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ASIA PACIFIC

India Issues New Battery Waste Management Rules

2022-09-08

In light of the popularization of electric vehicles, battery waste has attracted attention from the authority and the industry in India. The Ministry of Environment, Forest and Climate Change, Government of India made public the Battery Waste Management Rules, 2022 (hereinafter referred to as the 2022 Rules) in the Official Gazette on August 24, 2022, which came into force immediately.

Read More

Chemlinked, 08-09-22

https://chemical.chemlinked.com/news/chemical-news/india-issues-new-battery-waste-management-rules

China Issues Guide for Evaluation of VOCs Abatement in Industrial Enterprise

2022-09-05

On August 5, 2022, the All-China Environment Federation Committee of VOCs Emission Control (ACEF-VOCs) released the group standard "Guideline for Comprehensive Evaluation of Volatile Organic Compounds Abatement Effect in Industrial Enterprise" (hereinafter referred to as the Guideline), which came into force immediately. In addition to the self-evaluation of industrial enterprises, the Guideline also applies to the official evaluation conducted by the departments of ecology and environment at all levels in China.

Read More

Chemlinked, 05-09-22

https://chemical.chemlinked.com/news/chemical-news/china-issues-guide-for-evaluation-of-vocs-abatement-in-industrial-enterprises

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AMERICA

Order 2022-87-23-01 Amending the Domestic Substances List: SOR/2022-183

2022-08-17

Canada Gazette, Part II, Volume 156, Number 17

Registration

SOR/2022-183 July 27, 2022

CANADIAN ENVIRONMENTAL PROTECTION ACT, 1999

Whereas the substance set out in the annexed Order is specified on the Domestic Substances List;

And whereas the Minister of the Environment and the Minister of Health suspect that the information concerning a significant new activity in relation to the substance may contribute to determining the circumstances in which the substance is toxic or capable of becoming toxic within the meaning of section 64 of the Canadian Environmental Protection Act, 1999;

Therefore, the Minister of the Environment, pursuant to subsection 87(3) of the Canadian Environmental Protection Act, 1999, makes the annexed Order 2022-87-23-01 Amending the Domestic Substances List.

Gatineau, July 22, 2022

Steven Guilbeault

Minister of the Environment

Read More

Government of Canada, 17-08-22

https://www.gazette.gc.ca/rp-pr/p2/2022/2022-08-17/html/sor-dors183-eng.html

PFAS-Disclosure Legislation Moves to Governor's Desk in California

2022-09-06

In a continuing effort to address concerns surrounding consumer goods containing perfluoroalkyl and polyfluoroalkyl substances (PFAS), a broad

class of chemicals commonly referred to as "forever chemicals," the California legislature passed AB 2247 on Aug. 30, 2022. If the measure becomes law, it will require the registration by 2026 of all products sold, distributed or imported into the state of California containing intentionally added PFAS, with few exceptions. Violations of this law would be subject to civil, but not criminal, penalties. Gov. Newsom can either sign or veto the law by Sept. 30, 2022, or the bill will become law without his signature.

Unlike prior PFAS legislation in California, this bill is not restricted to particular industries or types of PFAS. As a result, it has garnered significant opposition from industry groups including the California Chamber of Commerce and the Chemical Industry Council of California, and "no" votes from moderate Democrats in both chambers. Despite organized opposition, AB 2247 may nonetheless become law because the Newsom administration may find it strikes a balance between consumer protection and an outright ban at a time when the federal government and individual states are increasing scrutiny of products containing PFAS.

Read More

JD Supra, 06-09-22

https://www.jdsupra.com/legalnews/pfas-disclosure-legislation-moves-to-3547275/

'Really terrible science experiment' leads to weeks-long spill from NC hog-waste lagoon

2022-09-09

The state inspector knew immediately there was trouble at White Oak Farms. When she visited the Wayne County farm on Feb. 3, the N.C. Department of Environmental Quality inspector saw a thick layer of hay laden with charcoal-colored foam in a ditch. That foam seemed to have oozed from under a black tarp covering a hog waste lagoon where manure was combined with unusual ingredients like liquified hog carcasses and discarded hot dogs and deli meat in a slurry to generate methane. The farm's owners, including a former member of the National Pork Board, had not reported a spill. In a notice of violation dated Feb. 18, two weeks after the inspection, David May, a supervisor in DEQ's Washington Regional Office, wrote that the inspector couldn't tell how deep the foam was. But, May wrote, "the inspector stepped in that area sinking at least 4 inches on the edge." White Oak Farms' problems were just beginning. Four months later, on May 30, the black cover ruptured, sending an estimated three

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million gallons of the gelatinous gray foam across the farm and toward nearby Nahunta Swamp. By the time the spill ended weeks later, enough foam had spilled to fill more than four Olympic-sized swimming pools. At least 37,000 gallons had reached wetlands.

Read More

The News & Observer, 09-09-2022

https://www.newsobserver.com/news/state/north-carolina/article264779224.html#storylink=cpy

Why Aren't Federal Agencies Enforcing Pesticide Rules That Protect Farmworkers?

2022-09-07

Ramona Reyes Saucedo was getting containers of a pesticide called Virkon S ready to be sprayed in greenhouses at Mastronardi Farms in Coldwater, Michigan, when she started to get sick. "I had burning sensations in my nostrils, and then I felt like I couldn't breathe well, and then my nose started bleeding," she told Civil Eats over the phone, in Spanish. "I wore a surgical mask and goggles on top of my glasses, but . . . it wasn't enough. I needed a special mask."

Reyes Saucedo, who is originally from Mexico, had tended to Mastronardi's tomato, cucumber, and strawberry plants seasonally for about six years before the company—which sells its produce under the brand Sunset—hired her as a sanitation worker. According to a lawsuit filed on behalf of workers on June 1, a tomato virus hit the greenhouses just as she was starting her new role. (Mastronardi did not respond to multiple requests for comment.)

To fight the pathogen, supervisors began telling workers to apply pesticides more frequently. Virkon S—which is known to cause respiratory irritation and which the U.S. Environmental Protection Agency (EPA) cautions can cause "irreversible eye damage and skin burns"—was one of three identified in the lawsuit. Reyes Saucedo's co-workers were also allegedly exposed to bleach and Virocid, which is harmful if inhaled and can cause severe burns, eye damage, and allergic skin reactions. Reyes Saucedo said one of her co-workers had a rash all over her arms. Many complained of burning eyes and bloody noses.

Read More

Civil Eats, 07-09-22

https://civileats.com/2022/09/07/why-arent-federal-agencies-enforcing-pesticide-rules-that-protect-farmworkers/

EUROPE

Now it will be easier to avoid formaldehyde in cosmetics

2022-08-30

Now many more cosmetic products must be labeled with a warning if they release the allergenic substance formaldehyde. The new change to the cosmetics regulations comes after several years of pressure from Denmark.

From now on, cosmetics must be labeled with a warning if the products contain substances that release formaldehyde above a limit of 0.001 percent. The EU has just adopted this. The limit value will thus be 50 times lower than the current 0.05 percent.

Formaldehyde is banned in cosmetics, but preservatives that release formaldehyde are still allowed to be used. Therefore, Denmark has long worked to have the labeling requirements changed so that it is easier for consumers to avoid cosmetics that contain the allergenic substance.

Read More

The Danish Environmental Protection Agency, 30-08-22

https://mst-dk.translate.goog/service/nyheder/nyhedsarkiv/2022/aug/nu-bliver-det-nemmere-at-undgaa-formaldehyd-i-kosmetik/?_x_tr_sl=auto&_x_tr_tl=en&_x_tr_hl=en&_x_tr_pto=wapp

In future, it will be possible to display the Swan label and the EU Flower in e-invoices

2022-08-30

New digital options make it possible for companies to make visible in e-invoices that their products are certified with the Swan label or the EU Flower. In this way, it will also be easier for municipalities and other public institutions to measure environmentally labeled purchases.

The government's strategy for green public procurement means that suppliers to the public sector will in future experience increasing demands

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for eco-labelled products in public tenders. This means that several purchases must be certified with the official eco-labels Swan and EU Flower or equivalent.

Therefore, it will now be easier for your company to make environmental labels visible digitally. When you send an e-invoice, you can emphasize that your product is certified with the Nordic Swan label or the EU Flower. All public purchasers will thus use the same standardized list for eco-labels, based on a common code list from GS1. The same will apply to private buyers who use e-invoices via Nemhandel.

"The government has set a target that all public purchases in areas where there are official labeling schemes must be eco-labelled or meet similar requirements in 2030, and many municipalities have already set their own targets for eco-labelled purchases. Therefore, it is very good news that it will now be possible to make the Swan label and the EU flower visible in e-invoices, as it will make it easier to follow up on the objectives and ensure development," says Martin Fabiansen, director of Ecolabelling Denmark.

Possible to harmonize trade with public and private customers

The standardization of the ecolabel registration enables the alignment of trade with public and private customers. The transaction between you as a supplier and various buyers can thus become more streamlined.

Data about eco-labels in e-invoices is thus an advantage for both public and private purchasers who use e-invoices via Nemhandel, as it provides the purchasers with useful data to measure whether their organization complies with objectives and requirements for the purchase of eco-labelled products.

Read More

Ecolabel, 30-08-22

https://www-ecolabel-dk.translate.goog/da/aktuelt/nyheder/2022/08/svanemaerket-og-eu-blomsten-i-e-faktura?_x_tr_sl=auto&_x_tr_tl=en&_x_tr_hl=en&_x_tr_pto=wapp

Reminder – upcoming GB active substance open invitation deadlines

2022-09-08

Submit a notification by the deadline to keep active substances in the GB Review Programme

HSE has published an open invitation to provide an opportunity for a person, company or task force/consortium to notify an intention to take up or take over the role of participant in the GB Review Programme for the following active substance/product type combinations.

IMPORTANT: The open invitation list contains active substance/product type combinations that have not yet been supported in GB – product manufacturers are advised to check the list to find out if the active substances used in their products are affected and to raise this with their active substance suppliers.

Anyone wishing to support one of the active substance/product type combinations on the list in GB will need to submit a notification (.docx) to HSE by 12 November 2022.

If a notification to take over the role of participant is not received, these active substance/product type combinations will be subject to a GB non-approval decision. Biocidal products containing active substances with GB non-approval decisions for the relevant product types will have to be removed from the GB market. HSE will provide separate updates on these where relevant.

If you are aware of any disproportionate negative effects that are likely to arise from the non-approval of any of the active substance/product type combinations listed above, please contact us.

Read More

HSE.gov.uk, 08-09-2022

https://www.hse.gov.uk/biocides/open-invitations.pdf

Reminder – upcoming GB active substance renewal submission deadlines

2022-09-08

Apply for active substance renewal by the deadlines to keep products on the GB market

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Under the GB BPR, active substance approvals will expire unless a renewal application is submitted at least 550 days before their expiry date.

The 550-day deadlines are coming up for the following active substance/ product type combinations under GB BPR:

- 3-phenoxybenzyl(1R,3R)-2,2-dimethyl- 3-(2-methylprop-1- enyl) cyclopropanecarboxylate (1R-trans-Phenothrin) CAS 26046-85-5 EC 247-431-2 in product type 18

28 February 2024

- bis(N-cyclohexyl-diazenium-dioxy)-copper (Cu-HDO) CAS 312600-89-8 EC n/a in product type 8

28 February 2024

- Iodine (CAS 7553-56-2 EC 231-442-4) in product types 1, 3, 4 and 22

28 February 2024

- Isopropyl-(2E,4E,7S)-11-methoxy-3,7,11-trimethyl-2,4-dodeca-dienoate (S-methoprene) CAS 65733-16-6 EC n/a in product type 18

28 February 2024

- n-Decanoic acid (Decanoic acid) CAS 334-48-5 EC 206-376-4 in product types 4, 18 and 19

28 February 2024

- n-Octanoic acid (Octanoic acid) CAS 124-07-2 EC 204-677-5 in product types 4 and 18

28 February 2024

- Polyvinylpyrrolidone iodine CAS 25655-41-8 EC n/a in product types 1, 3, 4 and 22

28 February 2024

Any person, company or taskforce/consortium can support an active substance/product type combination for renewal – it doesn't have to be the original supporter.

Check the GB Article 95 List to see who the original supporters were.

If a renewal application is not submitted for the above active substance/ product type combinations under GB BPR, the approvals will expire. This means the active substances can no longer be used in biocidal products of the relevant product types in Great Britain.

Read More

HSE.gov.uk, 08-09-2022

https://www.hse.gov.uk/biocides/uk-article-95-list.htm

INTERNATIONAL

Lagos govt makes case for water regulation

2022-09-07

The Lagos State Government has said water regulation will ensure that residents have access to water, safeguard their health and protect the environment.

The Executive Secretary of the Lagos State Water Regulatory Commission, Mrs Funke Adepoju, disclosed this in a statement on Tuesday, adding that the commission has been invited to represent Nigeria at the seventh International Water Regulators Forum slated to hold in Copenhagen, Denmark, this month.

She said, "The IWRF is the international meeting of the global network of regulators under the auspices of the International Water Association which has the vision to ensure that water is wisely, sustainably and equitably managed.

"For us at LASWARCO, we welcome this invitation and it is a testament to the fact that the world is noticing the regulatory reforms being championed in Lagos State under the leadership of Governor Babajide Sanwo-Olu in line with the THEMES agenda to transform the water regulatory landscape.

Read More

Punch, 07-09-22

https://punchng.com/lagos-govt-makes-case-for-water-regulation/

Assessing the circularity of single-use glass

2022-09-07

In 2020, 80% of glass packaging sold in Europe was collected for recycling (FPF reported). But how do collection programs in different countries affect the amount of glass that gets collected? And how much of that collected material is effectively recycled back into packaging? On

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September 1, 2022, Zero Waste Europe (ZWE) published a report diving into the circularity of single-use container glass in Germany, France, the United Kingdom, and United States to find where glass gets lost, and how the regions can improve at each step of the recycling process.

For each of the countries investigated, ZWE and their research partner Eunomia used four measurements to assess circularity, (i) collection rate, the amount of glass collected versus what is sold within the country; (ii) recycling rate, how much of the collected glass is good for remelting versus glass on the market; (iii) closed-loop recycling rate, percentage that is turned into new glass packaging (the true circular recycling rate); and (iv) recycled content rate, the percentage of container glass produced in the country made of recycled glass.

Germany's container glass recycling system is the most circular, it had the highest scores in all four measurements with 81% of container glass sold in the country collected for recycling, 79% is recycled, nearly all of which is recycled back to container glass, and 65% of glass packaging produced in the country is from recycled sources. France and the UK were roughly similar to one another in all aspects, collecting 70% and 71% respectively, though the UK recycles one-third less back into container glass. The US was noticeably the lowest with only a 44% glass collection rate and 21% closed loop recycling rate.

Read More

Food Packaging Forum, 07-09-2022

https://www.foodpackagingforum.org/news/assessing-the-circularity-of-single-use-glass

Have your say: Nine proposals to identify new substances of very high concern

2022-09-07

The substances and examples of their uses are:

- 4,4'-sulphonyldiphenol (bisphenol S; BPS) (EC 201-250-5, CAS 80-09-1). The substance is used for the manufacture of pulp, paper and paper products, textile, leather or fur, and chemicals.
- Perfluoroheptanoic acid and its salts (EC -, CAS -). The substances are not registered under REACH.
- Melamine (EC 203-615-4, CAS 108-78-1). The substance is used in polymers and resins, coating products, adhesives and sealants, leather treatment products, and laboratory chemicals.
- Isobutyl 4-hydroxybenzoate (EC 224-208-8, CAS 4247-02-3). The substance is used in the manufacture of substances and in coating products, fillers, putties, plasters, modelling clay, and inks and toners.
- Bis(2-ethylhexyl) tetrabromophthalate covering any of the individual isomers and/or combinations thereof (EC -, CAS -). The substance is used as a flame retardant and as a plasticiser for flexible polyvinylchloride and for use in wire and cable insulation, film and sheeting, carpet backing, coated fabrics, wall coverings and adhesives.
- Barium diboron tetraoxide (EC 237-222-4, CAS 13701-59-2). The substance is used in paints and coatings.
- Reaction mass of 2,2,3,3,5,5,6,6-octafluoro-4-(1,1,1,2,3,3,3-heptafluoropropan-2-yl)morpholine and 2,2,3,3,5,5,6,6-octafluoro-4-(heptafluoropropyl)morpholine (FC-770) (EC 473-390-7, CAS -). The substance is used in articles, by professional workers (widespread uses), in formulation or re-packing, at industrial sites and in manufacturing.
- 2,2',6,6'-tetrabromo-4,4'-isopropylidenediphenol (tetrabromobisphenol-A; TBBPA) (EC 201-236-9, CAS 79-94-7). The substance is used as a reactive flame retardant and as an additive flame retardant in the manufacture of polymer resins, in products such as epoxy coated circuit boards, printed circuit boards, paper and textiles.
- 1,1'-[ethane-1,2-diylbisoxy]bis[2,4,6-tribromobenzene] (EC 253-692-3, CAS 37853-59-1). The substance is not registered under REACH.

The deadline for comments is 17 October 2022.

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ECHA, 07-09-2022

https://echa.europa.eu/view-article/-/journal_content/title/9109026-209

Modified recommendations to registrants on how to cover mutagenicity information requirements

2022-09-07

ECHA's Member State Committee (MSC) agreed to modify the approach for investigating chromosomal aberration under REACH dossier evaluation during its June meeting.

The main changes include:

- To fulfil REACH Annex VIII 8.4.2 requirements, an in vitro micronucleus study (OECD Test Guideline 487) is the default test as it allows the mode of action (clastogenicity and/or aneugenicity) to be identified.
- If a concern for chromosomal aberration is identified in vitro, a follow-up study combining an in vivo comet assay (OECD Test Guideline 489) and an in vivo micronucleus test (OECD Test Guideline 474) will be needed in most cases.

Recommendations to registrants have been modified to reflect these changes, which have applied since 1 September 2022.

Exceptions to this general approach may apply. See the recommendations for more detail.

Read More

ECHA, 07-09-2022

https://echa.europa.eu/view-article/-/journal_content/title/9109026-209

Janet's Corner

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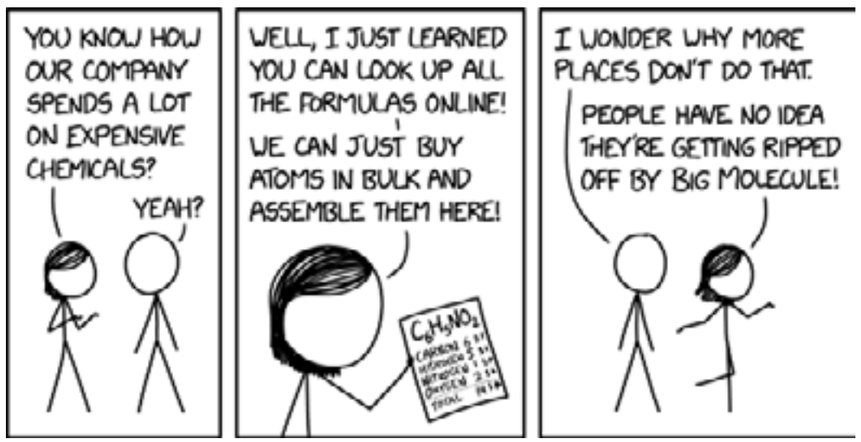
Chemicals

2022-09-16



https://xkcd.com/2648/

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Titanium dioxide

2022-09-16

Titanium dioxide (TiO2) (CAS Number 13463-67-7) is a non-combustible, white, crystalline, solid, odourless powder. It is insoluble in water, hydrochloric acid, nitric acid, and alcohol, and it is soluble in hot concentrated sulphuric acid, hydrogen fluoride, or alkali. TiO2 has several naturally occurring mineral forms, or polymorphs, which have the same chemical formula and different crystalline structure. Common TiO2 polymorphs include rutile (CAS Number 1317-80-322 2) and anatase (CAS Number 1317-70-0). While both rutile and anatase belong to the tetragonal crystal system, rutile has a denser arrangement of atoms. Both anatase and rutile are used as white pigment. Rutile TiO2 is the most commonly used white pigment because of its high refractive index and relatively low absorption of light. Anatase is used for specialised applications (e.g., in paper and fibres). TiO2 does not absorb visible light, but it strongly absorbs ultraviolet (UV) radiation. Commercial rutile TiO2 is prepared with an average particle size of 0.22 µm to 0.25 µm. Pigment-grade TiO2 refers to anatase and rutile pigments with a median particle size that usually ranges from 0.2 µm to 0.3 µm. Particle size is an important determinant of the properties of pigments and other final products. [1]

Titanium dioxide (TiO2) (CAS Number 13463-67-7) is a non-combustible, white, crystalline, solid, odourless powder.

USES [1]

TiO2 is used mainly in paints, varnishes, lacquer, paper, plastic, ceramics, rubber, and printing ink. In addition, it is used in welding rod coatings, floor coverings, catalysts, coated fabrics and textiles, cosmetics, food colorants, glassware, pharmaceuticals, roofing granules, rubber tire manufacturing, and in the production of electronic components and dental impressions. Both the anatase and rutile forms of TiO2 are semiconductors. TiO2 white pigment is widely used due to its high refractive index. Since the 1960s, TiO2 has been coated with other materials (e.g., silica, alumina) for commercial applications.

ROUTES OF EXPOSURE [2]

Exposure to titanium dioxide results from breathing in titanium dioxide dust. Possible exposure to intermediate products in titanium dioxide production may also occur. Exposure may occur at any stage in the mining of ores, in the preparation of titanium dioxide, and in any of the industries in which the powder is stored and used. Whilst the most common route of

exposure is inhalation, ingestion is possible when some dust accumulates on mucosal surfaces of the oropharynx and nasopharynx.

HEALTH EFFECTS

Acute Toxicity [2]

Titanium dioxide is an irritant to the upper airway, as are other nuisance dusts. No evidence indicates that it induces an acute inflammatory reaction at commonly seen exposure concentrations. In workers with pre-existing chronic obstructive airway disease, titanium dioxide may exacerbate symptoms.

Chronic Toxicity [3]

No conclusions can be drawn from the few studies that show respiratory effects in titanium-dioxide exposed workers, because of concurrent exposure to other substances that are well known to cause lung disease. There was no association between titanium dioxide exposure and increased mortality from any cause in a retrospective cohort mortality study of 4241 titanium dioxide workers. A few human population studies or clinical studies involving titanium-dioxide exposed workers have shown effects such as decreased lung function, mild fibrosis, and thickening of the lining of the chest cavity (pleural thickening). However, the workers in these studies were also exposed to other substances including asbestos and/or silica, which are well known to cause lung disease. Therefore, no conclusions can be drawn. In general, long-term exposures to high concentrations of dust may cause increased mucous flow in the nose and respiratory system. This condition usually disappears after exposure stops. Controversy exists as to the role occupational exposure to dust has in the development of chronic bronchitis (inflammation of the air passages into the lungs). Other factors such as smoking and general air pollution are also important, but dust exposure may contribute to this effect. In animal studies, long-term inhalation exposure has caused persistent adverse effects on the lungs (e.g. inflammation, fibrosis, changes to alveolar cells), which are believed to result from dust overloading of the lungs. Effects with ultrafine titanium dioxide occur at much lower exposure concentrations than are required with the larger sized pigment grade particles. The effects are more closely related to lung burden in terms of the surface area rather than the mass of the particles.

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Genetic Effects [2]

No data are available regarding human genetic effects, and very limited epidemiologic data about carcinogenicity are available.

Carcinogenic [3]

The International Agency for Research on Cancer (IARC) has determined that titanium dioxide is possibly carcinogenic to humans (Group 2B) based on inadequate evidence in humans and sufficient evidence in experimental animals. This conclusion relates to long-term inhalation exposure to high concentrations of pigmentary (powdered) or ultrafine titanium dioxide. The available human studies do not suggest an association between occupational exposure to titanium dioxide and risk for cancer.

SAFETY [4]

First Aid Measures

- Eye Contact: Check for and remove any contact lenses. In case of contact, immediately flush eyes with plenty of water for at least 15 minutes. Get medical attention if irritation occurs.
- Skin Contact: Wash with soap and water. Cover the irritated skin with an emollient. Get medical attention if irritation develops.
- Inhalation: If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get 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 Controls & Personal Protective Equipment

Engineering Controls

Use process enclosures, local exhaust ventilation, or other engineering controls to keep airborne levels below recommended exposure limits. If user operations generate dust, fume or mist, use ventilation to keep exposure to airborne contaminants below the exposure limit.

Personal Protective Equipment

- Safety glasses;

- lab coat;
- dust respirator (Be sure to use an approved/certified respirator or equivalent);
- gloves.

Personal Protection in Case of a Large Spill:

- Splash goggles;
- full suit;
- dust respirator;
- boots and
- gloves.
- A self contained breathing apparatus should be used to avoid inhalation of the product.
- Suggested protective clothing might not be sufficient; consult a specialist BEFORE handling this product.

REGULATION [5]

United States

OSHA: The Occupational Safety & Health Administration have established the following Permissible Exposure Limit (PEL) for titanium dioxide:

- General Industry: 15 mg/m^3 TWA
- Maritime: 15 mg/m^3 TWA

ACGIH: The American Conference of Governmental Industrial Hygienists has set a Threshold Limit Value (TLV) for titanium dioxide of: 10 mg/m^3 TWA; Appendix A4 - Not Classifiable as a Human Carcinogen

NIOSH: The National Institute for Occupational Safety and Health has set the following Recommended Exposure Limit (REL): Appendix A - NIOSH Potential Occupational Carcinogens

Australia

Safe Work Australia: Safe Work Australia has established a Time Weighted Average (TWA) concentration for titanium dioxide of 10mg/m^3 for an 8 hour workday.

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Greenland's Melting Glaciers Spew a Complicated Treasure: Sand

2022-09-01

SAND IS BOTH abundant and rare. Earth has vast deserts of the stuff, of course, but not the kind that's in such high demand that sand mafias are killing for it. That special variety is a critical component of the concrete used in buildings and infrastructure, the production of which has skyrocketed exponentially over the last few decades. That has come at a significant climate cost: The industry now accounts for 8 percent of global carbon emissions.

Sand is also at the center of a strange climate story. Climate change is destroying Greenland's ice sheet, producing an extraordinary amount of meltwater. (Even if we somehow totally stopped emissions today, Greenland's melting could still contribute nearly a foot of sea-level rise.) And in a twist of fate, that meltwater is loaded with the right kind of sand for concrete production, which causes more warming and more melting. Great plumes of glacial sediment are swirling along the coast, actually adding land along the edges of the island. Even though Greenland is only three times the size of Texas, its ice sheet is the source of 8 percent of suspended river sediments flowing into the oceans.

The country now has to figure out whether exploiting that valuable, abundant resource on a wider scale would be environmentally, socially, and economically tenable. "It is quite controversial—we're saying Greenland can benefit from climate change," says Mette Bendixen, a geographer at McGill University in Canada, who's studying the idea. "Contrary to most of the other parts of the Arctic coast, Greenland is not eroding. It's in fact growing bigger, because the ice sheet is melting. So you can think of the ice sheet as a tap that pours out not only water, but also all the sediment."

That sediment is special, indeed. Desert sand from, say, the Sahara is no good for making concrete because it's too rounded and uniform. Over millennia, winds push those grains around, polishing them. If you make concrete out of such sand, "it's almost like building with marbles," says Bendixen. "You want particles that are more angular in shape, not rounded. And that type of material is exactly what you get from rivers, for example, or material that has been deposited by glaciers."

As Greenland's ice sheet—which covers 700,000 square miles and is up to 10,000 feet thick—rubs against the land, it grinds up sediment, including

Meltwater from the island's ice sheet is loaded with the right kind of sand for concrete production—which further warms the planet.

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sand, fine silt, and larger chunks of gravel. And as the ice melts, torrents of water carry all that debris to the sea, while the pounding of the rivers themselves further erodes the landscape. Compared to the thousands of years that sand spends rolling around the Sahara and becoming rounded, the particles coming off Greenland are fresher. They're more angular and more diversely shaped. Instead of acting like marbles, they fit together like pieces of a jigsaw puzzle, which is good for concrete.

Greenland already harvests its sand for local, small-scale concrete production, since importing sand would be prohibitively expensive. This is limited to domestic companies, who have to win non-exclusive permits after passing environmental review by the government's scientific advisers. They can also apply to export the sand, but that requires additional licensing. "We are basically also open for sand extraction aiming at export, but then it will be treated like any other mining activity," says Kim Zinck-Jørgensen, of the Greenland government's Mineral Licence and Safety Authority. "And for that you'll have a much greater setup with regulations and also environmental impact assessments, social impact assessments."

Currently, dredging boats suck up sediment along the coast and filter out the sand, which is then brought back onshore. But if Greenland decides to scale up sand extraction for export, that would mean big ships would have to haul the stuff away to international ports. "It's important to stress that if you extract whatever natural resource, there will be environmental consequences," says Bendixen. "But really, here the environmental consequences can be super broad."

For one, those big ships will also be bringing in ballast, or the water they've collected from elsewhere and stored in their hulls for balance. If that ballast is released off the coast of Greenland, it may introduce invasive species. And, of course, dredging coastal sediments would further endanger underwater native creatures—and on land, increased mining operations might scare away the game that Inuit hunters rely on. (Greenland's population is about 90 percent indigenous Inuit. The Greenland branch of the Inuit Circumpolar Council, an NGO representing Inuit peoples, declined to comment for this story.)

Interestingly, though, last month Bendixen and her colleagues published a survey of Greenlanders about their opinions on sand extraction. They found that 84 percent of adult residents are in favor of it, and three-quarters want it to be a national project. "It turns out that the vast majority of Greenlanders think that it should be primarily a Greenlandic enterprise,"

says Rasmus Leander Nielsen, a political scientist at the University of Greenland, who did the survey with Bendixen. "Maybe you could have some smaller-scale, Greenlandic-led companies that could start off. And then eventually, when the business case is more favorable, then we could go into a larger export."

About that business case: While the global demand for sand has gone wild, the economics of exported Greenland sand aren't yet clear. A company would have to pay to run the local operations and foot the shipping costs to get the resource off the island. Those will be considerable, since sand is heavy and takes up a lot of room in a ship.

The Greenland government recently worked with a consultancy that did an assessment, finding that exporting the sand to Europe isn't economically feasible at the moment. "Whether it's feasible to export it further on to the Middle East, I don't know," says Thomas Lauridsen, chief adviser to Greenland's Ministry of Mineral Resources and Justice. "But we will then be in competition with European companies that will dredge sand in Europe or closer to the customer."

Lauridsen adds that it's up to the private sector to determine whether selling Greenland's sand is cost-effective or not. And that export cost calculus may change in the future. "By 2100, the demand for sand is going to rise 300 percent, and the price 400 percent," says Bendixen. "So we don't have to look that much farther into the future to start seeing a different calculation here in terms of whether it's worthwhile."

Yes, a world with more sand harvesting for making more concrete would also mean more carbon emissions, more warming, and more melting of Greenland's ice sheet. But, Bendixen says, all that glacial sand need not go exclusively toward concrete. Coastal communities are increasingly clamoring for sand to hold back rising seas, a fortification known as beach nourishment. "Just think of the irony in using the sand for beach nourishment to mitigate sea-level rise," says Bendixen, "which is caused by—to a large extent—the melting of the Greenland ice sheet!"

Wired, 1 September 2022

https://wired.com

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Dollar store products commonly tested positive for toxic chemicals, analysis says

2022-09-01

Canada needs more transparency and better enforcement to protect Canadians from unlimited exposure to toxic chemicals like lead and cadmium, an analysis from Environmental Defence said Wednesday.

The organization reported on tests conducted on dozens of products purchased at popular Canadian dollar stores. One in four of the products tested were positive for substances managed under the Canadian Environmental Protection Act. Many of the findings were within the allowable limits, but the report says those limits are not strong enough.

The outer ring on a set of stereo headphones was found to have 24 times the legal limit of lead, and five times the legal limit of cadmium.

The solder inside the same headphones had 170 times what is considered safe on outer portions of the headphones. The solder on a separate set of earbud style headphones had 3,000 times the amount of lead allowed on the accessible portions.

1 in 4 products tested were positive for substances managed under environmental legislation

But the solder is not covered by the regulations, a gap Environmental Defence insists must be closed.

Cassie Barker, toxics manager for Environmental Defence, said internal lead can still be exposed if products break or wear down.

"The way that kids use products, and you know they break things and so that internal [lead] quickly becomes external lead," she said.

The toxic harm from lead poisoning has been documented for more than 50 years. It can cause significant cognitive and developmental delays in young children with high exposures and can create risks of high blood pressure and kidney damage in adults. It has been barred from use in gasoline, food cans and paints.

Cadmium, often found in batteries, coatings and plastic stabilizers, is a known carcinogen.

Barker said the headphones, which exceeded the allowed limits of both metals, are proof that monitoring and enforcement of toxic substance regulations need to be beefed up.

"Obviously, retailers shouldn't be shirking their responsibility for having safe products on their shelves," she said, but regulators are leaving "big loopholes" for dollar stores to walk through.

Environmental Protection Act being updated

Other products that raised concerns for Environmental Defence were food cans lined with bisphenol A, commonly known as BPA. The chemical, which helps make plastics harder, was added to the list of toxic substances in Canada in 2010 after studies linked it to prostate disease, breast cancer, infertility and behavioural problems in children. It was banned from baby bottles and other plastic baby products that same year.

But it is still allowed in products such as food cans, said Barker. Some companies have moved away from using the substance on their own, but 60 per cent of the cans the organization tested contained it.

The report calls on Environment Canada to require companies to label all hazardous ingredients in products, including those that are hidden inside electronics or used in the packaging. It also recommends more regulatory enforcement and product testing so that harmful products can be identified before they hit store shelves.

Barker said the tests were done on items from dollar stores because such stores are often the only option for people with low incomes or in marginalized communities.

Environmental Defence provided its report to the companies whose stores it visited, including Dollar Tree and Dollarama. A statement from Dollar Tree said a similar study in the United States two years ago prompted it to remove 17 chemicals from its products.

A statement from Dollarama said, "consumer product safety is our utmost priority, and we have strict processes and controls in place to monitor product safety and quality. The four Dollarama product categories identified in the report (stereo headphone, earbud, pencil pouch and activity tracker) meet applicable Canadian product regulations and are safe to use for their intended purposes."

The Canadian Environmental Protection Act, which governs toxic chemicals in Canada, is in the midst of being updated.

Legislation that would enshrine the right to a healthy environment into law for the first time passed in the Senate in the spring, though the law doesn't define what a "healthy environment" means.

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Environment Minister Steven Guilbeault said in an interview that he is open to additional changes to the bill, which is expected to be debated in the House of Commons this fall.

Guilbeault said he hadn't yet read the Environmental Defence report and couldn't comment on its specific findings.

CBC News, 1 September 2022

https://cbc.ca

New study shows women at higher risk than men from air pollution and diesel fumes

2022-09-05

Diesel exhaust is known to be bad news for lungs, creating inflammation and impacting the body's ability to respond to respiratory infections. New evidence suggests that these effects may be worse for females than for males.

Adds to growing understanding that women are more susceptible to a range of respiratory problems.

A collaboration of researchers from two Canadian universities investigated the effects of breathing diesel exhaust fumes at three different concentrations of fine particulate matter (PM2.5) – 20, 50 and 150 mg per cubic metre – for four hours and compared it to breathing filtered air. The data was collected twice, four weeks apart.

The European Union limit for safe air is 25 mg of PM2.5 per cubic metre – a value often exceeded in city environments.

After each exposure, researchers examined plasma from the ten volunteers – five females and five males – looking for changes in levels of specific proteins within the plasma.

Researchers found variations in the levels of no less than 90 proteins, many of which are already known to play a role in inflammation, damage repair, blood clotting, cardiovascular disease and the immune system. Some of the level variations between females and males became more obvious with higher concentrations of the diesel exhaust.

"We already know that there are sex differences in lung diseases such as asthma and respiratory infections," said Dr Hemshekhar Mahadevappa from the University of Manitoba in Canada. "Our previous research showed that breathing diesel exhaust creates inflammation in the lungs and has an impact on how the body deals with respiratory infections."

This study has shown that diesel exhaust exposure – and air pollution by corollary – could have the potential to be much more dangerous for females than it is for males.

"This is important as respiratory diseases such as asthma are known to effect females and males differently, with females more likely to suffer severe asthma that does not respond to treatments," said Professor Neeloffer Mookherjee, one of the study's lead researchers who will be presenting the findings at the European Respiratory Society International Congress 2022. "Therefore, we need to know a lot more about how females and males respond to air pollution and what this means for preventing, diagnosing and treating their respiratory disease."

The research group intend to continue investigating the role these proteins play in the female and male responses to air pollution, including trying to unpack the reasons behind the variation in levels between male and female test subjects.

Understanding the effects air pollution has on health may help governments better legislate and enforce limits in the future – increasing the well-being of everyone.

Cosmos, 5 September 2022

https://cosmosmagazine.com

"Brand New Paradigm" – Scientists Discover How Human Eggs Remain Healthy for Decades

2022-09-05

According to research from the Center for Genomic Regulation (CRG) published in the journal Nature, immature human egg cells bypass a critical metabolic process believed to be necessary for producing energy.

The cells modify their metabolism to stop producing reactive oxygen species, dangerous molecules that can accumulate, damage DNA, and cause cell death. The research explains how human egg cells may lay dormant in ovaries for up to 50 years without losing their ability to reproduce.

"Humans are born with all the supply of egg cells they have in life. As humans are also the longest-lived terrestrial mammal, egg cells have to maintain pristine conditions while avoiding decades of wear-and-tear. We show this problem is solved by skipping a fundamental metabolic reaction that is also the main source of damage to the cell. As a long-term

The mystery of how oocytes may become dormant without losing their ability to reproduce has been solved by research-ers at the CRG.

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maintenance strategy, it's like putting batteries on standby mode. This represents a brand new paradigm never before seen in animal cells," says Dr. Aida Rodriguez, a postdoctoral researcher at the CRG and the first author of the study.

Human eggs are first formed in the ovaries during fetal development, undergoing different stages of maturation. During the early stages of this process, immature egg cells known as oocytes go into cellular arrest and stay dormant in the ovaries for up to 50 years. Oocytes, like all other eukaryotic cells, have mitochondria, or cell batteries, which they employ to produce energy for their needs during this period of dormancy.

Using a mixture of live imaging, proteomic, and biochemistry techniques, the researchers discovered that mitochondria in both human and Xenopus oocytes use alternative metabolic pathways to create energy not previously observed in other animal cell types.

A complex protein and enzyme known as complex I is the usual 'gatekeeper' that initiates the reactions required to generate energy in mitochondria. This protein is fundamental, working in the cells that constitute living organisms ranging from yeast to blue whales. However, the researchers found that complex I is virtually absent in oocytes. The only other type of cell known to survive with depleted complex I levels are all the cells that make up the parasitic plant mistletoe.

According to the authors of the study, the research explains why some women with mitochondrial conditions linked to complex I, such as Leber's Hereditary Optic Neuropathy, do not experience reduced fertility compared to women with conditions affecting other mitochondrial respiratory complexes.

The findings could also lead to new strategies that help preserve the ovarian reserves of patients undergoing cancer treatment. "Complex I inhibitors have previously been proposed as a cancer treatment. If these inhibitors show promise in future studies, they could potentially target cancerous cells while sparing oocytes," explains Dr. Elvan Böke, senior author of the study and Group Leader in the Cell & Developmental Biology program at the CRG.

Oocytes are vastly different from other types of cells because they have to balance longevity with function. The researchers plan to continue this line of research and uncover the energy source oocytes use during their long dormancy in the absence of complex I, with one of the aims being to understand the effect of nutrition on female fertility.

"One in four cases of female infertility is unexplained – pointing to a huge gap of knowledge in our understanding of female reproduction. Our ambition is to discover the strategies (such as the lack of complex I) oocytes employ to stay healthy for many years in order to find out why these strategies eventually fail with advanced age" concludes Dr. Böke.

Sci Tech Daily, 5 September 2022

https://scitechdaily.com

Anti-insulin protein helps queen ants live five times longer than workers

2022-09-04

A fascinating new study has discovered an insulin-suppressing protein that can help extend the lifespan of some ants. The research revealed that in a certain species of ant this anti-aging pathway is activated when workers transition to the position of queen and helps the insects live five times longer.

The new research focused on a particular species of ant called Harpegnathos saltator. Also known as the Indian Jumping Ant, these insects exhibit a relatively unusual behavior. When the queen of a colony dies, the female worker ants battle to take the throne.

And when the winner emerges to become the new queen she undergoes a transition allowing her to start laying eggs. Most curiously, however, alongside this reproductive transition is a dramatic 500% increase in lifespan.

Harpegnathos queens tend to live for between four and five years, while workers barely last longer than seven months. So a team of researchers set out to uncover exactly what changes occur in the ants to trigger such a dramatic lifespan extension.

"By undergoing reversible 'caste switching' from workers to pseudoqueens that results in a dramatic increase in both their lifespan and ability to reproduce, Harpegnathos ants provide a unique opportunity to study how aging and reproduction can be disconnected," said Claude Desplan, co-senior author on the study.

Focusing on the differences in gene expression between the workers and the queen, the researchers quickly discovered the key change that seemed to be occurring was across the insect's insulin pathways. This finding was expected, as insulin signaling is known to be crucial to egg production.

When the queen dies, the female Harpegnathos saltator worker ants battle for the throne, with the winner taking over the reproductive role for the colony and living five times longer than the others.

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So, of course the queen's reproductive pathways are switched on by triggering these insulin processes. But it was a mystery how this mechanism could so dramatically increase the ant's lifespan.

Here the researchers discovered that when the ant's ovary production kicks into gear another protein is expressed. Called Imp-L2, the molecule is described as a kind of "anti-insulin" protein. This protein blocks insulin signaling in different pathway found in fat cells and it's this mechanism that is thought to trigger the incredible lifespan-extending feature of the queen.

"The two main branches of the insulin signaling pathway appear to differentially regulate fertility and lifespan, with increased signaling in one aiding reproduction in pseudoqueens and decreased signaling in the other consistent with their extended longevity," said co-senior author Danny Reinberg.

One of the stranger features of this newly discovered mechanism is its reversibility. These ants can switch from worker to queen and back again, but when they revert back from queen to worker they lose their life-extending benefits, returning to the short seven-month worker lifespan.

While the study is inarguably an intriguing look at a weird life-extending mechanism in a specific type of ant, you are probably asking whether this particular pathway is present in any other organisms. And the answer according to Desplan is, maybe …

The researchers note there are prior studies suggesting Imp-L2 pathways can be found in fruit flies but it's unclear whether the mechanism has the same life-extending effect. The next step for Desplan and colleagues will be to investigate whether this mechanism can be detected in other invertebrates, and then, maybe, whether a similar pathway can be found in mammals.

The new research was published in Science.

New Atlas, 4 September 2022

https://newatlas.com

Humans Generate an 'Oxidation Field', And It Changes The Air Chemistry Around Us

2022-09-07

There are all kinds of pollutants in the air around us. Outdoors, these can be washed away through the falling rain, and the oxidation that happens after ultraviolet light from the Sun interacts with ozone and water vapor.

So, what happens indoors?

As a new study shows, there's also some oxidation going on indoors too: the chemical cleaning that occurs via these hydroxyl (OH) radicals – short-lived reactive species whose job is to oxidize other molecules – happens through a combination of ozone leaking in from the outside, and from the oxidation fields that we create around ourselves.

In some scenarios, levels of OH radicals indoors are comparable to daytime outdoor levels, scientists have found. In other words, we're walking, breathing, chemical reaction machines, which has implications for indoor air quality and human health.

"The discovery that we humans are not only a source of reactive chemicals, but we are also able to transform these chemicals ourselves was very surprising to us," says atmospheric chemist Nora Zannoni from the Institute of Atmospheric Sciences and Climate in Italy.

The team carried out experiments with three separate groups of four people in a special climate-controlled chamber, with levels of ozone that matched the upper end of what you might typically find indoors. Records were made of OH values both with and without ozone present, and before and after humans entered the room.

Through a combination of computational fluid dynamics modeling and actual air measurements (in part involving mass spectrometry techniques), it became clear that OH radicals were present, abundant – and forming around the human beings.

The scientists found that our personal oxidation fields are generated as ozone reacts to the oils and fats on our skin – particularly on the unsaturated triterpene squalene compound that makes up about 10 percent of the lipids that protect the skin and keep it supple.

"The strength and shape of the oxidation field is determined by how much ozone is present, where it infiltrates, and how the ventilation of the indoor space is configured," says Zannoni.

"The discovery that we humans are not only a source of reactive chemicals, but we are also able to transform these chemicals ourselves was very surprising to us."

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It's thought that we spend around 90 percent of our time indoors, and these findings have important implications for making sure that time is spent breathing air that's as clean and as healthy for us as possible – something we're all now acutely aware of, thanks to the pandemic.

While we always knew that oxidation processes were happening indoors, it seems that in some conditions, the reactions generated by humans are the dominant ones.

It's important to understand these processes, both in isolation and in relation to other indoor chemicals that might arise from building materials, furnishings, and scented products, because reactions could produce respiratory irritants as well as removing pollutants.

There's still a lot more work to do, as well: the scientists are keen to understand how humidity levels affect the reactions, for example, and how more and more people inside a room might change the picture.

Further, there is a possibility that the oxidation fields humans produce might even affect our perception of odor.

"We need to rethink indoor chemistry in occupied spaces because the oxidation field we create will transform many of the chemicals in our immediate vicinity," says atmospheric chemist Jonathan Williams, from the Max Planck Institute for Chemistry in Germany.

The research has been published in Science.

Science Alert, 7 September 2022

https://sciencealert.com

Generating hydrogen fuel from the very air we breathe

2022-09-07

Researchers have created an electrolyser that can draw on the water in the air and turn it into hydrogen fuel and oxygen.

Green hydrogen, made from water electrolysis, has great potential to store and transport renewable energy. But the process to make it requires water, and many of the places with the highest potential for solar energy are very dry.

"In Australia, we have abundant solar energy in the central desert areas, but there's no water at all – no groundwater, no fresh water. The only water we have is the water from the air," says Dr Gang Kevin Li, a senior lecturer in

the Department of Chemical Engineering at the University of Melbourne, and senior author on a paper describing the electrolyser, published in Nature Communications.

"Air is everywhere, and air contains a lot of a lot of water – 12.9 trillion tonnes at any moment."

The device, called the Direct Air Electrolysis (DAE) module, is made from a porous, sponge-like substance with electrodes at either end. The sponge is "hygroscopic": it absorbs moisture from the ambient air.

Li compares the substance to the silica gel you often see in little packets, designed to absorb moisture.

"It's like that, but the material we use is actually much stronger in hygroscopic properties."

Why isn't this material already in use for drinking water in deserts? It doesn't render the water very tasty – a key ingredient is sulphuric acid, for instance.

"The water is readily available for electrolysis, but not drinkable," says Li.

The material also contains an electrolyte meaning the H2O collected can be turned into H2 and O2, bubbling out at either electrode.

"It's actually a completely new concept, because previous electrolysers for hydrogen production from water have needed to be a closed system," says Li.

"Our system is different: we have a semi-open electrolyser, so we only have the top and bottom electrode closed, but the four sides of that electrolyser are open to the air.

"It means the moisture from the air can transfer into the hygroscopic electrolyte automatically, or spontaneously, without consuming energy. So we don't need extra energy to extract this water."

When connected to a power supply, the researchers were able to run the DAE for 12 days without a drop in performance.

They could also run it in extremely dry conditions.

"We can work it down all the way down as low as 4% relative humidity – much lower than an average desert humidity," says Li.

The device could be useful in deserts… or on Mars.

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(The Sahel Desert's in north Africa average relative humidity is around 20%, and Uluru records an average of about 21%.)

Their modelling showed that on a warm, sunny day, the A5-sized prototype could generate 3,700 litres of hydrogen, per day, per square metre of their tower.

The researchers have received funding to continue developing their prototype.

"We're going to scale up to one meter squared by the end of this year, and then 10 square metres by the end of next year," says Li.

But he wonders if the device could one day end up in space: after all, it can produce both hydrogen and oxygen.

"There is a small, tiny amount of water in the atmosphere of Mars," he says. "I imagine that if this device could be stored on extra-terrestrial planets […] it could become a fuel generator and produce oxygen continuously."

Cosmos, 7 September 2022

https://cosmosmagazine.com

A window to the brain: the retina gives away signs of Alzheimer's disease and could help with early detection

2022-09-06

The retina has long been poeticised as the window to the soul, but research now shows it could be a window to the brain and act as an early warning system for cognitive decline.

A growing body of research suggests the retina is thinner in people with Alzheimer's disease, reflecting the cell loss that is a hallmark of the neurodegenerative disease.

We investigated a group of middle-aged people who are part of the Dunedin Study, a comprehensive longitudinal project that has continued for five decades. We found people with thinner retinal nerve fibre layers (one of the cell layers in the retina) had slower mental processing speed. This is one of the first cognitive processes to decline in Alzheimer's disease.

The people in our study were 45 years old, which is young for investigating age-related neurological diseases like Alzheimer's. But treatments and interventions are most effective when administered during the earliest

A growing body of research suggests the retina is thinner in people with Alzheimer's disease, reflecting the cell loss that is a hallmark of the neurodegenerative disease.

stages of Alzheimer's and it is crucial to find ways of identifying people's risk as early as possible. Easy risk identification will also help with clinical trials for Alzheimer's disease treatments.

Why the retina is a good biomarker for the brain

The retina (the back of your eye) is part of the central nervous system, and some of its cells connect directly to the brain.

Many of the processes that happen in the brain also occur in retinal ganglion cells, another layer of cells that make up the retina. This includes some of the abnormal processes common in Alzheimer's disease, such as the abnormal deposition of amyloid beta protein and cell loss.

Retinal imaging has many advantages over other imaging technologies. It's fast, with each scan taking only a few seconds, non-invasive, painless and relatively cheap.

It's also already widely available. In Aotearoa, every hospital eye department has an optical coherence tomography (OCT) device for imaging the retina, and these devices are increasingly available in primary care clinics and retail optometrists.

Retinal imaging also lends itself to being interpreted by artificial intelligence applications. This means assessment of Alzheimer's disease risk from the retina could be quick, easy and widely available.

For these reasons, researchers are beginning to investigate how early the retina starts to thin in Alzheimer's disease. The disease has an insidious onset, with a gradual decline in cognitive processes such as memory, but the underlying pathology tends to be fairly far along by the time people notice the symptoms and seek medical treatment.

If we can detect retinal thinning before the symptoms become apparent, it could be possible to identify people who are in the earliest stages of Alzheimer's disease.

Retinal thinning and cognitive decline in middle age

The people we studied are all part of the unique Dunedin Study, which tracked the development of a thousand babies born in Ōtepoti Dunedin between April 1972 and March 1973.

They've been assessed repeatedly every few years since, on a wide range of topics including mental health, risk-taking behaviours, respiratory and cardiovascular function, social support and dental health, among others.

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They've also repeatedly undergone cognitive tests since they were children, each time using similar formats and standardised tests. This means we can compare their cognitive performance in middle age with their own results from childhood.

Most cognitive tests used in Alzheimer's studies are blunt tools designed to detect large drops in cognition. But the detailed cognitive data we have allow us to detect even small cognitive changes.

Using statistical techniques, we used each person's cognitive scores in childhood to predict what we'd expect their cognitive score to be at age 45, and measured how far away they were from what we'd predicted.

A number of study members' scores were substantially lower than what we'd expect, indicating they were experiencing cognitive decline, even in middle age.

Why this matters

While there are a number of potential causes of cognitive decline, papers from our research group are building up a picture of the factors associated with this outcome. We found people experiencing cognitive decline by 45 have older looking brains and more tiny bleeds and lesions, known as hyperintensities, in their white matter (measured using MRI).

Our research found people with thinner retinas had older looking brains and other structural brain abnormalities. This suggests cognitive decline, detected in its earliest stages, is associated with cell loss in the brain and the retina.

To investigate this question even further, we are now focusing on measuring study members' levels of a specific type of protein (phosphorylated tau pTau181) which is abundant in neurons and deposited in cells in several neurodegenerative diseases. This is thought to be one of the earliest indicators of Alzheimer's disease, and it will help us to understand whether the changes we are observing are specific to Alzheimer's disease and how early they can be detected.

Developing treatments for advanced stages of Alzheimer's disease has been ineffective so far, and it seems likely future pharmaceutical treatments will be most effective in the earliest stages of the disease.

Also, lifestyle-based interventions may help to mitigate symptomatic cognitive decline. This makes early identification of people who would benefit from these interventions extremely important.

The Conversation, 6 September 2022

https://theconversation.com

More Effective Cancer Immunotherapy: Stanford's New Method To Find Antigens That Trigger Specific Immune Cells

2022-09-05

A cell's secrets can be revealed by its surface. It is decorated with tens to hundreds of thousands of molecules that help immune cells determine friend from foe. Some of those protruding molecules are antigens that trigger the immune system to attack. However, it can be difficult for scientists to identify those antigens, which often vary across individuals, in the molecular forest.

A team of Stanford scientists has developed a new method to faster and more accurately predict which antigens will lead to a strong immune response. Their approach could help researchers develop more effective cancer immunotherapies. The study was led by Polly Fordyce, an Institute Scholar at Sarafan ChEM-H, and will be reported today (September 5, 2022) in the journal Nature Methods.

T cells, a class of immune cells, crawl along and squish past other cells as they patrol the body. They use T cell receptors to molecularly read peptides, or short pieces of proteins – which are cradled within larger proteins called major histocompatibility complexes (pMHCs) that project from cell surfaces. Healthy host cells display an array of pMHCs that do not trigger an immune response. However, once T cells recognize disease-indicating peptides, they become activated to find and kill cells bearing these foreign signatures. Understanding how T cells sensitively differentiate these antigenic peptides from host peptides to avoid mistakenly killing host cells has long been a mystery.

"A T cell can detect a single antigenic peptide amongst a sea of 10,000 or 100,000 non-antigenic peptides being displayed on cell surfaces," said Fordyce, assistant professor of bioengineering and of genetics.

The key to selectivity is in the T cell crawl. T cells' sliding puts stress on the bonds between receptors and peptides, and most of the time, that extra

"A T cell can detect a single antigenic peptide amongst a sea of 10,000 or 100,000 non-antigenic peptides being displayed on cell surfaces."

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stress is enough to break that bond. But sometimes, it has the opposite effect. Chris Garcia, co-author of the study and professor of molecular and cellular physiology and of structural biology, and others had previously shown that the most antigenic peptides are those whose interactions with T cell receptors grow stronger in response to sliding.

"It's kind of like a Chinese finger trap," said Fordyce. "When you pull a bit at the receptor-antigen interaction, the binding actually lasts longer."

Cellular mimicry

Identifying the best antigen-receptor pairs requires simultaneously applying that sliding, or shear, force between a peptide and a T cell and measuring T cell activation. Ideally, this would be done thousands of times to get repeatable data for many possible peptide/T cell receptor pairs. However, existing methods are time-intensive and can result in measuring only one peptide with hundreds of T cells in a day.

Postdoctoral scholar Yinnian Feng, the study's first author, developed a trick that allows the team to measure 20 unique peptides interacting with thousands of T cells in less than five hours.

To make a simplified system that mimics cells with dangling peptides, they constructed small spherical beads from a material that expands upon heating and attached a few molecules of a given peptide-studded pMHC to their surfaces. After depositing a T cell atop each bead and waiting long enough for receptors to bind to the peptides, they then very slightly heated the bead. The bead's expansion increases the distance between tether points, and the corresponding stretching of the T cell mimics the force it would experience sliding along cells in the body. After exerting that force, the team then measured how active the T cells were.

They could do hundreds of individual experiments in parallel by using beads that are each labeled with a unique color, making it possible to track multiple different pMHCs. They took two sets of pictures tiling across each slide after each run: one set that tells them which pMHC a given bead is displaying and another that tells them how active each T cell atop that bead is. Cross-referencing those images tells them which antigens led to the strongest T cell responses.

In this demonstration of their platform, the research team showed, with 21 unique peptides, that their results confirmed known activating and non-activating peptides for one T cell receptor and uncovered a previously unknown antigen that induced a strong T cell response. Working with

the Garcia lab, they have also already begun to address a challenge in immunotherapy: the T cell receptors that form the highest affinity interactions with antigens in the lab are often also activated by non-antigenic peptides in the body. This is a dangerous side effect that leads to the killing of healthy cells.

Using their technology, the team of researchers characterized T cell receptors engineered to specifically recognize tumor antigens without off-target reactivity. In future work, they plan to build libraries of over 1,000 peptides to uncover novel antigens.

The scientists hope that this approach, which is quick and requires few cells, or an optimized form of it could one day be used to improve personalized immunotherapies.

"This platform can help improve efforts to engineer T cells that specifically target cancer cells, as well as determine which antigens are capable of potently activating a patient's own T cells to more effectively target cancer cells," said Fordyce.

Sci Tech Daily, 5 September 2022

https://scitechdaily.com

It's Time to Make Cities More Rural

2022-09-08

JENNIFER BOUSSELOT HAS had one hell of a summer harvest. On a 576-square-foot plot of land, she's pulled up over 200 pounds of produce—cucumbers, peppers, tomatoes, and basil, among other goodies—and the growing season isn't anywhere close to done. Despite that resounding success, Bousselot is no farmer; she's a horticulturist at Colorado State University, and that plot of land is actually up in the sky. The garden, atop a building near the Denver Coliseum, was purpose-built for Bousselot's brand of research in an up-and-coming scientific field: rooftop farming.

As more people pour into metropolises—urban populations are projected to double in the next three decades, according to the World Bank—scientists like Bousselot are investigating how designers and planners can ruralize cities, greening roofs, and empty lots. The concept is known as "rurbanization," and it could have all kinds of knock-on benefits for ballooning populations, from beautifying blocks to producing food more locally. It dispenses with the "city versus country" binary and instead blends the two in deliberate, meaningful ways. "You don't have to set this

Enough with the urban vs. rural binary. When rurbanization brings agriculture into cities, everyone benefits.

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up as a dichotomy between urban and rural, really," says Bousselot. "What we should probably focus on is resilience overall."

"The rurbanization idea is: OK, if we mix this up a bit, maybe we can create benefits on both sides," adds Jessica Davies, principal investigator of Lancaster University's Rurban Revolution project, a scientific investigation of the concept. "So if we bring some of what we grow nearer to where we live, can we enhance our connection with food? Can we make food more accessible? Can we improve local ecosystems?"

Recent research has begun to provide data on how well urban agriculture actually works if you're planning to, you know, eat. A review paper published last month by researchers working on the Rurban Revolution project surveyed previous studies and determined that on average, urban agricultural yields (including both outdoor and indoor growing operations) were on par or higher than those of typical farms. But certain crops, like lettuces, tubers, and cucumbers, had yields up to four times higher when grown in cities. A separate team of scientists in Australia looked at 13 urban community farms for a year and found their yields to be twice that of typical commercial vegetable farms.

The caveat, though, is that this productivity comes in part from intensive human labor. On a commercial farm, crops are usually grown one at a time and tended with specialized equipment—you can't plant wheat and carrots in the same field because they're harvested in totally different ways. Crops also have to be spaced out to make room for where the equipment drives, reducing the amount of land that's actually producing food.

An urban farm, by contrast, can grow all kinds of crops packed closely together because they're harvested by hand. That's part of the reason why Bousselot's tiny rooftop garden in Denver is so productive. That crop diversity also means you can harvest different plants at different times—tomatoes in August, pumpkins in October—so the supply of food is more broadly distributed. Even though Bousselot has already harvested over 200 pounds of food, she still has two months left to go.

That requires human labor instead of a machine. So while urban farming can have a higher yield than traditional agriculture, it's not necessarily as efficient. "But that inefficiency could easily change," says Robert McDougall, an agricultural scientist at the independent research company Cesar Australia, who led the Australia study. "The people I studied were people who carried out urban farming mostly for recreational purposes,

and so weren't really interested in working as efficiently as possible. And they weren't necessarily using the most efficient sources of materials."

Take water, for example. Cities are currently designed to be impervious to rain, quickly draining it off streets to keep roads and buildings from flooding. But some urban areas are now transitioning into "sponge cities," designed to safely soak up rain and store it for later use. In Los Angeles, for instance, officials are experimenting with roadside green spaces, where water seeps underground and into storage tanks. Rurbanized cities of the future could tap into that water source to grow food, and the gardens themselves could act like sponges, collecting rainwater to prevent local flooding.

Better municipal composting programs could also provide urban farmers with mulch so they don't have to rely on synthetic fertilizers, which are terrible for the environment. "Were the gardeners I studied more tapped into these various sources of materials that were available within the environment around them," says McDougall, "they could have easily carried out their farming in a much more sustainable fashion."

Urban farms attract a host of pollinators like bees, McDougall has found. These insects, along with other pollinators like birds, could help boost biodiversity.

Cities also need all the green spaces they can get to counter the "urban heat island effect," or the tendency for the built environment to absorb more of the sun's energy than parks and forests do. Temperatures in urban areas can be 20 degrees Fahrenheit hotter than surrounding rural ones, where the plentiful vegetation releases water vapor—cooling the area as the plants essentially sweat. Bringing more plant life into cities will help cool things off and save lives during extreme heat events.

Urban agriculture can help insulate individual cities against food shocks, like if a particular mass-produced crop fails—which is increasingly likely as climate change spawns longer, more intense droughts. "You depend less on globalized supply chains," says environmental scientist Florian Payen, who authored that review paper on yields. (He's now at Scotland's Rural College, but did the research while at Lancaster University.) "And so you are maybe less vulnerable to all of the different things like we've seen with Covid, or with climate change, that can impact the supply chain."

Urban agriculture should also, in theory, reduce some of the emissions associated with conventional farming, which uses carbon-spewing

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machinery and requires shipping food vast distances to customers. But there isn't much data to back that up yet, Payen says.

"The evidence so far is not really conclusive as to whether producing in urban areas for urban dwellers actually is associated with a lower carbon footprint than rural production," says Payen. "And that is really based on the fact that there are lots of different ways of producing the food, and lots of different modes of transportation." Wheat production, for example, is highly mechanized and relies on massive harvesting vehicles. And different crops travel different distances to get to market.

Those calculations focus primarily on the emissions from heavy machinery and long-distance trucking and shipping. But Elizabeth Sawin, founder and director of the Multisolving Institute, which promotes interventions that fix multiple problems at once, sees adding farms as a way to subtract a different source of emissions: cars. "Don't underestimate how much of the square footage of our cities is devoted to the automobile, like highways or parking," she says. "As we open up more space for living with things like public transportation and dense housing, that could become space for growing food." Obliterating asphalt and planting seeds would transform cities from car-centric to people-centric systems.

In Denver, Bousselot is experimenting with solar panels to not only increase food security, but energy security as well. The idea, known as agrivoltaics, is to grow crops under rooftop solar panels that generate free, abundant energy for the building beneath them. The green roof also acts like insulation for the structure, reducing its cooling needs, while the partial shade the panels provide for the plants can significantly boost yields. (Too much sun is bad for certain crops. For example, other researchers have found that peppers produce three times as much fruit under solar panels than in full sun.) It's also warmer up on a roof, and Bousselot has seen tomatoes grow faster, reaching harvest sooner.

Her Denver rooftop also seems to protect its crops from pathogenic fungi. "Up on the green roof, because of the high-wind, high-solar-radiation conditions, we have very, very little issue with that," says Bousselot. "So I think there's a ton of potential for selecting crops that would produce even higher, potentially, on a rooftop compared to the same place on the ground."

But while rurbanization has enticing benefits, it has some inherent challenges, namely the cost of building farms in cities—whether on rooftops or at ground level. Urban real estate is much more expensive than rural land, so community gardeners are up against investors trying to turn

empty spaces into money—and even against affordable developments aimed at alleviating the severe housing crises in many cities. And while rooftop real estate is less competitive, you can't just slap a bunch of crops on a roof—those projects require engineering to account for the extra weight and moisture of the soil.

But the beauty of rurbanization is that agriculture and buildings don't have to compete for space. Urban land is limited, which means that high-yielding, fast-growing, space-efficient crops work great, says Anastasia Cole Plakias, cofounder and chief impact officer of Brooklyn Grange, which operates the world's largest rooftop soil farms. "That said, we approach the design of our own urban farms, as well as those we build for clients, with the consideration of the unique character of the community in which we're building it," says Plakias. "Urban farms should nourish urban communities, and the properties valued by one community might vary from another even in the same city."

A hand-tended garden on a side lot doesn't need a tremendous amount of space to make a tremendous amount of food. New developments could incorporate solar roofs from the start—they would have more upfront costs but produce free energy and food to sell in the long run.

No one is suggesting that urban agriculture will provide city-dwellers with 100 percent of the food they need to survive. Bousselot imagines it more as a collaboration, with commercial farmers churning out land-intensive and machine-harvested cereals like rice and wheat while urban gardeners grow nutrient-dense, hand-harvested vegetables like leafy greens—both creating jobs and reducing the length of the supply chain for perishable foods.

It would also provide something less quantifiable than crop yields: a renewed sense of community, says Sawin. "That's a source of local connectivity that will ripple beyond just the food that's produced," she says. "People then have social networks for everything from sharing childcare to sharing resources to helping one another through, possibly, shocks and destabilization."

Wired, 8 September 2022

https://wired/com

Why Is COVID Worse for Some People Than Others?

2022-09-02

Many people are currently catching COVID-19. Luckily, the majority of them are experiencing only mild symptoms. However, for some people, the disease takes a much more severe cause and our understanding of the underlying reasons is still insufficient. The human genome may hold a key to why COVID-19 is more serious for some individuals than others.

A team of researchers from the Berlin Institute of Health at Charité (BIH) together with colleagues from the United Kingdom and Canada have found genes and proteins that contribute to a higher risk of severe COVID-19. Their findings were recently published in Nature Communications.

Doctors and scientists around the world are still confused as to why some people become severely ill when infected with SARS-CoV-2 (the virus that causes the COVID-19 disease), while others experience only mild symptoms. A team of scientists at the BIH's Digital Health Center has identified genes that – in addition to known risk factors such as age and sex – predispose people to experience a more serious infection.

"It has been observed relatively early on that susceptibility to infection depends on a person's blood group, for example, which is inherited," explains Maik Pietzner, the study's lead author. "So it was clear that the course of the disease is at least in part determined by genetics."

"Scientists at the BIH were given access to genetic data that researchers had collected from COVID-19 patients worldwide, which also included disease severity. At the time, there were some 17 genomic regions observed to be associated with a higher risk of severe COVID-19," Pietzner explains, "but the causal genes and underlying mechanism remained unknown for many."

Previously, the Computational Medicine Group at BIH had developed a 'proteogenomic' approach to link protein-encoding regions of DNA to diseases via the protein product. In this new study, they applied this method to COVID-19 and came across eight particularly interesting proteins. "One of these was a protein responsible for an individual's blood group," Claudia Langenberg, head of the Computational Medicine Group, explains.

"We were aware that this gene was associated with the risk of infection, so it was like a proof of concept. The protein ELF5, meanwhile, seemed like it

"It has been observed relatively early on that susceptibility to infection depends on a person's blood group, for example, which is inherited."

could be much more relevant. We found that COVID-19 patients carrying a variant in the gene that encodes ELF5 were more much more likely to be hospitalized and ventilated, in some cases even died – so we took a closer look."

The team turned to their colleagues from the Intelligent Imaging Group, led by Christian Conrad, due to their expertise in single-cell analyses. Lorenz Chua, a doctoral student in the group was immediately enthusiastic to figure out which cells displayed a particular abundance of the ELF5 protein: "We found that ELF5 is present in all surface cells of the skin and mucous membranes, but is produced in particularly large quantities in the lungs. Since this is where the virus causes most of its damage, this seemed very plausible."

But Conrad puts a damper on any hopes that the researchers may have identified a new target molecule for drug development: "ELF5 is what is known as a transcription factor, and controls how frequently or infrequently other genes are switched on and off throughout the body," he explains. "Unfortunately, it is difficult to imagine interfering with this protein in any way, as that would undoubtedly cause many undesirable side effects."

Among the eight suspects, however, the scientists discovered another intriguing candidate: the protein G-CSF, which acts as a growth factor for blood cells. They discovered that COVID-19 patients who make genetically more G-CSF had a milder disease course. Synthetic G-CSF has long been available as a drug, therefore it is possible for it to be used as a treatment for COVID-19.

Translation of such genetic discoveries into clinical application is not an easy or quick process. The work – only possible through the support of many scientists and clinicians of the BIH and Charité, and open access results from studies around the world – highlights how open science and an international team effort can step by step uncover how the smallest changes in our genetic make-up alter the course of a disease, COVID-19 in this example.

"We started with global data from 100,000 participants and ended up looking at single molecules in individual cells. We believe that collaborations that allow us to rapidly move from the bigger picture and studying large populations to in-depth molecular follow-up can help to

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better understand the clinical consequences of this virus and teach us important lessons for future pandemics," Pietzner concludes.

Sci Tech Daily, 2 September 2022

https://scitechdaily.com

Axolotls can regenerate their brains, revealing secrets of brain evolution and regeneration

2022-09-02

The axolotl (Ambystoma mexicanum) is an aquatic salamander renowned for its ability to regenerate its spinal cord, heart and limbs. These amphibians also readily make new neurons throughout their lives. In 1964, researchers observed that adult axolotls could regenerate parts of their brains, even if a large section was completely removed. But one study found that axolotl brain regeneration has a limited ability to rebuild original tissue structure.

So how perfectly can axolotl's regenerate their brains after injury?

As a researcher studying regeneration at the cellular level, I and my colleagues in the Treutlein Lab at ETH Zurich and the Tanaka Lab at the Institute of Molecular Pathology in Vienna wondered whether axolotls are able to regenerate all the different cell types in their brain, including the connections linking one brain region to another. In our recently published study, we created an atlas of the cells that make up a part of the axolotl brain, shedding light on both the way it regenerates and brain evolution across species.

Why look at cells?

Different cell types have different functions. They are able to specialize in certain roles because they each express different genes. Understanding what types of cells are in the brain and what they do helps clarify the overall picture of how the brain works. It also allows researchers to make comparisons across evolution and try to find biological trends across species.

One way to understand which cells are expressing which genes is by using a technique called single-cell RNA sequencing (scRNA-seq). This tool allows researchers to count the number of active genes within each cell of a particular sample. This provides a "snapshot" of the activities each cell was doing when it was collected.

Severed neuronal connections between the removed area [of the brain] and other areas of the brain [could be] reconnected.

This tool has been instrumental in understanding the types of cells that exist in the brains of animals. Scientists have used scRNA-seq in fish, reptiles, mice and even humans. But one major piece of the brain evolution puzzle has been missing: amphibians.

Mapping the axolotl brain

Our team decided to focus on the telencephalon of the axolotl. In humans, the telencephalon is the largest division of the brain and contains a region called the neocortex, which plays a key role in animal behavior and cognition. Throughout recent evolution, the neocortex has massively grown in size compared with other brain regions. Similarly, the types of cells that make up the telencephalon overall have highly diversified and grown in complexity over time, making this region an intriguing area to study.

We used scRNA-seq to identify the different types of cells that make up the axolotl telencephalon, including different types of neurons and progenitor cells, or cells that can divide into more of themselves or turn into other cell types. We identified what genes are active when progenitor cells become neurons, and found that many pass through an intermediate cell type called neuroblasts—previously unknown to exist in axolotls—before becoming mature neurons.

We then put axolotl regeneration to the test by removing one section of their telencephalon. Using a specialized method of scRNA-seq, we were able to capture and sequence all the new cells at different stages of regeneration, from one to 12 weeks after injury. Ultimately, we found that all cell types that were removed had been completely restored.

We observed that brain regeneration happens in three main phases. The first phase starts with a rapid increase in the number of progenitor cells, and a small fraction of these cells activate a wound-healing process. In phase two, progenitor cells begin to differentiate into neuroblasts. Finally, in phase three, the neuroblasts differentiate into the same types of neurons that were originally lost.

Astonishingly, we also observed that the severed neuronal connections between the removed area and other areas of the brain had been reconnected. This rewiring indicates that the regenerated area had also regained its original function.

Amphibians and human brains

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Adding amphibians to the evolutionary puzzle allows researchers to infer how the brain and its cell types has changed over time, as well as the mechanisms behind regeneration.

When we compared our axolotl data with other species, we found that cells in their telencephalon show strong similarity to the mammalian hippocampus, the region of the brain involved in memory formation, and the olfactory cortex, the region of the brain involved in the sense of smell. We even found some similarities in one axolotl cell type to the neocortex, the area of the brain known for perception, thought and spatial reasoning in humans. These similarities indicate that these areas of the brain may be evolutionarily conserved, or stayed comparable over the course of evolution, and that the neocortex of mammals may have an ancestor cell type in the telencephalon of amphibians.

While our study sheds light on the process of brain regeneration, including which genes are involved and how cells ultimately become neurons, we still don't know what external signals initiate this process. Moreover, we don't know if the processes we identified are still accessible to animals that evolved later in time, such as mice or humans.

But we're not solving the brain evolution puzzle alone. The Tosches Lab at Columbia University explored the diversity of cell types in another species of salamander, Pleurodeles waltl, while the Fei lab at the Guangdong Academy of Medical Sciences in China and collaborators at life sciences company BGI explored how cell types are spatially arranged in the axolotl forebrain.

Identifying all the cell types in the axolotl brain also helps pave the way for innovative research in regenerative medicine. The brains of mice and humans have largely lost their capacity to repair or regenerate themselves. Medical interventions for severe brain injury currently focus on drug and stem cell therapies to boost or promote repair. Examining the genes and cell types that allow axolotls to accomplish nearly perfect regeneration may be the key to improve treatments for severe injuries and unlock regeneration potential in humans.

Medical Xpress, 2 September 2022

https://medicalxpress.com

Embryos with DNA from three people develop normally in first safety study

2022-09-06

When the first baby to be conceived using a technique that mixes genetic material from three people was born, in 2016, scientists worried that the procedure had not been studied to show it was safe. Now, scientists in China have conducted the first comprehensive study of the technique in early-stage human embryos, and report that it seems does not seem to affect their development1.

Techniques for using genetic material from three people to make embryos are designed to prevent mothers with defects in their mitochondria — the organelles that provide cells with energy — from passing them on to their children. Mitochondria contain their own DNA, and children inherit all of their mitochondria from their mother.

"Mitochondrial replacement therapy is a controversial field," says study co-author Wei Shang, an obstetrician and gynaecologist at the Chinese PLA General Hospital in Beijing. "With our research, we hope to provide a foundation for the development of the technique."

Spindle transfer

Shang and her colleagues studied the safety of one of three main types of mitochondrial replacement therapy, called spindle transfer, which was used to make the first baby with genetic material from three people, who was born in Mexico in 2016. In this method, the nuclear DNA from the egg of a woman with faulty mitochondria is transferred to a donor egg with healthy mitochondria that has had its nuclear DNA removed. The egg is then fertilized with the father's sperm in a test tube. The resulting embryo contains genes from both parents in addition to mitochondrial genes from the donor.

As part of the study, the team compared dozens of human embryos that underwent spindle transfer with a control group of embryos. Both sets of embryos were allowed to develop for up to one week after fertilization. The researchers found that cells from a five-day-old 'blastocyst' in both groups had almost identical levels of gene expression and transcription, suggesting that spindle transfer does not seem to affect early embryonic development. The authors reported their findings in PLoS Biology last month1.

Researchers in China show that a technique used to replace diseased mitochondria does not affect early development.

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"This is the first [study] that has performed such a comprehensive comparison of human embryos that were created with spindle transfer," says Dietrich Egli, a stem-cell biologist at Columbia University in New York City. He adds that the work is "unique and fabulous" for its high quality and the amount of data it provides. Egli says that the safety of spindle transfer was expected — because of evidence from previous animal studies and the healthy child born in 2016 — but not conclusively shown until now.

Mitochondrial diseases

About one in 5,000 children are born with diseases caused by harmful mutations in their mitochondrial DNA. The faulty genes can lead to problems in many organs including the heart and the brain. So far, mitochondrial replacement therapy seems to be the most effective way of blocking these genes from being passed down to offspring, Egli says.

But Min Jiang, a mitochondrial biologist at Westlake University in Hangzhou, China, says that the long-term impacts of mitochondrial replacement therapy remain unclear. With current techniques, a small amount of the mother's mitochondrial DNA will be inadvertently carried over into the donor egg, usually accounting for less than 2% of the embryo's total mitochondria. Shang says they have improved the technique to keep that level "almost undetectable", but Jiang warns that research suggests that the proportion of maternal mitochondrial DNA might increase as cells develop2, increasing the offspring's risk of developing mitochondrial diseases.

"The maternal mitochondria and nucleus have coexisted for a long time, so maybe the nucleus may prefer cells with maternal mitochondria," Jiang says, adding that the interaction between the two organelles requires more research. "So far, the studies show spindle transfer works. But the long-term health of children born using the therapy will need to be investigated with clinical trials," she says.

Highly regulated

Only a few countries, including the United Kingdom and Australia, have approved mitochondrial replacement therapy. The technique is banned in the United States; in China, its use as a treatment for infertility was prohibited in 2003, but the government has not specified whether the method is banned as a way to prevent children from inheriting mitochondrial diseases.

Shang says the team had planned to conduct clinical trials of mitochondrial replacement therapy in China. Chinese law does not explicitly prohibit such trials. But the team shifted its focus to collecting more safety data in the laboratory in the aftermath of the 'CRISPR baby' scandal. In 2018, Chinese scientist He Jiankui shocked the world when he announced that he had used the gene-editing technique CRISPR–Cas9 to genetically edit the DNA in embryos later implanted into a woman. International scientists widely condemned He's use of CRISPR in embryos as risky and unethical, and He was jailed for conducting an illegal medical practice.

Egli says the safety study on spindle transfer will provide important evidence to help regulators in countries where the process is not allowed make an assessment of its safety and efficacy. "It can really help advance the field," he says.

Nature, 6 September 2022

https://nature.com

How a single protein could unlock age-related vision loss

2022-09-07

Research led by Sanford Burnham Prebys professor Francesca Marassi, Ph.D., is helping to reveal the molecular secrets of macular degeneration, which causes almost 90% of all age-related vision loss. The study, published recently in the Biophysical Journal, describes the flexible structure of a key blood protein involved in macular degeneration and other age-related diseases, such as Alzheimer's and atherosclerosis.

"Proteins in the blood are under constant and changing pressure because of the different ways blood flows throughout the body," says Marassi. "For example, blood flows more slowly through small blood vessels in the eyes compared to larger arteries around the heart. Blood proteins need to be able to respond to these changes, and this study gives us fundamental truths about how they adapt to their environment, which is critical to targeting those proteins for future treatments."

There are hundreds of proteins in our blood, but the researchers focused on vitronectin, one of the most abundant. In addition to circulating in high concentrations in the blood, vitronectin is found in the scaffolding between cells and is also an important component of cholesterol.

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Vitronectin is a key player in many age-related diseases, but for Marassi's team, the most promising target is macular degeneration, which affects as many as 11 million people in the United States. This number is expected to double by 2050.

"This protein is an important target for macular degeneration because it accumulates in the back of the eye, causing vision loss. Similar deposits appear in the brain in Alzheimer's disease and in the arteries in atherosclerosis," says Marassi. "We want to understand why this happens and leverage this knowledge to develop new treatments."

To approach this question, the researchers were interested in learning how the protein changes its structure at different temperatures and under different levels of pressure, approximating what happens in the human body.

"Determining the structure of a protein is the most important part of determining its function," adds Marassi.Through detailed biochemical analysis, the researchers found that the protein can subtly change its shape under pressure. These changes cause it to bond more easily to calcium ions in the blood, which the researchers suggest leads to the buildup of calcified plaque deposits characteristic of macular degeneration and other age-related diseases.

"It's a very subtle rearrangement of the molecular structure, but it has a big impact on how the protein functions," says Marassi. "The more we learn about the protein on a structural and mechanistic level, the better chance we have of successfully targeting it with treatments."

These structural insights will streamline the development of treatments for macular degeneration.

These structural insights will streamline the development of treatments for macular degeneration because it will allow researchers and their partners in the biotech industry to custom-design antibodies that selectively block the protein's calcium binding without disrupting its other important functions in the body.

"It will take some time to convert it into a clinical treatment, but we hope to have a working antibody as a potential treatment in a few years' time," says Marassi. "And since this protein is so abundant in the blood, there may be other exciting applications for this new knowledge that we don't even know about yet."

Additional authors on the study include Ye Tian, Ph.D., Kyungsoo Shin, Ph.D., Alexander E. Aleshin, Ph.D., Sanford Burnham Prebys Medical Discovery Institute and Wonpil Im, Lehigh University.

Medical Xpress, 7 September 2022

https://medicalxpress.com

Four science-based ways to tell if your cat loves you

2022-09-07

Even the most devoted cat owners wonder at some point, perhaps waking up in a cold sweat in the middle of the night, whether their cat really loves them. Dog people like to smugly point out dogs' long history as humankind's best friend.

But research shows cats' reputation as a cold and aloof pet is undeserved.

Because of their evolutionary ancestry, domestic cats are, by their nature, more independent than dogs. The wild ancestors of our cats didn't live in social groups as canines do. However, during the process of domestication, cats developed the ability to form social relationships not just with other cats, but also with people.

While they may not rely upon people to feel safe as dogs do, many cats show affection towards their guardians and seem to highly value the company of their human companions. Their attachment to humans is partly influenced by their experiences of being handled by people as a kitten.

Cats behave towards humans in the same way that they respond to their feline friends, so the secret of whether your cat feels bonded to you lies in their behavior.

1. Look out for scenting

The ability to communicate with other cats over long distances and when no longer physically present was an advantage to their wild ancestors. Our pet cats have retained this "supersense" and rely heavily on this form of communication.

In particular, cats use scent to identify members of their social group or family, by sharing a group scent profile. Cats have scent glands on their flanks, head and around their ears, and often rub their heads against people and objects that are familiar and comforting.

Research shows cats' reputation as a cold and aloof pet is undeserved.

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Does your cat rub its head or side against your legs? The soft sensation you feel against your calves is actually your cat identifying you as a friend and is a huge compliment.

2. Watch how they greet you

One of the most obvious signs that your beloved pet is fond of you, is the way that your cat greets you. When cats greet members of their social group they show signals to indicate friendship and a desire to move closer. Cats also show these signals to humans.

A tail held in the upright flagpole position shows a friendly intention (the feline equivalent of a wave), indicating familiarity,trust, and affection. Some cats also use an upright question mark shaped tail to greet someone they like, or to motion that they want to play.

Cats sometimes intertwine their tails as a sign of friendship and the human equivalent of this is to wrap their tail around your calf.

Rolling over and exposing their vulnerable under belly is another gesture that a cat has ultimate trust in you. However cats prefer to be petted on the head and neck area, so this is not usually a request for a belly rub.

Attempts to stroke a cat's belly will often result in a hasty retreat, or even claws. The chirrup or trill greeting is a melodious sound that cats make when saying hello to preferred individuals. So if your cat sings to you in this way, be assured they are pleased to see you.

That familiar feeling when your cat hits the back of your knee can also be a sign that they feel an extremely close bond to you. The feline version of a high-five, the head bump is usually saved for a cat's closest feline friends and most trusted humans.

3. Look for blinks

Your cat might also be secretly signaling their affection in the way they look at you. When cats encounter strange humans or other cats they don't know, they usually greet them with an unblinking stare. But they are more likely to slowly blink at cats they have a good relationship with.

Research suggests slow blinks are associated with a positive emotional state and can be a sign of trust, contentment and affection, similar to a human smile. If you wish to return the compliment, blink and your cat might blink back. This is nice a way to bond with your cat if they aren't keen on being touched.

4. They get up close

Cats are very protective of their personal space and don't like unwelcome guests to invade it. If a cat allows you to get close to them, that suggests a close bond, particularly where the contact is frequent or long lasting.

Curling up on your lap for a nap is a sign of deep trust. Grooming only happens between cats with a warm relationship, so licking your hand or face can be a show of endearment, even though those barbed tongues may not feel all that gentle.

Phys Org, 7 Septembr 2022

https://phys.org

Manuka honey could help to clear deadly drug-resistant lung infection, research suggests

2022-09-07

A potential new treatment combining natural manuka honey with a widely used drug has been developed by scientists at Aston University to treat a potentially lethal lung infection and greatly reduce side effects of one of the current drugs used for its treatment.

The findings, which are published in the journal Microbiology, show that the scientists in the Mycobacterial Research Group in the College of Health and Life Sciences at Aston University were able to combine manuka honey and the drug amikacin in a lab-based nebulization formulation to treat the harmful bacterial lung infection Mycobacterium abscessus.

Manuka honey is long known to have wide ranging medicinal properties, but more recently has been identified for its broad spectrum antimicrobial activity. Now scientists have found that manuka honey has the potential to kill a number of drug resistant bacterial infections such as Mycobacterium abscessus—which usually affects patients with cystic fibrosis (CF) or bronchiectasis.

According to the Cystic Fibrosis Trust, CF is a genetic condition affecting around 10,800 people—one in every 2,500 babies born in the UK—and there are more than 100,000 people with the condition worldwide. The NHS defines bronchiectasis as a long-term condition where the airways of the lungs become widened, leading to a build-up of excess mucus that can make the lungs more vulnerable to infection.

Manuka honey is long known to have wide ranging medicinal properties, but more recently has been identified for its broad spectrum antimicrobial activity

In the study, the researchers used samples of the bacteria Mycobacterium abscessus taken from 16 infected CF patients. They then tested the antibiotic amikacin, combined with manuka honey, to discover the dosage required to kill the bacteria.

As part of the study, the team used a lab-based lung model and nebulizer—a device that produces a fine spray of liquid often used for inhaling a medicinal drug. By nebulizing manuka honey and amikacin together, it was found they could improve bacterial clearance, even when using lower doses of amikacin, which would result in less life-changing side-effects to the patient.

In the UK, of the 10,800 people living with CF, Mycobacterium abscessus infects 13% of all patients with the condition. This new approach is advantageous not only because it has the potential to kill off a highly drug resistant infection, but because of the reduced side effects, benefiting quality of life and greatly improving survival chances for infected CF patients.

Mycobacterium abscessus is a bacterial pathogen from the same family that causes tuberculosis, but this bug differs by causing serious lung infections in people (particularly children) with pre-existing lung conditions, such as CF and bronchiectasis, as well as causing skin and soft tissue infections. The bacteria is also highly drug resistant.

Currently, patients are given a cocktail of antibiotics, consisting of 12 months or more of antimicrobial chemotherapy, and this treatment often doesn't result in a cure. The dosage of amikacin usually used on a patient to kill the infection is 16 micrograms per milliliter. But the researchers found that the new combination using manuka honey, required a dosage of just 2 micrograms per milliliter of amikacin—resulting in a one-eighth reduction in the dosage of the drug.

Until now Mycobacterium abscessus has been virtually impossible to eradicate in people with cystic fibrosis. It can also be deadly if the patient requires a lung transplant, because they are not eligible for surgery if the infection is present.

Commenting on their findings, lead author and Ph.D. researcher Victoria Nolan said, "So far, treatment of Mycobacterium abscessus pulmonary infections can be problematic due to its drug resistant nature. The variety of antibiotics required to combat infection result[s] in severe side effects.

"However, the use of this potential treatment combining amikacin and manuka honey shows great promise as an improved therapy for these terrible pulmonary infections.

"There is a need for better treatment outcomes and in the future we hope that this potential treatment can be tested further."

Dr. Jonathan Cox, senior lecturer in microbiology at Aston University, said, "By combining a totally natural ingredient such as manuka honey with amikacin, one of the most important yet toxic drugs used for treating Mycobacterium abscessus, we have found a way to potentially kill off these bacteria with eight times less drug than before. This has the potential to significantly reduce amikacin-associated hearing loss and greatly improve the quality of life of so many patients—particularly those with cystic fibrosis.

"I am delighted with the outcome of this research because it paves the way for future experiments and we hope that with funding we can move towards clinical trials that could result in a change in strategy for the treatment of this debilitating infection."

Dr. Peter Cotgreave, chief executive of the Microbiology Society, said, "The Microbiology Society is proud to support the scientific community as it explores innovative solutions to overcome the growing global challenge of antimicrobial resistance. This study demonstrates one of many ways in which microbiologists are pioneering new methods to tackle drug-resistant infections, by incorporating natural products, like manuka honey, into existing therapies."

Phys Org, 7 September 2022

https://phys.org

What's being done to protect astronauts from radiation in deep space?

2022-09-06

In 1982, author James Michener published his sprawling novel "Space." In it, he describes a fictional Apollo 18 mission to the moon. While the astronauts are on the surface, the sun unleashes a huge storm, trapping them outside of their protective capsule. The two men get blasted by lethal amounts of radiation before they can get to safety.

They manage to make it back to their lander but are so sick that they can't fly back to rejoin their third crewmate in the orbiting lunar command module. They end up crashing back to the surface and dying. As grisly as this sounds, a radiation event like the one in "Space" poses a very real challenge to space explorers. And it's this sort of scenario that lunar mission planners want to avoid. Today, they're working on ways to mitigate exposure, and, if astronauts do get a dose of radiation, finding medical methods to treat them.

Space weather and radiation

Solar outbursts send energetic particles our way via the solar wind every day. They cause space weather, which interferes with communications systems between Earth and the many missions in space (including ISS). It can also seriously disrupt systems here on Earth. Space weather (and the solar storms that cause it) intensify when the sun is more active, during a period called solar maximum.

Solar storms can range from mild outbursts to significant solar energetic particle events, which can be lethal to humans in space. They happen as proton-laden material bursts out from the sun, generally associated with big solar flares and coronal mass ejections (CMEs). The particles get accelerated by the flares and CMEs and that's what makes them so deadly. For astronauts in space, the best protection is to be behind protective walls in their capsules and habitats. But, if it turns out that people on a mission are exposed to radiation, medical procedures to help astronauts recover are important to have.

Space weather (and the solar storms that cause it) intensify when the sun is more active, during a period called solar maximum.

It's worth remembering that there has been at least one "close call" with lunar explorers and potential solar activity. In 1972, solar storms blasted out past Earth and the moon. They disrupted satellite communications as well as ground-based communications systems on Earth. Luckily, no Apollo missions were impacted, although the storms occurred between the Apollo 16 and 17 missions. Had they burst out during those missions, things would have gone badly for the astronauts, who would have been sitting ducks either on their way to the moon or while on the surface.

Artemis 1's radiation studies

Fortunately, there is a mission to study the radiation environment beyond Earth: Artemis 1. It's important during this time as we head into solar maximum. When it flies, radiation and medical research will be a major focus of that mission. The Orion capsule has radiation monitors from NASA and ESA on board, along with specialized test mannequins. There are also CubeSats with experiments (such as genetically modified yeast that stands

in for human reactions to radiation). These were all designed to study the radiation environment astronauts will face on the way to the moon.

Orion has radiation shielding, of course, to protect humans and technology. Future craft such as SpaceX's Human Landing System will be well-shielded to protect astronauts on their way to the moon and back to the planned Lunar Gateway. In the event of a very severe storm, astronauts could hide in onboard shelters until it's safe. That's what ISS crews did when the sun let loose a particularly fierce outburst in September 2017.

Radiation hazards beyond Earth

It's worth remembering, however, that the ISS is within the protective bubble of Earth's magnetosphere. Astronauts venturing outside the magnetosphere in Orion or other spacecraft will be at risk. So will people living and working on the moon. There's no such magnetospheric protection available "out there." In a strong solar storm, people in space will get blasted with lethal amounts of radiation very quickly.

"Leaving the magnetosphere is like leaving a safe harbor and venturing out into the open ocean," said Melanie Heil, Segment Coordinator of the European Space Agency's Space Weather Office. "Radiation exposure for astronauts at the moon can be an order of magnitude higher than on the Space Station and several orders of magnitude higher than on Earth's surface. Future astronauts will face higher risks from solar particle events: it is very important that we study the radiation environment beyond the magnetosphere and improve our ability to predict and prepare for solar storms."

For its part, ESA is working on the European Radiation Sensor Array (ERSA) project. That's a series of sensors to give real-time radiation monitoring on board the future crewed lunar Gateway space station. The idea is to get measurements from both inside and outside of crew capsules and habitats to understand radiation risks and leaks. It's also possible to include radiation sensors on uncrewed lunar orbiters such as Lunar Pathfinder. Another possibility is to put sensors on future lunar telecommunication satellites.

Predicting solar activity

In addition to shielding our astronauts and lunar explorers, it's important to explore the radiation environment between Earth and the moon as Artemis will do. But, we need more information about the solar outbursts themselves. While astronomers know a lot about solar activity, we still

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need a solid "early warning system" for solar storms. It could help alert astronauts and lunar explorers in time to take safety measures.

That's the goal of space weather researchers around the world. Early observation of active regions on the solar disk occur is a major goal of ESA's 2029 Vigil mission. It will give advance warnings for potentially hazardous space weather events that could endanger astronauts and explorers. Other missions, such as SOHO, STEREO, Solar Dynamics Observatory, and the Parker Solar Probe, provide valuable long-term data about the sun's activity.

Phys Org, 6 September 2022

https://phys.org

Using Viruses To Turbocharge the Immune System Against Cancer

2022-09-06

A combination of two therapies shows promise for treatment-resistant cancers.

The immune system has evolved to safeguard the body from an incredibly diverse range of potential threats. Among these are bacterial diseases, including plague, diphtheria, cholera, and Lyme disease, and viral contagions such as influenza, Ebola virus, and SARS CoV-2 (the virus that causes COVID-19).

Despite the remarkable power of the immune system's complex defense network, there is one type of threat that is especially challenging to combat. This arises when the body's own native cells turn rogue, leading to the phenomenon of cancer. Even though the immune system frequently engages to try to rid the body of malignant cells, its efforts are often thwarted, leaving the disease to progress unchecked.

In new research published on August 25, 2022, in the journal Cancer Cell, corresponding authors Grant McFadden, Masmudur Rahman, and their colleagues propose a new line of attack that shows promise for treatment-resistant cancers.

The strategy involves a combination of two methods that have each shown considerable success against some cancers on their own. The study explains how oncolytic virotherapy, a technique using cancer-fighting viruses, can act in concert with existing immunotherapy techniques to boost the immune capacity to effectively target and destroy cancer cells.

Oncolytic viruses represent an exciting new avenue of cancer therapy. Such therapeutic viruses have the remarkable ability to hunt and

terminate cancer cells while leaving healthy cells unharmed. They also enhance the immune system's ability to recognize and terminate cancer cells.

One such virus, known as myxoma, is the focus of the current study and an area of expertise for the research team. The study reveals that the use of T-cells infected with myxoma virus can induce a form of cancer cell death not previously observed.

Known as autosis, this form of cell destruction may be especially useful against solid tumors that have proven treatment-resistant to various forms of cancer therapy, including immunotherapy alone.

"This work affirms the enormous potential of combining virotherapy with cell therapy to treat currently intractable cancers," McFadden says.

McFadden directs the Biodesign Center for Immunotherapy, Vaccines and Virotherapy at Arizona State University.

Internal sentries

The human immune system is composed of a range of specialized cells designed to patrol the body and respond to threats. It is involved in an endless arms race against pathogens, which evolve sophisticated techniques to attempt to outwit immune defenses, propagate in the body, and cause disease. Cancer presents a unique challenge to the immune system as tumor cells often lack the identifying cell features that enable the immune system to attack them by distinguishing self from non-self.

Through a range of evasive strategies, cancer cells can further short-circuit immune efforts to hunt and destroy them. Scientists hope to help the immune system to overcome cancer's notorious tactics of disguise, by developing new experimental techniques belonging to a category known as adoptive cell therapy, or ACT.

Such methods often involve extracting a collection of cancer-fighting white blood cells known as T-cells, modifying their seek-and-destroy capacities, and reinjecting them in patients. Two forms of ACT immunotherapy are described in the new study: CAR T-cell therapy (CART) and T Cell Receptor Engineering (TCR). In each case the basic idea is the same: treating cancer with activated T lymphocytes extracted from the patient.

New method delivers a one-two punch to tumor cells

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The development of these therapies has been nothing short of revolutionary. In fact, some cancer patients facing grim prospects have made remarkable recoveries following the use of immunotherapy. However, techniques like CART and TCR nevertheless have their limitations and are frequently ineffective against advanced solid tumors. In such cases, cancer cells often manage to evade destruction by T-cells by downregulating or losing the surface antigens or MHC proteins that T-cells use to identify them.

The new research highlights the ability of immunotherapy when it is coupled with virotherapy to break through the wall of cancer resistance, specifically using myxoma-equipped T-cells. The myxoma can target and kill cancer cells directly, but more usefully, can induce an unusual form of T-cell-directed cell death known as autosis. This form of cell death augments two other forms of programmed cancer cell death induced by T-cells, known as apoptosis and pyroptosis.

During myxoma-mediated autosis, cancerous cells in the proximity of those targeted by the therapy are also destroyed in a process known as bystander killing. This effect can considerably enhance the dual therapy's aggressive eradication of cancer cells, even in notoriously hard-to-treat solid tumors.

A combined myxoma-immunotherapy approach, therefore, holds the potential to turn so-called "cold tumors," which fly under the immune system's radar, into "hot tumors" that immune cells can identify and destroy, allowing CAR T-cells or TCR cells to enter the tumor environment, proliferate and activate.

"We are at the edge of discovering newer aspects of the myxoma virus and oncolytic virotherapy," Rahman says. "In addition, these findings open the door for testing cancer-killing viruses with other cell-based cancer immunotherapies that can be used in cancer patients."

A new frontier for the treatment of this devastating disease is rising with the ability to radically reengineer oncolytic viruses like myxoma to target a range of resistant cancers.

Sci Tech Daily, 6 September 2022

https://scitechdaily.com

World's oldest amputation: Foot removed 31,000 years ago—without modern antibiotics or painkillers

2022-09-07

Some 31,000 years ago in the misty rainforests of the island of Borneo, stone tool met bone and a limb was severed—but a young life was saved. Researchers have found evidence for the earliest known surgical amputation, tens of thousands of years before the advent of modern surgical tools, antibiotics, or painkillers.

The findings illuminate both the medical expertise and compassion of the pioneering hunter-gatherers who populated Southeast Asia at this time, says Charlotte Roberts, a bioarchaeologist at Durham University who was not involved with the work but—as a former nurse—is familiar with the procedure. "We cannot doubt they were very sophisticated."

The find traces to early 2020, when a team of Australian and Indonesian scientists excavated the floor of a cave called Liang Tebo in a remote, densely forested region of eastern Borneo. "There are absolutely no settlements, no telephone signal, no electricity," says team member Andika Arief Drajat Priyatno, an archaeologist at the East Kalimantan Cultural Heritage Preservation Center.

Other researchers had previously inspected the cave, noting red-outlined hand stencils and zig-zag decals lining its limestone walls and ceiling. Those paintings haven't been dated yet, but rock art depicting figures such as wild cattle and other animals from other caves in the region are at least 40,000 years old. That makes the hunter-gatherers who lived here the world's first known figurative artists.

As workers, including Andika and others, scraped away a section of cave floor inch by inch, they discovered a remarkably intact human skeleton reclined in a kneeling position, with stones positioned above its head and hands, as if they were grave markers. The individual, whose sex could not be determined from their bones, was in their early 20s when they died. A small chunk of ochre, a natural pigment, was buried near the person's face. That hints that they may have created some of the markings on the cave walls, says the study's senior author, Maxime Aubert, a geochemist and archaeologist at Griffith University, Gold Coast, in Australia.

When the skeleton was fully revealed, the researchers noticed it was missing the bottom of its left leg from about the middle of the shin downward. The shin bones had fused at the bottom—a clear sign of healing following a traumatic injury, explains co-author Melandri Vlok, a

Skeleton buried in Borneo cave suggests early artists were also early surgeons

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bioarchaeologist at the University of Sydney. But then the team's work had to halt, as the COVID-19 pandemic descended and Indonesia closed its borders.

When the scientists returned the following year, Vlok noticed the end of the leg was cut cleanly in a straight line, with no sign of crushing or shattering, as expected if a rock had fallen on it or an animal had bitten it off. "It looks exactly like what you would expect if a sharp blade cut completely perpendicular to the bone," she says. "It made us confident this was surgery."

The ancient surgeon likely used a stone or bone tool to cut through the leg, Aubert says, although the team hasn't yet found the Stone Age equivalent of a bone saw.

The researchers radiocarbon dated bits of charcoal in sediment layers immediately above and below the grave to about 31,000 years ago. They also applied another technique known as electron spin resonance dating to directly date one of the skeleton's molars; the results matched the sediment's radiocarbon dates.

Taken together, the evidence suggests people on the island are the first known to perform a successful amputation, the team reports today in Nature. Previously, the oldest confirmed amputation—of a man's arm below the shoulder—dated to about 7000 years ago in what today is France.

The team can't say why ancient surgeons amputated the Borneo limb—whether because of disease or traumatic injury. Based on the degree of fusing of the shin bones, the individual lived and grew for another 6 to 9 years, Vlok says. The cause of death is unclear.

The region's tropical environment means it's incredibly easy for wounds to become infected, Vlok says. "I once cut my finger during an excavation and quickly had to rush to the hospital to get antibiotics," she says. Surviving surgery would have been virtually impossible without something to clean the wound, as well as to relieve pain, says India Dilkes-Hall, a co-author and archaeologist at the University of Western Australia, Perth.

Fortunately, Borneo's rich biodiversity offers a vast pharmacopoeia. For example, when properly processed, the normally toxic fruit of the Pangium edule tree can be used as an antiseptic, Dilkes-Hall says. Humans had been in the region for thousands of years and may have learned the medicinal properties of local plants, she notes.

"The argument here is exceptionally well-constructed," says Haagen Klaus, an anthropologist at George Mason University who was not involved with the work. "They make a very convincing case for a surgical amputation 31,000 years ago."

Some anthropologists have tended to dismiss early hunter-gatherer societies as primitive, he says, but findings like this one suggest that wasn't the case. "It's become very clear they had lives and societies far more complex and sophisticated than we imagined, including knowledge of medicine and human anatomy."

Science, 7 September 2022

https://science.org

Cancer warning: One of Britain's most-loved drinks found to cause seven types of disease

2022-09-09

Unfortunately, one in two people will develop cancer at some point in their lives – so it's sensible to do all we can to mitigate this risk.

Billions is spent on cancer research, and thankfully with each passing year the medical profession is dramatically improving its treatment and rate of diagnoses.

The risk factors are well documented - such as smoking - but there's one leading cause of cancer that is often overlooked, and it's one most of us indulge in.

And that's all types of alcoholic drink.

According to Cancer Research UK, alcohol causes seven types of cancer, including breast, mouth and bowel cancer.

"Alcohol gets broken down into a harmful chemical and can also affect our body's chemical signals, making cancer more likely to develop," says the charity.

Research has also shed light on the destructive impact alcohol can have on DNA, the blueprint of life within our cells.

"Alcohol is broken down via a strict process and converted into energy. And it's acetaldehyde, at the centre of this chain, that's the weakest link," explains Cancer Research UK.

The dangers of smoking are well documented, but there's another far more stealthy way we could be harming ourselves - and it's one that many of us indulge in ...

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"If acetaldehyde isn't broken down further it builds up in cells, where it damages DNA in a way that could cause cancer."

Professor Ketan Patel and his team of Cancer Research UK-funded scientists at the MRC Laboratory of Molecular Biology in Cambridge, have revealed the sort of damage acetaldehyde causes to DNA.

How cells are damaged - and how they're fixed

Their study has shown the way cells prevent such damage and how the harm is fixed if it happens.

The team's work focuses on stem cells - a type of cell that supplies the many different specialised cells our bodies are made of.

It's important to understand how the DNA code in stem cells can become damaged, as this can lead to different types of cancer.

Results were 'striking and remarkable'

The team studied blood stem cells in mice.

"They're a good way of monitoring changes and damage to DNA in a way that's more informative than looking at cells in a dish," explained Professor Patel.

These stem cells were analysed to see if external factors such as alcohol can damage DNA in a way that can increase the risk of cancer.

Scientists already know cells can protect DNA from acetaldehyde by using a group of enzymes called acetaldehyde dehydrogenases, also known as ALDH.

Professor Patel said: "When they're working properly, the ALDH enzymes stop acetaldehyde building up by converting it into acetate, which cells can use as a source of energy".

To see the damage acetaldehyde might cause to stem cells' DNA, Professor Patel and his team had to look at cells that didn't have these enzymes.

To do this, they used lab-based genetic engineering to create mice whose blood stem cells didn't produce the enzyme ALDH2, meaning they couldn't break down acetaldehyde.

They then gave these mice diluted ethanol, the purest form of alcohol, and used techniques to see the DNA inside the cells and read its code.

According to Professor Patel, the results were 'striking and remarkable'.

'Bits of DNA deleted and broken'

They found that in bone marrow samples carrying blood cells lacking the ALDH2 enzyme, just a single dose of ethanol caused a build-up of acetaldehyde that wreaked havoc with the DNA.

"We saw huge amounts of DNA damage in these cells. Bits of DNA were deleted, bits were broken and we even saw parts of chromosomes being moved about and rearranged," said the professor.

How much alcohol is safe to drink?

To mitigate the risks of alcohol, both men and women are advised not to regularly drink more than 14 units a week.

A unit of alcohol is 8g or 10ml of pure alcohol, which equates to:

- Half a pint of lower to normal-strength lager/beer/cider (ABV 3.6 percent)
- A single small shot measure (25ml) of spirits (25ml, ABV 40 percent).

Cancer – signs and symptoms to look out for

Change in bowel habits

1. Blood in your poo

2. Diarrhoea or constipation for no obvious reason

3. A feeling of not having fully emptied your bowels after going to the toilet

4. Pain in your stomach (abdomen) or back passage (anus)

Bloating

Make an appointment with a GP if you've experienced bloating for three weeks or more.

Lump in your breast

See a GP if you notice a lump in your breast of if you have a lump that's rapidly increasing in size elsewhere on your body. You will be referred for tests if necessary.

Coughing, chest pain and breathlessness

1. Get in touch with your GP if you've had a cough for more than three weeks.

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2. Symptoms such as chest pain or shortness of breath may also be a sign of a severe condition such as pneumonia.

Unexplained weight loss

See your doctor if you've experienced a lot of weight loss over the last couple of months that cannot be put down to changes to your diet, stress or exercise.

Bleeding

Any unexplained bleeding, such as blood in your urine, bleeding between periods, bleeding from your bottom, blood when you cough or vomit should be investigated by a doctor.

Moles

Make sure you see a GP if you have a mole that changes shape or looks uneven, changes colour, gets darker, or has more than two colours; starts itching, crusting, flaking or bleeding or gets larger or protrudes more from the skin.

Mirror, 9 September 2022

https://mirror.co.uk

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Technical Notes

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

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Tyre additive chemicals, tyre road wear particles and high production polymers in surface water at 5 urban centres in Queensland, Australia

Molecular fingerprints of polar narcotic chemicals based on heterozygous essential gene knockout library in Saccharomyces cerevisiae

Metabolomics for exposure assessment and toxicity effects of occupational pollutants: current status and future perspectives

ENVIRONMENTAL RESEARCH

Neurotoxic effects of environmental contaminants-measurements, mechanistic insight, and environmental relevance

Priority pesticides in Chile: predicting their environmental distribution, bioaccumulation, and transport potential

Environmental contamination status with common ingredients of household and personal care products exhibiting endocrine-disrupting potential

PHARMACEUTICAL/TOXICOLOGY

Colorectal cancer and occupational exposure to solar ultraviolet B radiation in Denmark

Suspect and non-targeted screening-based human biomonitoring identified 74 biomarkers of exposure in urine of Slovenian children

OCCUPATIONAL

Developing human biomonitoring as a 21st century toolbox within the European exposure science strategy 2020-2030

Occupational acute argon gas poisoning: A case report