen fuel cell, which relies on platinum. Now a research team led by Bruce E. Koel, a professor of biological and chemical engineering at Princeton University, has opened a door to finding far cheaper alternatives. In a paper published April 4 in the journal *Nature Communications*, the researchers reported that a chemical compound based on hafnium worked about 60 percent as effectively as platinum-related materials but at about one-fifth the cost. "We hope to find something that is more abundant and cheaper to catalyse reactions," said Xiaofang Yang, principal scientist at HiT Nano Inc. and visiting collaborator at Princeton who is working with Koel on the project. Fuel cells work by converting energy stored in hydrogen atoms directly into electricity. NASA has long used fuel cells to power satellites and other space missions. Today, they're beginning to be used for electric cars and buses. Hydrogen is the simplest and most abundant element not just on this planet, but also in the known universe. At the most basic level, fuel cells produce electricity by splitting hydrogen into its two components, a proton and an electron. The protons flow through a membrane and combine with oxygen to form water. The negatively charged electrons flow toward a positively charged pole in the fuel cell. This flow of electrons is the current that the fuel cell generates, which can power engines or other electrical devices. This splitting requires a material such as platinum to catalyse the reaction. Catalysts are also used in

Researchers used plasma to create new catalysts that are much cheaper than and almost as effective as standard, platinum-group versions.

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reactions that create the hydrogen gas that serves as fuel for the fuel cell. In the most desirable, fossil-fuel independent case, renewable electrical energy can be used to split water molecules (two hydrogen atoms and one oxygen) in the presence of a catalyst. The reaction splits the water into oxygen and hydrogen gases. The more efficient the catalyst, the less energy is needed to split the water. Some advanced fuel cells, called regenerative fuel cells, combine both reactions. But most current fuel cells rely on hydrogen created by separate systems and sold as fuel. Princeton researchers have developed a method to create lower-cost catalysts for fuel cells and hydrogen fuel production. Right now, the best catalysts for both reactions are platinum group metals. The researchers don't think that will change because "platinum is almost perfect," Koel said. With platinum group metals, the electrochemical reactions to draw out the hydrogen are quick and efficient, plus the metals can stand up to the harsh acidic conditions currently required for such reactions. The problem, though, is that the platinum is rare and costly. "You can't really imagine replacing the transportation infrastructure with fuel cells based on platinum," Koel said. "It's too rare and too expensive to use at that scale." For such applications, platinum's perfection may not be needed. One good-enough substitute, the researchers found, is hafnium oxyhydroxide that has been treated with a nitrogen plasma (plasma is an ionized gas and is a state of matter found in fluorescent lights and the sun) to incorporate nitrogen atoms into the material. Previously, many materials have been overlooked for electrochemistry applications because they are non-conducting. However, the researchers found that processing hafnium oxide with the nitrogen plasma forms a thin film of material that functions as a highly active catalyst that also survives in strong acid conditions. While this hafnium-based film is only about two-thirds as effective as platinum, hafnium is far cheaper than platinum. The researchers plan to test zirconium, which is even cheaper, next. Although they could be useful in fuel cells, Yang and Koel believe that these kinds of materials could be most valuable in systems that deploy a catalyst to electrochemically split water to produce hydrogen for use as fuel. "The future renewable economy heavily depends on how we can efficiently split water to generate hydrogen," Yang said. "This step is pretty important." But Yang and Koel emphasize that their discovery isn't going to lead to a rush of new affordable technologies just yet—or even in the near future. Right now, the procedure to create the material is complex and confined to the lab. While they've confirmed the performance of the film, one always has to consider the engineering required for making it practically on a large scale. Instead, this discovery is opening the door to further exploration of materials that may be able to replace platinum. "We still don't understand why this particular material is

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so special, but we're confident about the properties that we've measured," Koel said. "The material is complicated, so we have a lot of work to do."

Phys.org, 10 June 2019

<http://phys.org>

Getting the oil out of befouled water

2019-06-11

Oil and water are famously reluctant to mix fully together. But separating them completely—for example, when cleaning up an oil spill or purifying water contaminated through fracking—is a devilishly hard and inefficient process that frequently relies on membranes that tend to get clogged up, or “fouled.” A new imaging technique developed at MIT could provide a tool for developing better membrane materials that can resist or prevent fouling. The new work is described in the journal *Applied Materials and Interfaces*, in a paper by MIT graduate students Yi-Min Lin and Chen Song and professor of chemical engineering Gregory Rutledge. Cleaning up oily wastewater is necessary in many industries, including petroleum refining, food processing, and metal finishing, and the untreated waste can be damaging to aquatic ecosystems. Methods of removing oily contaminants vary, depending on the relative amounts of oil and water and the sizes of the oil droplets. When the oil is emulsified, the most efficient clean-up method is the use of membranes that filter out the tiny oil droplets, but these membranes quickly get fouled by the droplets and require time-consuming cleaning. But the fouling process is very hard to observe, making it difficult to assess the relative advantages of different materials and architectures for the membranes themselves. The new technique developed by the MIT team could make such evaluations much easier to carry out, the researchers say. These filtration membranes “tend to be very hard to look inside of,” Rutledge says. “There’s a lot of effort to develop new types of membranes, but when they get put in service, you want to see how they interact with the contaminated water, and they don’t lend themselves to easy examination. They are usually designed to pack in as much membrane area as possible, and being able to look inside is very hard.” The solution they developed uses confocal laser scanning microscopy, a technique in which two lasers are scanned across the material, and at the point where the two beams cross, a material marked with a fluorescent dye will glow. In their approach, the team introduced two fluorescent dyes, one to mark the oily material in the fluid, the other to mark the fibres in the filtration membrane. The technique allows the material to be scanned not only across the area of the membrane, but

A new imaging technique developed at MIT could provide a tool for developing better membrane materials that can resist or prevent fouling.

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also into the depth of the material, layer by layer, to build up a full 3-D image of the way the oil droplets are dispersed in the membrane, which in this case is composed of an array of microscopic fibres. The basic method has been used in biological research, to observe cells and proteins within a sample, Rutledge explains, but it has not been applied much to studying membrane materials, and never with both the oil and the fibres labelled. In this case, the researchers are observing droplets that range in size from about 10 to 20 microns (millionths of a metre), down to a few hundred nanometres (billionths of a metre). Until now, he says, "methods for imaging pore spaces in membranes were pretty crude." For the most part, the pore characteristics were inferred by measuring flow rates and pressure changes through the material, giving no direct information about how the oily material actually builds up in the pores. With the new process, he says, "now you can actually measure the geometry, and build a three-dimensional model and characterize the material in some detail. So, what's new now is that we can really look at how separation takes place in these membranes." By doing so, and by testing the effects using different materials and different arrangements of the fibres, "this should give us a better understanding of what fouling really is," Rutledge says. The team has already demonstrated that the interaction between the oil and the membrane can be very different depending on the material used. In some cases, the oil forms tiny droplets that gradually coalesce to form larger drops, while in other cases the oil spreads out in a layer along the fibres, a process called wetting. "The hope is that with a better understanding of the mechanism of fouling, people will be able to spend more time on the techniques that are more likely to succeed" in limiting that fouling, Rutledge says. The new observational method has clear applications for engineers trying to design better filtration systems, he says, but it also can be used for research on the basic science of how mixed fluids interact. "Now we can begin to think about some fundamental science on the interaction between two-phase liquid flows and porous media," he says. "Now, you can develop some detailed models" of the process. And the detailed information about how different structures or chemistries perform could make it easier to engineer specific kinds of membranes for different applications, depending on the types of contaminants to be removed, the typical sizes of the droplets in these contaminants, and so on. "In designing membranes, it's not a one-size-fits-all," he says. "Potentially you can have different types of membranes for different effluents." The method could also be used to observe the separation of different kinds of mixtures, such as solid particles in a liquid, or a reverse situation where the oil is dominant and the membrane is used to filter out water droplets, such as in a fuel filtration system, Rutledge says. "When

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I read his paper in depth, I was impressed by Greg's way of using 3-D imaging to understand the complex fouling process in membranes used for oil-water emulsions," says William J. Koros, the Roberto C. Goizueta Chair for Excellence in Chemical Engineering and GRA Eminent Scholar in Membranes at the Georgia Institute of Technology, who was not involved in this research.

Phys.org, 10 June 2019

<http://phys.org>

Settling the debate: Solving the electronic surface states of samarium hexaboride

2019-06-11

A team led by Osaka University used angle-resolved photoelectron spectroscopy to probe the unusual surface conductivity of samarium hexaboride crystals. They showed that the material is a co-existing phase of "topological insulator" in which electrical current can flow along the surface but not through the bulk of the sample, a "Kondo insulator", which undergoes a metal-to-insulator transition due to the strong electron correlation. This work, which demonstrates that topological insulators can simultaneously have strong electron correlations, may allow for the development of quantum spin devices that use the magnetic spins of individual electrons to outperform current computers. A long-standing debate has existed regarding the metallic surface electronic structure of samarium hexaboride (SmB₆). SmB₆ is known to be an insulator only at low temperatures due to strong electron correlations, called the "Kondo effect." Unlike most materials, the resistance in Kondo insulators actually increases with decreasing temperature. However, the origin of the remnant conductivity at low temperatures has not yet been revealed. A popular hypothesis is that SmB₆ is also a topological insulator, which can have metallic electronic states on its surface. However, the surface electronic structures of SmB₆ obtained so far have been complex and difficult to interpret and thus this question of whether or not SmB₆ is indeed topological has been a long-standing debate. In this work, the team observed the surface states from a new crystal orientation and succeeded in significantly simplifying the surface states. The main insight was measuring along a particular surface direction, which had previously been difficult to do. To obtain this surface, the researchers first had to prepare an atomically flat, extremely clean surface of the crystal in a very precise manner. They accomplished this by heating a single crystal of samarium hexaboride to very high temperatures in an ultra-high

A team led by Osaka University used angle-resolved photoelectron spectroscopy to probe the unusual surface conductivity of samarium hexaboride crystals.

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vacuum chamber. They then performed angle-resolved photoelectron spectroscopy, which monitors the electrons ejected from the crystal when exposed to intense beams of light. Using a ferromagnetic detector, they were able to determine not only the speeds of the electrons, but also if they had their spins oriented up or down. "We were able to show that samarium hexaboride is a topological insulator, without any ambiguity," says lead author Shin-ichi Kimura. "This opens a new research area in which strong correlations and topological effects can exist in the same material."

EurekAlert, 10 June 2019

<http://www.eurekalert.org>

Structuring sweetness: What makes Stevia 200 times sweeter than sugar

2019-06-11

New research from Washington University in St. Louis reveals the molecular machinery behind the high-intensity sweetness of the stevia plant. The results could be used to engineer new non-caloric products without the aftertaste that many associate with sweetener marketed as Stevia. Although the genes and proteins in the biochemical pathway responsible for stevia synthesis are almost completely known, this is the first time that the three-dimensional structure of the proteins that make rebaudioside A -- or 'RebA', the major ingredient in the product Stevia -- has been published, according to the authors of a new paper in the Proceedings of the National Academy of Sciences. "If someone is diabetic or obese and needs to remove sugar from their diet, they can turn to artificial sweeteners made from chemical synthesis (aspartame, saccharin, etc), but all of these have 'off-tastes' not associated with sugar, and some have their own health issues," said Joseph Jez, professor of biology in Arts & Sciences and lead author of the new study. "Stevias and their related molecules occur naturally in plants and are more than 200 times sweeter than sugar," he said. "They've been consumed for centuries in Central and South America, and are safe for consumers. Many major food and beverage companies are looking ahead and aiming to reduce sugar/calories in various projects over the next few years in response to consumer demands worldwide." Researchers determined the structure of the RebA protein by x-ray crystallography. Their analysis shows how RebA is synthesised by a key plant enzyme and how the chemical structure needed for that high-intensity sweetness is built biochemically. To make something 200 times sweeter than a single glucose molecule, the plant

**New research
from Washington
University in St.**

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enzyme decorates a core terpene scaffold with three special sugars. That extra-sweet taste from the stevia plant comes with an unwanted flavour downside, however. "For me, the sweetness of Stevia comes with an aftertaste of licked aluminium foil," Jez said. Many consumers experience this slightly metallic aftertaste. "The taste is particular to the predominant molecules in the plant leaf: the stevioside and RebA," he said. "It is their chemical structure that hits the taste receptors on the tongue that trigger 'sweet,' but they also hit other taste receptors that trigger the other tastes." "RebA is abundant in the stevia plant and was the first product made from the plant because it was easy to purify in bulk. Call this 'Stevia 1.0,'" Jez said. "But in the leaf are other related compounds with different structures that hit the 'sweet' without the aftertaste. Those are 'Stevia 2.0,' and they will be big." There are many ways that the newly published protein structure information could be used to help improve sweeteners. "One could use the snapshot of the protein that makes RebA to guide protein engineering efforts to tailor the types and/or pattern of sugars in the stevias," Jez said. "This could be used to explore the chemical space between 'sweet' and 'yuck.'" "There are also molecules in other plants that are not 'stevias' but can deliver intense sweetness," he said. "We could use the information of how the stevia plant does it as a way of finding those details."

EurekaAlert, 10 June 2019

<http://www.eurekaalert.org>

New core-shell catalyst for ethanol fuel cells

2019-06-11

Scientists at the U.S. Department of Energy's (DOE) Brookhaven National Laboratory and the University of Arkansas have developed a highly efficient catalyst for extracting electrical energy from ethanol, an easy-to-store liquid fuel that can be generated from renewable resources. The catalyst, described in the *Journal of the American Chemical Society*, steers the electro-oxidation of ethanol down an ideal chemical pathway that releases the liquid fuel's full potential of stored energy. "This catalyst is a game changer that will enable the use of ethanol fuel cells as a promising high-energy-density source of 'off-the-grid' electrical power," said Jia Wang, the Brookhaven Lab chemist who led the work. One particularly promising application: liquid fuel-cell-powered drones. "Ethanol fuel cells are lightweight compared to batteries. They would provide sufficient power for operating drones using a liquid fuel that's easy to refill between flights—even in remote locations," Wang noted. Much of ethanol's potential power is locked up in the carbon-carbon bonds that form the backbone of the

Greatly boosts efficiency of ethanol electro-oxidation, offering promise for liquid-fuel-cell-powered drones

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molecule. The catalyst developed by Wang's group reveals that breaking those bonds at the right time is the key to unlocking that stored energy. "Electro-oxidation of ethanol can produce 12 electrons per molecule," Wang said. "But the reaction can progress by following many different pathways." Most of these pathways result in incomplete oxidation: The catalysts leave carbon-carbon bonds intact, releasing fewer electrons. They also strip off hydrogen atoms early in the process, exposing carbon atoms to the formation of carbon monoxide, which "poisons" the catalysts' ability to function over time. "The 12-electron full oxidation of ethanol requires breaking the carbon-carbon bond at the beginning of the process, while hydrogen atoms are still attached, because the hydrogen protects the carbon and prevents the formation of carbon monoxide," Wang said. Then, multiple steps of dehydrogenation and oxidation are needed to complete the process. The new catalyst--which combines reactive elements in a unique core-shell structure that Brookhaven scientists have been exploring for a range of catalytic reactions--speeds up all of these steps. To make the catalyst, Jingyi Chen of the University of Arkansas, who was a visiting scientist at Brookhaven during part of this project, developed a synthesis method to co-deposit platinum and iridium on gold nanoparticles. The platinum and iridium form "monoatomic islands" across the surface of the gold nanoparticles. That arrangement, Chen noted, is the key that accounts for the catalyst's outstanding performance. "The gold nanoparticle cores induce tensile strain in the platinum-iridium monoatomic islands, which increases those elements' ability to cleave the carbon-carbon bonds, and then strip away its hydrogen atoms," she said. Zhixiu Liang, a Stony Brook University graduate student and the first author of the paper, performed studies in Wang's lab to understand how the catalyst achieves its record-high energy conversion efficiency. He used "in situ infrared reflection-absorption spectroscopy" to identify the reaction intermediates and products, comparing those produced by the new catalyst with reactions using a gold-core/platinum-shell catalyst and also a platinum-iridium alloy catalyst. "By measuring the spectra produced when the infrared light is absorbed at different steps in the reaction, this method allows us to track, at each step, what species have been formed and how much of each product," Liang said. "The spectra revealed that the new catalyst steers ethanol toward the 12-electron full oxidation pathway, releasing the fuel's full potential of stored energy." The next step, Wang noted, is to engineer devices that incorporate the new catalyst. The

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mechanistic details revealed by this study may also help guide the rational design of future multicomponent catalysts for other applications.

EurekaAlert, 7 June 2019

<http://www.eurekaalert.org>

Neutrons allow analysis of polymer gels' unusual attributes

2019-06-11

Products like cosmetics, adhesives, and paints rely on a common key component: gels. Polymer gels, a gel type with unique properties, have piqued the interest of researchers because of their potential uses in medical applications. Studies have shown that modifying the structures of polymer gels can significantly affect their properties, but it is unclear why. To learn how and why that happens, a team of researchers from the Massachusetts Institute of Technology (MIT) and the Department of Energy's (DOE's) Oak Ridge National Laboratory (ORNL) are using neutron scattering to take a deeper look. Polymer gels are made up of polymer chains with junctions connecting them. As thermodynamic conditions change, the sizes of the junctions change relative to the chains connecting them. The changes can cause the gels to become stronger and develop better response properties. To investigate these relationships, the researchers are using the EQ-SANS instrument at ORNL's Spallation Neutron Source—a DOE Office of Science User Facility. "We're trying to understand the role of the junction size and how the junction interactions contribute to the mechanical properties of the gel," said Christopher Lam, a postdoctoral research associate at ORNL. Polymer gels are useful for drug delivery because their structures adapt to changes in their environment. For example, a polymer gel with temperature response properties could flow easily at room temperature but then stiffen in a warmer environment like the human body. These types of gels can help ensure that when a drug is injected into the body, it stays in the area it is meant to impact. Similarly, polymer gels with pressure response properties can be designed to flow easily while under low pressure in a syringe but then stiffen as the gel is ejected and pressure increases. Neutrons are good probes of materials like polymer gels, largely because of their sensitivity to hydrogen and its isotope, deuterium. Using a unique technique known as contrast matching, researchers replaced some of the hydrogen atoms in the gel with deuterium, which allowed specific structural components to be highlighted by the neutrons. Using the EQ-SANS instrument's new rheo-SANS environment enabled the researchers to subject the gels to shear

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stress—which is stress parallel to the cross section of the material, like two plates sliding past each other—and observe the corresponding changes in structure. By comparing how the structures of gels with large junctions and those with small junctions shear and deform, the researchers can begin to understand how the sizes of gel junctions can impact the gel properties. Using their findings, the researchers can find ways to develop improved polymer gels. “If we have an understanding of the structure of the gels, that basically gives us a better framework,” said Lam. “Then we can say ‘we need this property, this chemical design, and this ratio of components and concentration.’” I’m always trying to find a balance between how much we do fundamentally and how we can think about applying that to something we’ll use. I’m trying to use this fundamental understanding to really design better biomedical gels.” Other researchers on this experiment include lead principal investigators Bradley D. Olsen of the Department of Chemical Engineering at MIT, ORNL’s Wei-Ren Chen, and Michelle Calabrese, a postdoctoral researcher at MIT. The research is supported by DOE’s Office of Science.

Phys.org, 7 June 2019

<http://phys.org>

New polymer tackles PFAS pollution

2019-06-11

The problem of cleaning up toxic polyfluorinated alkyl substances (PFAS) pollution—commonly used in non-stick and protective coatings, lubricants and aviation fire-fighting foams—has been solved through the discovery of a new low-cost, safe and environmentally friendly method that removes PFAS from water. In The US, contamination by PFAS and other so-called “forever chemicals” has been detected in foods including grocery store meats and seafoods by FDA tests, prompting calls for regulations to be applied to manmade compounds. Consistent associations between very high levels of the industrial compounds in peoples’ blood and health risks have been reported but insufficient evidence has been presented to prove the compounds as the cause. In Australia, PFAS pollution—which does not break down readily in the environment—has been a hot news item due to the extensive historical use of fire-fighting foams containing PFAS at airports and defence sites, resulting in contaminated ground water and surface water being reported in these areas. Researchers from the Flinders University Institute for NanoScale Science and Technology have—on World Environment Day—revealed a new type of absorbent polymer, made from waste cooking oil

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and sulfur combined with powdered activated carbon (PAC). While there have been few economic solutions for removing PFAS from contaminated water, the new polymer adheres to carbon in a way that prevents caking during water filtration. It works faster at PFAS uptake than the commonly used and more expensive granular activated carbon method, and it dramatically lowers the amount of dust generated during handling PAC that lowers respiratory risks faced by clean-up workers. "We need safe, low-cost and versatile methods for removing PFAS from water, and our polymer-carbon blend is a promising step in this direction," says Flinders University's Dr. Justin Chalker, co-director of the study. "The next stage for us is to test this sorbent on a commercial scale and demonstrate its ability to purify thousands of litres of water. We are also investigating methods to recycle the sorbent and destroy the PFAS." During the testing phase, the research team was able to directly observe the self-assembly of PFOA hemi-micelles on the surface of the polymer. "This is an important fundamental discovery about how PFOA interacts with surfaces," explains Dr. Chalker. The team demonstrated the effectiveness of the polymer-carbon blend by purifying a sample of surface water obtained near a RAAF airbase. The new filter material reduced the PFAS content of this water from 150 parts per trillion (ppt) to less than 23 parts per trillion (ppt), which is well below the 70 ppt guidance values for PFAS limits in drinking water issues by the Australian Government Department of Health. The core technology for this PFAS sorbent is protected by a provisional patent. "Our canola oil polysulfide was found to be highly effective as a support material for powdered activated carbon, enhancing its efficiency and prospects for implementation," says Nicholas Lundquist, Ph.D. candidate at Flinders University and first author in the groundbreaking study. The research paper, "Polymer supported carbon for safe and effective remediation of PFOA- and PFOS-contaminated water", by Nicholas Lundquist, Martin Sweetman, Kymberley Scroggie, Max Worthington, Louisa Esdaile, Salah Alboaiji, Sally Plush, John Hayball and Justin Chalker, has been published in the published in ACS Sustainable Chemistry & Engineering. This project was a collaboration funded by the South Australian Defence Innovation Partnership, with further support from industry partners Puratap and the Salisbury Council. Co-directors of the study were A/Prof Sally Plush and Prof John Hayball at UniSA and Dr. Justin Chalker at Flinders University. Flinders Ph.D. student Nicholas Lundquist was the lead author of the study in collaboration with Research Fellow Dr. Martin Sweetman of UniSA. "This successful project has laid the groundwork for significant ongoing, collaborative research between

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Ultra-processed food link to disease and death grows — so do we need to shift our food policy?

2019-06-12

Just weeks after researchers showed a cause-and-effect relationship between ultra-processed food and weight gain, two more studies have linked these foods with disease and death. The pair of studies, published in the BMJ today, both looked at consumption of ultra-processed food and health outcomes and — perhaps unsurprisingly — it's not good news. The first, which was based in France, found increasing the proportion of ultra-processed food in the diet by 10 per cent was associated with significantly higher rates of cardiovascular disease and cerebrovascular disease (such as stroke). The second, based in Spain, found people who consumed more than four servings of ultra-processed food per day were 62 per cent more likely to die of any cause compared to those who had less than two servings per day. In both studies, large groups of adults completed food intake questionnaires, then their rates of disease were tracked for up to 10 years. The findings provide further weight to the already sizeable pile of evidence that highly processed food is linked to poorer health, said Mark Lawrence, who co-wrote an editorial on the topic, also published today. We might need to reconsider what it is about these foods that makes them unhealthy, said Professor Lawrence, a food policy expert from Deakin University. "It's not just about the so-called 'risky' nutrients in foods," he said. "The nature of the cause is associated with the physical and chemical changes that happen to the food as a result of this high degree of industrial processing. "It's an independent risk factor irrespective of the presence of, say, sodium or added sugar in the food." Australian adults get more than a third of their energy from "discretionary foods", according to a recent Australian Institute of Health and Welfare report. This definition isn't exactly the same as "ultra-processed" but there is a fair bit of overlap between the two.

What is an 'ultra-processed' food?

If the term "ultra-processed" food conjures images of fluoro-orange cheese-flavoured snacks and sour gummy lollies, you wouldn't be wrong. But there are other foods you might not realise also fall into this category. Packaged biscuits, sausages, instant soups and fruit yoghurts are all classed as ultra-processed under the NOVA food classification system, which is recognised by global health agencies including the UN Food and Agriculture Organisation. Ultra-processed foods tend to be higher in nutrients we know are not good for us, namely salt, fat and added sugar, but this new wave of evidence suggests their health impact is more than

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the sum of their parts, said Alexandra Jones from the George Institute for Global Health. This means a common approach for reformulating packaged foods by simply reducing their salt, fat and sugar content, or fortifying them with fibre and vitamins, might not be enough, Ms Jones said. "This evidence suggests that perhaps there are some foods that — because they're ultra-processed — it doesn't matter what we do to their nutrient content, it's not going to make them better for us," she said. "You basically can't make an ultra-processed food healthy by just pumping it full of nutrients. Current food labelling in Australia focuses on salt, fat and sugar. But both Professor Lawrence and Ms Jones said evidence was mounting to suggest the degree of processing should also be communicated to consumers.

Health star rating should be 'mandatory', experts say

Obesity experts are calling for more regulation around food manufacturing as half of all processed supermarket food is revealed to be "discretionary" — or junk. "This has implications across a lot of different areas. I think the front of pack labelling is the most tangible one at the moment," Professor Lawrence said. "It could be something as simple as, is this an ultra-processed food or not." Ms Jones said Australia's current labelling systems, which include nutrient breakdowns, ingredient lists and the opt-in health star ratings, were useful and evidence based — but these studies suggested we may need to go further in the future. "As we watch this evidence evolving, we will be looking at whether we need to review all our nutritional policies to factor in processing as an additional consideration," Ms Jones said. But that doesn't mean we should ignore information about fats, sugar and salt in a product. "We shouldn't be scrapping what we already do know well and which is supported by a lot of evidence, which is that there's a lot of risks associated with consumption of foods which are high in salt, sugar and fat, so stay with that advice. "A lot of these ultra-processed foods are going to be high in these nutrients anyway."

ABC News, 30 May 2019

<http://www.abc.net.au/news/>

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Coffee not as bad for heart and circulatory system as previously thought

2019-06-12

Drinking coffee might keep us up at night, but new research has given us a reason to sleep easy knowing that the popular drink isn't as bad for our arteries as some previous studies would suggest. The research from Queen Mary University of London has shown that drinking coffee, including in people who drink up to 25 cups a day, is not associated with having stiffer arteries. The research, led by Professor Steffen Petersen, was presented today at the British Cardiovascular Society (BCS) Conference in Manchester and part-funded by the British Heart Foundation (BHF). Arteries carry blood containing oxygen and nutrients from your heart to the rest of your body. If they become stiff, it can increase the workload on the heart and increase a person's chance of having a heart attack or stroke. The study of over 8,000 people in the UK debunks previous studies that claimed drinking coffee increases arterial stiffness. Previous suggestions that drinking coffee leads to stiffer arteries are inconsistent and could be limited by lower participant numbers, according to the team behind this new research. Coffee consumption was categorised into three groups for the study. Those who drink less than one cup a day, those who drink between one and three cups a day and those who drink more than three. People who consumed more than 25 cups of coffee a day were excluded, but no increased stiffening of arteries was associated with those who drank up to this high limit when compared with those who drank less than one cup a day. The associations between drinking coffee and artery stiffness measures were corrected for contributing factors like age, gender, ethnicity, smoking status, height, weight, how much alcohol someone drank, what they ate and high blood pressure. Of the 8,412 participants who underwent MRI heart scans and infrared pulse wave tests, the research showed that moderate and heavy coffee drinkers were most likely to be male, smoke, and consume alcohol regularly. Dr. Kenneth Fung, who led the data analysis for the research at Queen Mary University of London, said: "Despite the huge popularity of coffee worldwide, different reports could put people off from enjoying it. Whilst we can't prove a causal link in this study, our research indicates coffee isn't as bad for the arteries as previous studies would suggest." Although our study included individuals who drink up to 25 cups a day, the average intake amongst the highest coffee consumption group was 5 cups a day. We would like to study these people more closely in our future work so that we can help to advise safe limits." Professor Metin Avkiran, Associate Medical Director at the British Heart Foundation, said: "Understanding the impact that coffee has on our

Drinking coffee might keep us up at night, but new research has given us a reason to sleep easy knowing that the popular drink isn't as bad for our arteries as some previous studies would suggest.

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heart and circulatory system is something that researchers and the media have had brewing for some time. "There are several conflicting studies saying different things about coffee, and it can be difficult to filter what we should believe and what we shouldn't. This research will hopefully put some of the media reports in perspective, as it rules out one of the potential detrimental effects of coffee on our arteries."

Medical Xpress, 3 June 2019

<http://medicalxpress.com>

High blood pressure is one of Australia's biggest killers, but you can take control

2019-06-12

You're sitting at the GP's office, a cuff around your upper arm. As it inflates, so does your creeping worry. Much like a test result at school, a blood pressure result can feel immovable, inevitable and baffling. Cryptic combinations of numbers like 145/90 or 120/80 tell you how well you have done and what your prospects may be. But what do these numbers mean? And is there anything you can do to change them?

What is blood pressure?

As your heart pumps, blood is pushed around your body through blood vessels, placing a force on the walls of those vessels. Pressure can build up if your vessels are too narrow, if your heart is beating too fast or too hard, or if the volume of your blood increases due to fluid retention. When this pressure is consistently too great, you have high blood pressure (also known as hypertension), which puts strain on your body. "You've got 100,000 heartbeats in an average day. If each time your heart beats it is beating against an increased pressure, this causes structural and functional damage to the heart, the kidneys, the brain and the arteries themselves," explained James Sharman, deputy director of the Menzies Institute for Medical Research. "Over 50 per cent of heart disease, stroke, and heart failure is attributed to increased blood pressure."

How do I know if I have high blood pressure?

The tricky thing is, high blood pressure may be playing havoc with your body without you knowing. That is why it's known as a silent killer. It is worthwhile checking your blood pressure even if you feel fit and healthy, according to Natalie Raffoul, risk reduction manager at the Heart Foundation. "People think if they feel fine, they don't have to worry about

You're sitting at the GP's office, a cuff around your upper arm.

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it. In fact, that is not correct," she said. To get an accurate picture of your blood pressure your GP will get you to take multiple tests over time. Blood pressure naturally changes throughout the day. It reacts to exercise, rest, caffeine consumption and more. It can even elevate due to the stress of a blood pressure test.

So, what do those numbers mean?

The two numbers you receive back are separate measures. The top number in your reading is your systolic blood pressure. This value is always the highest because it measures the pressure in your arteries when your heart contracts. The bottom reading is called diastolic blood pressure. This value is lower because it measures the pressure between contractions. The risk to your health increases on a continuum as both those numbers increase, Dr Sharman said. "However, for convenience, some threshold values of 'normal' and 'raised' blood pressure have been created," he said.

How did you rate?

A reading of 120/80 mm Hg is considered normal. Readings between 120/80 and 139/89 mm Hg are considered normal to high. If your reading comes in at 140/90 mm Hg or greater you have high blood pressure.

What causes high blood pressure?

It can be hard to pinpoint the exact reason why a person may present with high blood pressure, but the risk factors are well known.

Your blood pressure can be affected by factors such as:

- Eating patterns, including salty foods
- Weight
- Alcohol consumption
- How much physical activity you do

The good news? "[Around] 80 to 90 per cent of high blood pressure cases are preventable," Dr Sharman said.

What steps can I take to help prevent high blood pressure?

Dr Sharman encourages people to start taking control of their blood pressure by getting active. This may seem counterintuitive as exercise temporarily raises blood pressure. However, inactivity is a big risk factor for this disease. "Exercise addresses so many risk factors in one hit," Dr Sharman said. "It will help improve the structure and function of your arteries and heart, it will make your cholesterol profile more favourable,

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improve blood glucose, improve insulin sensitivity, less likely to develop diabetes and of course it's part of a regimen to maintain a healthy body weight." Even a single exercise session can reduce blood pressure for up to 24 hours. When exercise is incorporated into daily life, the effect is more long lasting. A healthy diet packed with fruit and vegies is a great way to lower your risk of high blood pressure. Cutting down on salt will also help, Ms Raffoul said. "The link between high salt intake and high blood pressure is strong," she said. "The higher your salt intake, the more fluid your body retains." Health experts recommend you limit your daily salt intake to no more than one-and-a-half teaspoons a day. The lion's share of most people's salt intake is hidden in highly processed foods, sauces (such as soy or tomato sauce), takeaway or restaurant foods. Salt can hide in surprising places. According on the Australian Healthy Food Guide, just two slices of some breads can provide a third of your recommended daily salt intake. When you are eating packaged food, Ms Raffoul suggests looking for "no salt" or "low salt" options. You can also replace your humble table salt with spicier alternatives. "The simplest thing you can do to reduce your salt intake is to use herbs and spices to flavour your food instead of salt," she said.

Reducing stress may also help — at least in the short term.

When you get a fright, the colour drains from your face. This is a result of the famed "flight or fight response". Small blood vessels in the skin, digestive system and other places contract. This redirects blood to where it needs to go to keep you alive in that moment. "Acute periods of stress, which replicate the flight or fight response, do elevate blood pressure temporarily," Ms Raffoul said. "Getting these temporary spikes daily can cause long-term damage to your blood vessels and increase your risk of a heart event," she said. "The link between chronic anxiety and high blood pressure is not yet fully understood." Quitting smoking is also recommended, Dr Sharman said. "If you have got high blood pressure and you smoke, it amplifies your risk [of stroke or a heart event] substantially," he said.

What if high blood pressure runs in my family?

Having a family history of high blood pressure does not mean you are doomed to high blood pressure forever. "People think if they have high blood pressure in their family they can't do anything about it," Ms Raffoul said. "There are still plenty of things you can do about it." Knowing that high blood pressure is common in your family can be a powerful tool.

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Talking to your GP about your family history can help them give treatment and advice.

What happens if I'm diagnosed with high blood pressure?

If lifestyle changes alone are not enough to help you manage your blood pressure, your GP may also recommend medications, which need to be taken for the long-term. "Often people think if they are on blood pressure lowering medicines, they can stop taking their medicine if their blood pressure becomes normal, when in fact these are usually longer-term medicines," she said. Monitoring your blood pressure using a home testing kit with guidance from a GP on a regular basis can help you take ownership of your treatment. But there can be some pitfalls if you invest in the wrong machine, Ms Raffoul said. "When buying home blood pressure devices, you need to make sure you get a validated device so that the readings that they get at home are accurate and reliable." She recommended buying blood pressure machines from a reputable seller such as your pharmacy, and avoiding using finger or wrist devices. "High blood pressure is usually quite easily managed through positive lifestyle changes and possibly medications," she said.

ABC News, 1 June 2019

<http://www.abc.net.au/news/>

Type A blood converted to universal donor blood with help from bacterial enzymes

2019-06-12

On any given day, hospitals across the United States burn through some 16,500 litres (35,000 pints) of donated blood for emergency surgeries, scheduled operations, and routine transfusions. But recipients can't take just any blood: For a transfusion to be successful, the patient and donor blood types must be compatible. Now, researchers analysing bacteria in the human gut have discovered that microbes there produce two enzymes that can convert the common type A into a more universally accepted type. If the process pans out, blood specialists suggest it could revolutionize blood donation and transfusion. "This is a first, and if these data can be replicated, it is certainly a major advance," says Harvey Klein, a blood transfusion expert at the National Institutes of Health's Clinical Centre in Bethesda, Maryland, who was not involved with the work. People typically have one of four blood types—A, B, AB, or O—defined by unusual sugar molecules on the surfaces of their red blood cells. If a person with

Researchers analysing bacteria in the human gut have discovered that microbes there produce two enzymes that can convert the common type A blood into a more universally accepted type.

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type A receives type B blood, or vice versa, these molecules, called blood antigens, can cause the immune system to mount a deadly attack on the red blood cells. But type O cells lack these antigens, making it possible to transfuse that blood type into anyone. That makes this “universal” blood especially important in emergency rooms, where nurses and doctors may not have time to determine an accident victim’s blood type. “Around the United States and the rest of the world, there is a constant shortage,” says Mohandas Narla, a red blood cell physiologist at the New York Blood Centre in New York City. To up the supply of universal blood, scientists have tried transforming the second most common blood, type A, by removing its “A-defining” antigens. But they’ve met with limited success, as the known enzymes that can strip the red blood cell of the offending sugars aren’t efficient enough to do the job economically. After 4 years of trying to improve on those enzymes, a team led by Stephen Withers, a chemical biologist at the University of British Columbia (UBC) in Vancouver, Canada, decided to look for a better one among human gut bacteria. Some of these microbes, latch onto the gut wall, where they “eat” the sugar-protein combos called mucins that line it. Mucins’ sugars are similar to the type-defining ones on red blood cells. So, UBC postdoc Peter Rahfeld collected a human stool sample and isolated its DNA, which in theory would include genes that encode the bacterial enzymes that digest mucins. Chopping this DNA up and loading different pieces into copies of the commonly used lab bacterium *Escherichia coli*, the researchers monitored whether any of the microbes subsequently produced proteins with the ability to remove A-defining sugars. At first, they didn’t see anything promising. But when they tested two of the resulting enzymes at once—adding them to substances that would glow if the sugars were removed—the sugars came right off. The enzymes also worked their magic in human blood. The enzymes originally come from a gut bacterium called *Flavonifractor plautii*, Rahfeld, Withers, and their colleagues report today in *Nature Microbiology*. Tiny amounts added to a unit of type A blood could get rid of the offending sugars, they found. “The findings are very promising in terms of their practical utility,” Narla says. In the United States, type A blood makes up just under one-third of the supply, meaning the availability of “universal” donor blood could almost double. But Narla says more work is needed to ensure that all the offending A antigens have been removed, a problem in previous efforts. And Withers says researchers need to make sure the microbial enzymes have not inadvertently altered anything else on the red blood cell that could produce problems. For now, the researchers are focusing on only converting type A, as it’s more common than type B blood. Having the ability to transform type A to

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type O, Withers says, "would broaden our supply of blood and ease these shortages."

Science, 10 June 2019

<http://sciencemag.org/>

Canada to ban plastic bags and straws as it cleans up its act

2019-06-12

Canada plans to ban some single-use plastics like straws, plastic bags and cutlery by early 2021 to reduce non-recyclable waste and protect the world's oceans. Prime Minister Justin Trudeau announced the move from the banks of a lake in Gault Nature Reserve in Quebec on Monday – less than five months out from an election in which climate change and pollution are among the top campaign issues. "To be honest, as a dad, it's tough trying to explain this to my kids," Trudeau said. "How do you explain dead whales washing up on beaches around the world, their stomachs jam-packed with plastic bags? "As parents we're at a point when we take our kids to the beach and we have to search out a patch of sand that isn't littered with straws, Styrofoam or bottles. That's a problem, one that we have to do something about." Canada's move follows one by the European Parliament, which voted earlier this year to ban several single-use plastic products, and recent disputes with the Philippines and Malaysia over the shipment of Canadian waste to Asia. Last year, Canada sponsored a G7 ocean plastics charter intended to spur a reduction in plastics use. In May the United Nations said 180 countries reached a deal to reduce sharply the amount of plastic that gets washed into the oceans. Canada's delay on implementation until 2021 gives time to make a "science-based decision" on exactly which plastics are harmful to the environment and human health, according to a government statement. It will also give businesses time to adjust. Fast-food restaurants will have to find new solutions for straws and cutlery, for example. Canada may require manufacturers to use a set amount of recycled content, the statement said. Also, the federal government will work with provincial authorities so that companies, rather than just municipalities, take more responsibility for the recycling process. Canada recently became entangled in a political dispute with the Philippines over 1500 tons of household waste – mislabelled as recyclable plastics – shipped to South-East Asia in 2013 and 2014. Canada agreed to take it back last month after a protracted diplomatic spat. Malaysia similarly said it would return 3000 tons of plastic waste from Canada, the United States, Japan and the United Kingdom. "The issue of plastic

Canada plans to ban some single-use plastics like straws, plastic bags and cutlery by early 2021 to reduce non-recyclable waste and protect the world's oceans.

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pollution will increasingly be seen as an issue for developing countries that feel they are being dumped with waste from rich countries that should be taking care of their own waste internally," said Sara Seck, a Dalhousie University law professor.

Sydney Morning Herald, 11 June 2019

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

Justice Through Citizen Science: How 'Chemical Fingerprinting' Could Change Public Health

2019-06-12

In the early 2000s, residents of a small, Rust Belt city called Tonawanda, New York, began noticing something strange: Over the years, it seemed, an increasing number of people were getting sick — primarily with cancer. Tonawanda's a highly industrial city with more than 50 polluting facilities situated within a three-mile radius. It was common for the air to feel dense and to smell like gasoline. Residents wondered what toxic chemicals might be in the air and if they were making them sick. Seeking to answer that question, in 2005 a small group of concerned residents took to their streets armed with five-gallon buckets, plastic baggies, plastic hoses and a handheld vacuum to suck out samples from the heavy, foul-smelling air. Lab testing confirmed their fears: Air samples they'd taken near a plant called Tonawanda Coke, which produced a high-carbon form of coal, contained extremely high levels of industrial toxins, including benzene — a hydrocarbon linked to cancers, infertility, growth problems and an array of blood diseases. It was present in the air at a rate of 25 times what the federal government estimates an average American is exposed to in a lifetime. The group's work resulted in a legal investigation, a federal lawsuit and the eventual shutdown of Tonawanda Coke in 2018. It was a major victory spurred by a small, DIY investigation. But the success didn't end there. It led to a first-of-its-kind "chemical fingerprinting" study that could have far-reaching impacts to hold polluters accountable and even prevent towns like Tonawanda from becoming toxic dumping grounds in the future. In 2013 a judge found Tonawanda Coke guilty of violating 11 counts of the Clean Air Act and three counts of the Resource Conservation and Recovery Act. The company was ordered in 2014 to pay a \$12.5 million penalty plus \$12.2 million for community health and environmental research that could reveal the full extent of the factory's pollution legacy — the first time in history such a legal decision has ever been made. Today the environmental component of that court-ordered research — a \$711,000 soil project that involves testing for specific

The technology exists to hold polluters accountable, but can it now be used to help monitor pollution and prevent toxic messes?

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chemical signatures in soil to map areas that have been exposed to the highest levels of air pollution — is in its final phase, with its results to be made public later this year. Residents will then learn the extent of the pollution in the region caused by the coke plant. But much has already been accomplished thanks to the continued work of local residents, who have assumed “citizen scientist” roles in collecting soil samples for study. While chemical fingerprinting has been done before to find polluters, this is the first federally court-ordered project funded by a convicted party and designed by local scientists to uncover the extent of an industrial polluter’s impacts on its community by testing chemical fingerprints with the help of citizen scientists. Experts believe this kind of community-driven project is a cost-effective way to understand long-term pollution legacies from companies like Tonawanda Coke and also to identify additional polluted areas that need to be cleaned up. “Soil sampling is a surrogate for historic air pollution, especially for the most carcinogenic compounds emitted by industrial plants,” says Joseph Gardella Jr., State University of New York at Buffalo chemistry professor and research leader. “Many pollutants in the air end up depositing themselves in soil, providing us with a record of what factories have historically been pouring out, what people have been breathing in and what needs to be cleaned up now.”

Fingerprinting Polluters

The scientific process of developing a specific chemical fingerprint and tracing it back to a specific source, in this case Tonawanda Coke, is known as “source apportionment.” Each factory releases its own specific mixture of pollutants. They perform some kind of combustion process or processes, and so they release chemicals specific to those processes belonging to a class of cancer-causing chemicals called polycyclic aromatic hydrocarbons (PAHs). Burning cigarettes, running vehicles, cooking on a charcoal grill and making a bonfire also releases PAHs — albeit in much smaller amounts. Different types of combustion — including the production of coke, which comes from heating coal at high temperatures — release different types of PAHs and other associated health-harming chemicals, such as particulate matter, sulfur and carbon dioxide. In 2017, while Tonawanda Coke was still running some of its coke ovens, Gardella and his team took air and soil samples on site, as well as a sample of the coke the plant produced, to gather data that could be used to develop a chemical fingerprint unique to the factory. Then they held community meetings where they called on the public for help collecting soil samples from their properties and taught them how to collect samples that could be used for scientific analysis. In total residents collected 182 soil samples, and

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Gardella's team also analysed public data on contaminants from 65 toxic release sites in their test area in northwestern Erie County, New York. The scientists sent both the air and soil samples to independent laboratory ALS Environmental to be analysed for 169 different industrial chemicals. The results? "On the Tonawanda Coke property, soil samples had levels of PAHs that were through the roof," says Gardella. "I had never seen anything this contaminated before, and I've seen some pretty contaminated sites." Analysis of the resident-collected soil samples also revealed high levels of pollution, specifically on properties immediately surrounding the plant; as well as properties east, northeast and west of the plant. Chemicals found in soil samples included PAHs, PCBs, cyanide and heavy metals such as lead, mercury and arsenic. Some of the residential samples in the worst polluted areas had levels of toxic chemicals that exceeded federal and state guidelines that would necessitate a clean-up.

Mapping the Risks

Understanding the kind of pollutants in the area was just the first step. Next, to understand whether or not the pollutants on residential properties definitely came from Tonawanda Coke and not another industrial polluter, researchers need to do more testing. In 2018 the scientists asked residents to take 130 more samples within the most highly polluted areas and began the process of determining source apportionment — matching the chemical fingerprint. "I am currently building a library of chemical standards from pollutants found on the Tonawanda Coke property so I know what chemicals we are looking for and what its unique chemical fingerprint should look like," says Kaitlin Ordiway, a State University of New York at Buffalo graduate student now working on the source apportionment component of the study. Because Tonawanda was the only coke plant in this highly industrial area of New York, Ordiway says she's using advanced chemical tests to look specifically for PAHs associated with coke production. These include anthracene, phenanthrene, benzo(a)pyrene and benzo(g,h,i)perylene. PAHs are more complex versions of one of the simplest aromatic hydrocarbons, benzene, a very common — and toxic — emission from industries of all kinds.

Chemicals from soil samples

"The PAHs I'm looking for have a more complex molecular structure than benzene, and so they can be used to develop a more detailed and accurate fingerprint," Ordiway says. Chemical fingerprinting and the methods used by the University at Buffalo team have been widely used to uncover sources of industrial pollution, according to Paul Boehm, corporate vice

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president and principal scientist at Exponent, an engineering and scientific consulting firm. This includes cases for all kinds of pollution, he says, such as from the Deepwater Horizon and Exxon Valdez oil spills. He adds that “what makes or breaks such investigations” includes the quantity and quality of samples used to establish the fingerprints, considerations of all other possible chemical sources in the area including natural “background” levels of PAHs, the techniques used to analyse the data, and most importantly, the experience and skills of the scientists who are analysing and interpreting the data.

Gardella and his team say that, after their fingerprinting process is finished, they’ll use GIS technology to develop contamination maps with their data that will inform environmental agencies about the exact location of various contaminants. Specifically, they’ll determine where a clean-up of toxic soil might be necessary and whether or not Tonawanda Coke is responsible for it or if another polluter is to blame and should be investigated. Gardella says he and his team expect to announce the results in later 2019. Chemical fingerprinting research and map-making can be time consuming, Gardella says, but when citizen scientists are used to help gather data, it’s not very expensive. He believes the process should be used routinely by state and federal environmental agencies to identify polluters and polluted areas instead of waiting for a court- order, as in the case of Tonawanda. Because the technology to perform source apportionment already exists and the testing methods are relatively inexpensive, environmental agencies just have to develop the capacity and training to carry it out, he says. “When that happens, this could become proactive work rather than retrospective work, resulting in better pollution monitoring across the country and healthier lives for people living in areas affected by industrial pollution,” Gardella says.

The Revelator, 10 June 2019

<https://therevelator.org>

How your body processes food is only partially down to your genes

2019-06-12

As children, Helen Sparre and Sarah Guy appeared identical in both face and figure; a pattern which continued into their twenties – when both twins were underweight – and into their thirties and early forties, when they began to gain some additional pounds. Yet, according to a new study, in which they participated, these similarities are only skin-deep:

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Just 50 per cent of our response to glucose, and less than 20 per cent of our response to dietary fats is genetic, meaning that even identical twins respond very differently to the same meal. "Everyone is unique in their food response, which may help explain why one-size-fits-all dietary guidelines often fail," says Tim Spector at Kings College, London, who led the study. He is now developing an app which could ultimately predict the healthiest food choices for any given individual, following a test. The team found that, whereas some people experienced a rapid and prolonged increase in blood sugar and insulin in response to a given meal, such as a high-fat or high-carb muffin, others responded to the same meal with a large and sustained increase in the amount of fat circulating in their bloodstream. The first of these responses is a pattern associated with an increased risk of weight gain and type 2 diabetes, whereas the second is associated with an increased risk of cardiovascular disease. Surprisingly, these differences were also observed in twins sharing identical DNA sequences. For instance, in response to a sugary drink, one twin had more than double the spike in blood glucose of their identical twin — a pattern also observed when they consumed a standard muffin. But when they consumed a high fibre muffin, their responses were more similar. "It shows us that our environment is also important to our response to food," says Isabel Garcia-Perez at the Centre for Translational Nutrition and Food Research at Imperial College London.

Gut differences

One possible explanation for these differences, is variation in the participants' gut microbiota. In the study, identical twins were found to share just 37 per cent of the same gut microbes; in unrelated individuals it was 35 per cent. Variability in people's sleep, circadian rhythms, or exercise could also explain the differences, says Spector, who presented the results at the American Diabetes Association conference in San Francisco this week. The team are using the data from the study to try to build a system that can predict how people would respond to untested foods. So far, the system can predict glucose responses with 73 per cent accuracy. The team plan to release an app next year, which will be used to gather more data from individuals, and which they hope could ultimately advise them on the healthiest food choices based on their responses to a test meal, or series of meals. "This is a massive and unprecedented effort to identify the predictors of people's response to caloric and nutrient intake, and it is an approach has the potential to tell us a lot," says Claude Bouchard at Pennington Biomedical Research Centre in Louisiana. Even so, recent studies suggest the metabolic fate of a meal can also be influenced by

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what we consumed the day before – something they haven't necessarily accounted for in this study, he says. As for Sarah and Helen, the message they've taken from participating in the study is that, although they may look identical, their responses to foods are very different: Sarah has an 'unhealthy' metabolic response to chocolate, but Helen tolerates it well – whereas she has an 'unhealthy' response to potato crisps, which isn't shared by her twin. "It's funny because when we were little, we always used to say that if you put the two of us together, you'd have one person," says Sarah, "and that's what these results appear to be showing as well."

New Scientist, 10 June 2019

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

How teabags became a secret weapon in the fight against climate change

2019-06-12

It is summer on Herschel Island in the Canadian Arctic and Haydn Thomas is digging in the tundra for teabags. One in particular eludes him. He knows he left it around here last year, but now it is nowhere to be found. "Foolishly, I buried it where the permafrost is very unstable," he says. An hour or more later, he abandons the search. This is one that got away. But it is a small defeat: there are at least 5000 more teabags waiting to be recovered from tundra around the world. It may seem bizarre, but burying teabags is all the rage among ecologists. "It's like a treasure hunt, trying to find them after you've left them somewhere for a year, sometimes two years," says Isla Myers-Smith at the University of Edinburgh, UK, who supervises Thomas's research. "I like a good treasure hunt," she says. Of course, there is more to it than fun. Teabags, it turns out, provide an ingenious window onto a largely hidden world: soil. When soil litter – dead leaves, twigs and other organic material – decomposes, it emits carbon dioxide, which contributes to global warming. Being able to measure the rate at which this happens is important – and nowhere more so than in the Arctic, where the tundra holds vast quantities of carbon and is emitting it into the air at an accelerating rate as the land heats up. Sizing up this problem should allow us to better predict the ramifications of a warmer world, and chart a course to avert disastrous climate change. So, how did teabags become a secret weapon in understanding the biggest problem the world faces? It started in 2010, when Joost Keuskamp and Judith Sarneel at Utrecht University in the Netherlands had a eureka moment. Both study soil decomposition, and their research entails painstakingly sewing or gluing together the seams of hundreds of tiny

Climate change could release a torrent of carbon from the Arctic tundra into a warming world. To gauge the threat, ecologists have recruited the humble teabag

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bags, filling them with dead plant material, then weighing and burying them in the ground. The ecologists later dig up the bags and reweigh them to track the progress of decay. During a well-earned tea break, the pair were bemoaning the tedium of this time-consuming job. If only there were some way to avoid it, they mused, while staring into the depths of their teacups. Teabags! It was a genius idea. Not only would using them bypass all the sewing and gluing, but if ecologists everywhere buried the same type and brand of teabag instead of homemade litterbags, it would also give them a standard piece of kit with which to do their studies. Soil decomposition occurs when microorganisms, including fungi and bacteria, digest dead plant material, transforming it into nutrients and releasing carbon dioxide. The rate of decay depends on environmental conditions such as humidity, temperature, soil acidity and nutrient content, together with the chemical properties of the litter and the types of microorganisms present. It is a two-stage process. Typically, decay is fast at first, as microbes consume all the easily degraded organic material. In the next phase, the decomposition rate is slower because the material left behind is more resistant and takes longer to break down.

Tea for two

After much trial and error, Sarneel, now at Umeå University in Sweden, and Keuskamp realised that, by burying two different types of tea for two or three months, they could capture data on both phases at the same time. Woody rooibos tea, also known as redbush, is slow to decompose, so the amount of weight lost gives a measure of the initial decay rate. Meanwhile, rapidly decomposing green tea quickly reaches the slower phase of decay, so can be used to measure its rate. The Tea Bag Index was born. Since they went public with their method in 2013, teabag ecology has taken off. Last year, the first global comparative study of soil litter decomposition was published by the TeaComposition initiative, a collaboration of researchers from more than 190 institutions. They looked at early stage decay rates of the two types of teabags in soil at 336 sites within nine different biomes, including boreal forests, equatorial regions, the Mediterranean and Arctic tundra. They found that rooibos tea always decayed much slower than green tea, reassuring them that the Tea Bag Index works in vastly different geographic regions and biomes. As expected, decay of both tea types was faster in warmer, more humid environments. However, for tea at least, moisture levels have more impact on decomposition rates than temperature. Being able to make such global comparisons is a huge leap forward for soil scientists. But the group acknowledged that data from the Arctic was sparse. That matters because tundra contains huge amounts

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of carbon – almost twice as much as the atmosphere – in the form of dead vegetation. Historically, low temperatures in the Arctic have kept the decomposition rates in tundra soil low, locking up this carbon. With global warming, that is no longer the case. However, we don't know how fast carbon dioxide is being released from the tundra into the atmosphere or what impact this will have. That is what Myers-Smith and her team are trying to find out. They are particularly keen to see what is going on in places like Herschel Island, where rising temperatures are leading to increased plant growth. "One of the big questions is, what happens to that biomass once it gets deposited into the soil," says Myers-Smith. Might it rapidly decompose, creating a feedback loop that makes things worse? To tackle this question, Thomas heads up the Tundra Tea Bag Experiment, an international collaboration involving some 50 researchers. It has buried teabags at over 350 sites worldwide and aims to find out how decomposition rates across the tundra differ with changes in soil and air temperature and moisture. Analysis is ongoing, but early hints are concerning. In the Arctic, soils are often below 0°C but warm up through the summer. As temperature and moisture increase, decomposition speeds up. The researchers had predicted – in line with assumptions used by many climate models – that after an initial spurt, rates of decay would begin to level off. That isn't happening. "We're seeing a linear relationship across the whole tundra," says Myers-Smith. "Some of the highest rates of decomposition occurred at sites that were the warmest and the wettest." She hopes that the findings, which will be published soon, will be used to update climate models and improve our ability to predict the effects of climate change at high latitudes. Sarneel and Keuskamp never imagined that their labour-saving innovation would one day have such global reach. "Sometimes, it's really good to follow your crazy ideas and see where it all ends up," says Sarneel. That remains to be seen: results are still brewing, as all over the world bags of rooibos and green tea are steeping.

New Scientist, 5 June 2019

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

Sleeping with artificial light at night associated with weight gain in women

2019-06-12

Sleeping with a television or light on in the room may be a risk factor for gaining weight or developing obesity, according to scientists at the National Institutes of Health. The research, which was published online June 10 in *JAMA Internal Medicine*, is the first to find an association

Sleeping with a television or light on in the room may be a risk factor for gaining weight or developing obesity, according to scientists.

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between any exposure to artificial light at night while sleeping and weight gain in women. The results suggest that cutting off lights at bedtime could reduce women's chances of becoming obese. The research team used questionnaire data from 43,722 women in the Sister Study, a cohort study that examines risk factors for breast cancer and other diseases. The participants, aged 35-74 years, had no history of cancer or cardiovascular disease and were not shift workers, daytime sleepers, or pregnant when the study began. The study questionnaire asked whether the women slept with no light, a small nightlight, light outside of the room, or a light or television on in the room. The scientists used weight, height, waist and hip circumference, and body mass index measurements taken at baseline, as well as self-reported information on weight at baseline and follow-up five years later. Using this information, the scientists were able to study obesity and weight gain in women exposed to artificial light at night with women who reported sleeping in dark rooms. The results varied with the level of artificial light at night exposure. For example, using a small nightlight was not associated with weight gain, whereas women who slept with a light or television on were 17% more likely to have gained 5 kilograms, approximately 11 pounds, or more over the follow-up period. The association with having light coming from outside the room was more modest. Also, the scientists wondered if not getting enough rest factored into the findings. "Although poor sleep by itself was associated with obesity and weight gain, it did not explain the associations between exposure to artificial light while sleeping and weight," said corresponding author Dale Sandler, Ph.D., chief of the Epidemiology Branch at the National Institute of Environmental Health Sciences (NIEHS), part of NIH. Co-author Chandra Jackson, Ph.D., head of the NIEHS Social and Environmental Determinants of Health Equity Group, is interested in racial disparities in sleep health. She notes that for many who live in urban environments, light at night is more common and should be considered. Streetlights, store front neon signs, and other light sources can suppress the sleep hormone melatonin and the natural 24-hour light-dark cycle of circadian rhythms. "Humans are genetically adapted to a natural environment consisting of sunlight during the day and darkness at night," Jackson said. "Exposure to artificial light at night may alter hormones and other biological processes in ways that raise the risk of health conditions like obesity." The authors acknowledge that other confounding factors could explain the associations between artificial light at night and weight gain. However, their findings did not change when analyses controlled for characteristics that may be associated with exposure to light at night. These factors included age, having an older spouse or children in the home, race, socioeconomic status, calories consumed, and physical

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activity. Also, the study did not include men. Lead author Yong-Moon (Mark) Park, M.D., Ph.D., is a postdoctoral fellow in Sandler's group. He said the research suggests a viable public health strategy to reduce obesity incidence in women. "Unhealthy high-calorie diet and sedentary behaviours have been the most commonly cited factors to explain the continuing rise in obesity," Park said. "This study highlights the importance of artificial light at night and gives women who sleep with lights or the television on a way to improve their health."

Science Daily, 10 June 2019

<http://www.sciencedaily.com>

Undetected diabetes linked to heart attack and gum disease

2019-06-12

People with undetected glucose disorders run a higher risk of both myocardial infarction and periodontitis, according to a study published in the journal *Diabetes Care* by researchers at Karolinska Institutet in Sweden. The results demonstrate the need of greater collaboration between dentistry and healthcare, say the researchers, and possibly of screening for diabetes at dental clinics. Severe periodontitis is already known to be associated with a higher risk of myocardial infarction and lowered glucose tolerance, and diabetes to be more common in people who have suffered a heart attack. The researchers behind these earlier findings have now studied whether undetected glucose disorders (dysglycaemia) -- that is, a reduced ability to metabolise sugar -- is linked to both these conditions: myocardial infarction and periodontitis. The results are published in the journal *Diabetes Care*. The study was a collaboration between cardiologists and dentists at Karolinska Institutet and was based on data from a previous study called PAROKRANK. It included 805 myocardial infarction patients from 17 Swedish cardiology clinics and 805 controls, who were matched by age, sex and post code. The patients' periodontitic status was assessed with X-rays and dysglycaemic status with glucose load tests. Participants with a diabetes diagnosis were excluded from the study, which left 712 patients and 731 controls with data on both periodontitic status and glucose status, the latter of which was divided into three categories: normal, reduced glucose tolerance, newly detected diabetes. Comparisons were made after adjusting for age, sex, smoking habits, education and civil status. The study shows that previously undetected glucose disorders, which include diabetes and impaired glucose tolerance, were linked to myocardial infarction. It was roughly twice as common

People with undetected glucose disorders run a higher risk of both myocardial infarction and periodontitis, according to a new study.

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for myocardial infarction patients to have undetected dysglycaemia as for healthy controls, confirming the research group's earlier findings. Myocardial infarction affects approximately 30,000 people in Sweden annually. Undetected diabetes was also found to be linked to severe periodontitis. When myocardial infarction patients and controls were analysed separately, the association was clearer in the patients than in the controls, which is possibly because many of the controls were very healthy and few had severe periodontitis and undetected diabetes. "Our findings indicate that dysglycaemia is a key risk factor in both severe periodontitis and myocardial infarction and that the combination of severe periodontitis and undetected diabetes further increases the risk of myocardial infarction," says the study's lead author Anna Norhammar, cardiologist and Associate Professor at Karolinska Institutet's Department of Medicine in Solna. The results substantiate previously known links between periodontitis and diabetes and show that such an association also exists in previously unknown diabetes. According to the researchers, the findings should make diabetes specialists consider their patients' dental health and the need for closer collaboration with dentists. "The PAROKRANK study is a good example of such collaboration," says the present study's senior author Lars Rydén, Professor at Karolinska Institutet's Department of Medicine in Solna and chair of the academically initiated PAROKRANK study. "Our study shows that undetected glucose disorders are common in two major diseases -- myocardial infarction and periodontitis," says Dr Norhammar. "Many people visit the dentist regularly and maybe it's worth considering taking routine blood-sugar tests in patients with severe periodontitis to catch these patients." One of the study's limitations is that despite the large number of participants, the number of patients and controls with severe periodontitis and undetected diabetes was low. The observed differences in the links between undetected diabetes and severe periodontitis in patients and controls can therefore be attributable either to the low number of patients or to genuine differences in correlation. The study was financed with grants from AFA Insurance, the Swedish Heart and Lung Foundation, the Swedish Research Council and Region Stockholm (ALF funding).

Science Daily, 10 June 2019

<http://www.sciencedaily.com>

A new study backs up what we've long suspected – the way chocolate is packaged creates a stronger emotional pull than what it actually tastes like.

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Scientists May Have Found Why We Love Fancy Chocolate So Much, And It's Not The Taste

2019-06-12

How much of your chocolate buying is based on taste, and how much is based on the shininess of its wrapping? A new study backs up what we've long suspected – the way chocolate is packaged creates a stronger emotional pull than what it actually tastes like. And while the chocolate we buy in the future is mostly dependent on how it tastes, the research suggests, how we perceive that taste on our tongue is influenced to some extent on the way the treat was wrapped up. The team behind the study, from the University of Melbourne in Australia, says their work could be helpful for companies looking for ideas for how to market their products – as well as making us more aware of how we're choosing what to put in our shopping baskets. "There's a difference in how consumers perceive intrinsic product cues – like flavour, aroma, and texture – which are associated with sensory and perceptual systems, and how they perceive external cues – like packaging materials, information, brand name, and price – which are associated with cognitive and psychological mechanisms," says one of the team, Frank R. Dunshea. "The information provided via packaging can influence customers' expectations and affect their emotional response when their sensory experience confirms or doesn't confirm their initial impression." For this experiment, 75 chocolate tasting volunteers were asked questions based on three conditions: a taste test with no packaging, a look at the packaging with no tasting, and a taste test with the packaging visible. For the last part, samples of the same chocolate were wrapped in six different packaging concepts – bold, fun, everyday, special, healthy and premium. Participants were asked to rate the taste of the product, the emotions it prompted, and how likely they would be to buy the chocolate in the future. People rated a chocolate's taste lower if the wrapper didn't match what was inside. What's more, when the wrappers mentioned positive words, there was a positive link between liking both the packaging and the taste of the chocolate. Where the packaging made a real difference was in the emotions the volunteers reported while they were tasting, and the emotional associations were much stronger when the wrappers were visible. Ultimately, positive emotions prompted by the packaging had a direct influence on the acceptability of the chocolate itself. Previous research has identified how emotions and packaging can guide our food choices – particularly if our expectations about the food we're eating match up with the way it was presented on the shelf – and this new study draws the two ideas together. Even though the chocolate taste ended up as the biggest

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influence on which bar the volunteers would buy in the future, how it's presented definitely plays a part – which is something to bear in mind the next time you're out shopping. "An estimated 60 percent of consumers' initial decisions about products are made in stores solely by judging the packaging," says one of the researchers, Sigfredo Fuentes. "As a result, our findings offer important insights that can be used in product design and development to control product intrinsic and extrinsic attributes by enhancing the emotional attachment towards the food products." The research has been published in *Heliyon*.

Science Alert, 10 June 2019

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

Scientists Have Some Disappointing News For All of Us Hitting The Snooze Button

2019-06-12

To sleep or to snooze? You probably know the answer, but you don't prefer it. Most of us probably use the snooze function on our alarm clocks at some point in our lives. Just a few more minutes under the covers, a time to gather our thoughts, right? While such snoozing might seem harmless, it may not be. For starters, it is important to understand why we are using the snooze button in the first place. For some it's a habit that started early on. But for many, it can signal a significant problem with sleep. Poor sleep has been shown to be associated with a number of health disorders including high blood pressure, memory problems and even weight control. I'm a facial pain specialist and have extensively studied sleep and how it impacts painful conditions. With testing, we discover that many of our chronic pain patients also suffer with various sleep disorders.

What does normal sleep look like?

If one is tired when the alarm goes off, is it helpful to use the snooze button? While there are no scientific studies that address this topic specifically, the answer is probably not. Our natural body clock regulates functions through what's known as circadian rhythms – physical, mental and behavioural changes that follow a daily cycle. Most adults require approximately seven and a half to eight hours of good sleep per night. This enables us to spend adequate time in the stages of sleep known as non-rapid eye movement sleep (NREM) and rapid eye movement sleep (REM). We tend to cycle from the three stages of NREM into REM sleep four to six

**To sleep or to snooze?
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don't prefer it.**

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times per night. The first portion of the night is mostly NREM deep sleep and the last portion consists of mostly REM sleep.

Good sleep is important

Maintaining this well-defined structure is important for good, restful sleep. If this process is disturbed, we tend to awaken still feeling tired in the morning. A number of factors can affect the sleep cycles. For example, if a person is not breathing well during sleep (snoring or sleep apnoea), this will disturb the normal sequences and cause the individual to awaken feeling unrefreshed. Sleep quality can be diminished by the use of electronic devices, tobacco or alcohol in the evening. Even eating too close to bedtime can be problematic. The use of snooze buttons often starts during the teenage years, when our circadian rhythms are altered somewhat, causing us to want to stay up later and get up later in the morning. Delaying getting out of bed for nine minutes by hitting the snooze is simply not going to give us any more restorative sleep. In fact, it may serve to confuse the brain into starting the process of secreting more neurochemicals that cause sleep to occur, according to some hypotheses. Bottom line: It's probably best to set your alarm for a specific time and get up then. If you are consistently tired in the morning, consult with a sleep specialist to find out why.

Science Alert, 9 June 2019

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

Algorithm provides customized caffeine strategy for alertness

2019-06-12

A web-based caffeine optimization tool successfully designs effective strategies to maximize alertness while avoiding excessive caffeine consumption, according to preliminary results from a new study. Using multiple sleep-deprivation and shift-work scenarios, the researchers generated caffeine-consumption guidance using the open-access tool 2B-Alert Web 2.0, and then they compared the results with the U.S. Army guidelines. Their analysis found that the solutions suggested by the quantitative caffeine optimisation tool either required on average 40% less caffeine or enhanced alertness by an additional 40%. "Our 2B-Alert Web tool allows an individual, in our case our service members, to optimise the beneficial effects of caffeine while minimising its consumption," said principal investigator Jaques Reifman, Ph.D., a Department of the Army

A web-based caffeine optimisation tool successfully designs effective strategies to maximise alertness while avoiding excessive caffeine consumption, according to preliminary results from a new study.

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Senior Research Scientist for Advanced Medical Technology, serving at the U.S. Army Medical Research and Development Command at Ft. Detrick, Maryland. According to the authors, caffeine is the most widely consumed stimulant to counter the effects of sleep deprivation on alertness. However, to be safe and most effective, the right amount must be consumed at the right time. Last year at SLEEP 2018 in Baltimore, Reifman presented data comparing the algorithm with the caffeine dosing strategies of four previously published experimental studies of sleep loss. The current study extended his team's previous work by incorporating the automated caffeine-guidance algorithm in an open-access tool so that users can input several factors: the desirable peak-alertness periods within a sleep/wake schedule, the minimum desirable level of alertness, and the maximum tolerable daily caffeine intake. With this added capability, the 2B-Alert Web 2.0 tool now allows users to predict the alertness of an "average" individual as a function of his or her sleep/wake schedule and caffeine schedule. It also enables users to automatically obtain optimal caffeine timing and doses to achieve peak alertness at the desired times. This freely available tool will have practical applications that extend beyond the realms of the military and the research lab, noted Reifman. "For example, if you pull an all-nighter, need to be at peak alertness between, say, 9 a.m. and 5 p.m., and desire to consume as little caffeine as possible, when and how much caffeine should you consume?" he said. "This is the type of question 2B-Alert was designed to answer." The research abstract was published recently in an online supplement of the journal *Sleep* and will be presented Wednesday, June 12, in San Antonio at SLEEP 2019, the 33rd annual meeting of the Associated Professional Sleep Societies LLC (APSS), which is a joint venture of the American Academy of Sleep Medicine and the Sleep Research Society.

Science Daily, 7 June 2019

<http://www.sciencedaily.com>

What do cold and flu medicines actually do? Our guide, from pseudoephedrine and paracetamol to vitamin C

2019-06-12

Your head feels like it's been stuffed with cotton wool and your throat like you've swallowed a thousand razors. Achy-jointed and bleary-eyed, you stare at the pharmacy shelf, wondering what combination of potions and pills might help you feel human again. How do you know which medicines will work, and which ones will make you feel wired, drowsy, or do nothing at all? Take your tissue box and head back to bed, friend. We've got you.

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Your body on a cold or flu

First things first: what's actually happening in your body when you've got a lurgy? Colds are caused by one of hundreds of strains of virus, usually rhinovirus or respiratory syncytial virus. "There's quite a constellation of viruses that cause them," said Jill Thistlethwaite, a Sydney GP and spokesperson for NPS Medicinewise. Viruses spread when droplets of moisture from a sick person's nose or mouth find their way into your nose or mouth, where the virus takes up residence and begins to multiply.

Putting cold and flu vitamins to the test

When you're in the grip of a phlegm-fuelled misery fest, you can become desperate for any sort of relief. So which supplements help? Those unpleasantly familiar symptoms — runny nose, sore throat, coughing and sneezing — are caused when the virus invades the tissues of your nose and throat, triggering your body's immune system to fight back. The resulting blood flow to those areas causes swelling and nasal discharge (otherwise known as snot) and can also contribute to the headache that sometimes comes with a stuffed-up nose. But while being sick with a cold can be deeply unpleasant, they're not usually a severe illness, and generally last a few days. The average Australian adult gets between two and four colds per year. Flu, on the other hand, is a different, more dangerous beast. Similar to a cold, it occurs when a strain of influenza virus infects your respiratory system, but it can last a week or two and has more severe symptoms, including fevers, chills and muscle aches. Flu can be life-threatening in some people and can cause serious complications like pneumonia, so see a doctor if you're concerned, especially if you're at higher risk due to age, pregnancy or chronic health problems. "One of the issues is that in the early stages of flu, the symptoms are very similar to what you may get with a cold. So, unless you actually do a test to see which virus is causing your symptoms, you don't always know what the problem is," Dr Thistlethwaite said. One of the most effective things you can do to avoid getting colds and flu is to practice good hygiene. You can also guard against the flu by getting vaccinated — but because it's so prone to mutating, you need to get a flu shot every year to have the best chance of being protected. But that's no help to you if you're already sick, is it? So, let's talk medicines.

Ingredients to look for

Here are some of the most common active ingredients in cold and flu medications and what they do.

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- **Pseudoephedrine:** Pseudoephedrine is a decongestant, which means it helps dry up a runny nose. It does that through vasoconstriction, or tightening up the blood vessels in your nose. This stops so much fluid leaking out, thus drying up your runny nose and blocked sinuses. It's also a stimulant, so it might give you a boost in energy too, said Geraldine Moses, a pharmacy expert at the University of Queensland. That means it has the potential to be abused and can be used to make amphetamines, so the sale of pseudoephedrine is tightly restricted. It can also have a rebound effect on symptoms, according to Dr Moses. "One problem with pseudoephedrine is that it's so effective that when it wears off, the blood vessels rebound so they 'boing' back to being dilated, and you can get a worse blocked nose when each dose wears off."
- **Phenylephrine:** Phenylephrine is also a decongestant, but it's not as effective as pseudoephedrine, especially in the lower doses most medicines contain, Dr Moses said. She pointed out both decongestant drugs only relieved symptoms, and weren't necessary to treat the illness. "This feeling like you have to take something is one we need to challenge."
- **Paracetamol and ibuprofen:** Pain relievers paracetamol and ibuprofen can both help ease cold and flu symptoms. Paracetamol can help reduce fever, Dr Moses said, and ibuprofen can be particularly effective for sore throats because it is anti-inflammatory. But it's important to watch out for how much you're taking. Many cold and flu medications already include ibuprofen and paracetamol, so if you're also taking them individually you could risk overdosing, which can cause damage to your kidneys and liver. It's not just tablets to watch out for either — some remedies, such as flavoured powders designed to be dissolved in hot water, also contain paracetamol.
- **Nasal sprays:** Some sprays contain vasoconstrictor drugs that do a similar job to decongestants in that they dry up the nose. Delivering them straight to the nasal membranes means they work without affecting the rest of your body. But rebound congestion — where the stuffed nose comes back worse than ever as soon as the drug wears off — can be even more of a problem with these, Dr Moses said. Salt water sprays are a better choice because they're extremely safe and very effective, she said. "Most nasal sprays sold in pharmacies these days only have saline in them and they're terrific."
- **Menthol:** Menthol is often found in lozenges that promise to help clear the nose. Dr Moses said they do work but the effect is incredibly brief. "They might clear your nose but maybe for five seconds — maybe

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six," she said. "Plus, they are usually delivered in a very sugary lozenge because menthol tastes disgusting. "So really the benefit is minimal and you're risking ... rotting your teeth."

- Cough medicines: Evidence that cough medicines are effective is very limited. They're not recommended for young children because of the risk of side effects that would outweigh the benefit. According to the World Health Organisation, you're probably better off using a remedy that's in your pantry, not your medicine cupboard: honey.

Should you bother with cold and flu drugs?

While medicines can give you some relief, they're only masking your symptoms and won't make you get better more quickly or stop you from being contagious. You can infect other people before you even start having symptoms, Dr Thistlethwaite warned, so even if your nose isn't running because you're taking a decongestant, you're still shedding the virus everywhere you go. So, think about staying home from work. That doesn't mean drugs are useless, however. Dr Moses suggests being selective about what you really need. "It can help support you to get through that week of having a cold but understand it's not going to reduce the duration of the cold or magically make it go away. "What we often encourage is taking these medicines in separate tablets and not just racing out and getting a thing called a cough and cold remedy and hoping that all the right drugs will be in one tablet." And if you're thinking of stocking up on vitamins or supplements when you're at the pharmacy, you're probably better off saving your money. There's little to no evidence that vitamin C, zinc, echinacea or garlic protect you from getting infected, or ease symptoms. At best, some of them may reduce the duration of those symptoms by about a day. What's more, some herbal remedies can interact with conventional medicines and cause adverse reactions, Dr Moses warned, so be sure to talk to your doctor or pharmacist.

ABC News, 11 June 2019

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