CHEMWATCH

Bulletin Board

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ASIA PACIFIC

Announcement of the State Food and Drug Administration on Adjusting Some Contents of the "Medical Device Classification Catalog" (No. 30 [2022])

2022-03-28

In order to further deepen the reform of the medical device review and approval system, according to the actual development of the medical device industry and supervision work, and in accordance with the relevant requirements of the "Regulations on the Supervision and Administration of Medical Devices" and the "Working Procedures for Dynamic Adjustment of the Classification of Medical Devices", the State Food and Drug Administration Part of the content of the "Device Classification Catalog" has been adjusted. The relevant matters are hereby announced as follows:

1. Adjustment content Adjustments

are made to the contents of the "Medical Device Classification Catalog" for 27 types of medical devices. Please refer to the attachment for the specific adjustment contents.

2. Implementation requirements

(1) For the radio frequency therapeutic apparatus and radio frequency skin therapeutic apparatus among the radio frequency therapy (non-ablation) equipment in 09-07-02, which are involved in the adjustment in the annex, from the date of this announcement, it can be approved according to the "Medical Devices" Registration and filing management measures (Order No. 47 of the State Administration for Market Regulation) apply for registration. From April 1, 2024, products such as radio frequency therapeutic apparatus and radio frequency skin therapeutic apparatus shall not be produced, imported or sold without obtaining a medical device registration certificate in accordance with the law.

The relevant registrants and manufacturers of radio frequency therapeutic apparatus and radio frequency skin therapeutic apparatus products shall earnestly fulfill the main responsibility of product quality and safety, comprehensively strengthen the quality management of the whole product life cycle, and ensure the safety and effectiveness of the listed products. From the date of this announcement, the relevant registrants and manufacturers of radio frequency therapeutic devices and radio frequency skin therapeutic devices should take the initiative to report

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to the provincial drug regulatory department where the products are located (where the agent is located for imported products). , Applicable safety standard commitment, production quality management system and operation, customer complaint handling and adverse event system and implementation, etc. Provincial-level drug regulatory departments should establish enterprise credit files, strengthen inspections of registrants and manufacturers of such products, urge enterprises to implement their main responsibilities, speed up the completion of product registration, and improve the quality management system. From April 1, 2024, enterprises that have not obtained medical device production and business licenses (recording) shall not engage in the production and sales of related products.

(2) For other products whose contents have been adjusted, from the date of publication of this announcement, the drug regulatory authorities shall, in accordance with the Measures for the Administration of Medical Device Registration and Filing, and the Announcement on the Announcement of the Application Materials Requirements for Medical Device Registration and the Format of Approval Documents, etc. , and accept medical device registration applications according to the adjusted categories.

For medical devices that have been accepted but have not yet completed registration approval (including initial registration and renewal registration), the drug regulatory department will continue to review and approve according to the original acceptance category. If registration is approved, a medical device registration certificate will be issued, and it will be indicated in the remarks column of the registration certificate. Adjusted product management category.

For registered medical devices, if the management category is adjusted from the third category to the second category, the medical device registration certificate will continue to be valid within the validity period. If renewal is required, the registrant shall apply to the corresponding drug regulatory department for renewal of registration according to the changed category 6 months before the expiration of the medical device registration certificate. Registration certificate.

If a registration change occurs within the validity period of the medical device registration certificate, the registrant shall apply to the original registration department for registration change. If the original registration certificate is issued in accordance with the original "Medical Device Classification Catalog", the product management category after the implementation of the announcement shall be indicated in the remarks

column of the registration document for the change of products involved in this announcement.

(3) Drug supervision and administration departments at all levels should strengthen the publicity and training of the content adjustment of the "Medical Device Classification Catalog", and effectively do a good job in the review and approval and post-marketing supervision of related products.

Read More

National Medical Products Administration, 28-03-22

https://www.nmpa.gov.cn/ylqx/ylqxggtg/20220330144627167.html?type=pc&m=

Australia Customs (Prohibited Exports) Regulations updated

2022-03-07

On 7 March 2022, the Australia Customs (Prohibited Exports) Regulations were updated.

The following substance was deleted from Schedule 2:

1. Mercury

Read More

Yordas Hive, 07-03-22

https://www.yordashive.com/news/the-australia-customs-prohibited-exports-regulations-updated

China Launches Inspection Campaign on key Industrial Products Including Hazardous Chemicals

2022-04-15

On March 16, 2022, the State Administration for Market Regulation of China released the 2022 Action Plan for Key Industrial Products Quality and Safety Inspection, which marked the beginning of a special inspection campaign on the quality and safety of 10 key industrial products in 2022.

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Chemlinked, 15-04-22

https://chemical.chemlinked.com/news/chemical-news/china-launches-inspection-campaign-on-key-industrial-products-including-hazardous-chemicals

AMERICA

Comments on Proposed Ban of Ongoing Asbestos Uses Due June 13, 2022

2022-04-13

The U.S. Environmental Protection Agency (EPA) proposed on April 12, 2022, to prohibit ongoing uses of chrysotile asbestos, the only known form of asbestos currently imported into the United States. 87 Fed. Reg. 21706. EPA proposes under Section 6(a) of the Toxic Substances Control Act (TSCA) to prohibit manufacture (including import), processing, distribution in commerce, and commercial use of chrysotile asbestos in bulk or as part of chrysotile asbestos diaphragms used in the chlor-alkali industry and chrysotile asbestos-containing sheet gaskets used in chemical production. EPA proposes that these prohibitions take effect two years after the effective date of the final rule. EPA also proposes to prohibit manufacture (including import), processing, distribution in commerce, and commercial use of chrysotile asbestos-containing brake blocks used in the oil industry, aftermarket automotive chrysotile asbestos-containing brakes/linings, other chrysotile asbestos-containing vehicle friction products (not including the National Aeronautics and Space Administration (NASA) Super Guppy Turbine aircraft use), and other chrysotile asbestos-containing gaskets. EPA proposes that these prohibitions take effect 180 days after the effective date of the final rule. EPA further proposes to prohibit manufacture (including import), processing, and distribution in commerce of: aftermarket automotive chrysotile asbestos-containing brakes/linings for consumer use, and other chrysotile asbestos-containing gaskets for consumer use. EPA proposes that these prohibitions take effect 180 days after the effective date of the final rule. EPA also proposes disposal and recordkeeping requirements under which regulated parties would document compliance with certain proposed prohibitions. Comments on the proposed rule are due June 13, 2022. A detailed analysis of the proposed rule is available in our April 7, 2022, memorandum.

Read More

TSCA Blog, 13-04-22

https://www.tscablog.com/entry/comments-on-proposed-ban-of-ongoing-asbestos-uses-due-june-13-2022

Alaska Senate bill would expand regulation of 'forever chemicals' in drinking water

2022-04-13

Alaska lawmakers are considering a bill that would expand testing and regulations for PFAS chemicals in drinking water, which has been linked to cancer and other serious health conditions.

Sen. Jesse Kiehl, D-Juneau, has sponsored legislation that would police seven varieties of the so-called "forever chemicals," which don't break down and often enter the environment from firefighting foams used at airports.

"These things are bad for people in extremely small amounts. We're talking about parts per trillion in your drinking water," Kiehl told the Senate Finance Committee on April 12.

PFAS action levels altered in 2019

State regulators in 2018 began policing six varieties of PFAS in the final days of Gov. Bill Walker's administration after PFAS was discovered in drinking water in wells across Alaska. The incoming Dunleavy administration watered down those regulations the following year. They now mirror federal standards and apply to two of the most common varieties of PFAS.

Among other things, Senate Bill 121 would expand action levels to seven varieties and lower the threshold of what are considered acceptable levels of PFAS in drinking water. The upshot would be more households and businesses with PFAS in their groundwater could be eligible to receive alternative sources of drinking water from the state by entering the regulatory standards directly into law.

Kiehl told the Senate committee that the bill would also heavily restrict the use of the most common contamination source in Alaska — firefighting foams that contain PFAS — except in certain cases.

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"The bill has an exception for those in the oil and gas business until an alternate firefighting substance is found," he said.

Many firefighting foams designed to put out fuel fires contain PFAS.

Rural Alaskans speak out on health risks

Yakutat Borough Manager Jon Erickson testified in support of the PFAS bill. He says his Southeast community has PFAS contamination in wells near the state-owned airport.

"And there are a number of other businesses out there," he testified by telephone. "And they are all using PFAS at this time. DOT saw the problem and so they send in cases of bottled water. So the restaurants can still operate."

He says extending municipal water in the area that's not PFAS contaminated would cost the community of 600 people at least $6 million, according to estimates from state officials.

Read More

KTOO, 13-04-22

https://www.ktoo.org/2022/04/13/alaska-pfas-bill/

Notice of Modification to Proposed Regulation on Safe Harbor Warnings for Glyphosate and Addition of Documents to Rulemaking File

2022-04-13

The Office of Environmental Health Hazard Assessment (OEHHA) is providing notice of modifications made to a previously proposed regulation, Title 27, California Code of Regulations, new sections 25607.48 and 25607.49 and addition of documents to the rulemaking file. It is providing this notice pursuant to Government Code sections 11346.8(c) and 11347.1(b), and Title 1, California Code of Regulations, section 44.

OEHHA first proposed the regulation by publishing a Notice of Proposed Rulemaking in the California Regulatory Notice Register (CRNR) on July 23, 2021. In parallel, OEHHA issued an Initial Statement of Reasons (ISOR) for the proposal.

OEHHA provided a 76-day comment period on the original proposal, extending from July 23 to October 7, 2021. It held a public hearing on September 9, 2021.

Since the close of the comment period, OEHHA has determined modifications of the original regulatory text are needed. In addition, OEHHA is relying upon additional documents in this rulemaking and is adding these documents to the rulemaking file. The purpose of this notice is to provide the public with notice of (1) the modified proposed regulatory text and (2) the additional documents included in the rulemaking file, and to open a 15-day public comment period, running from April 13, 2022, through April 28, 2022. Consistent with the Administrative Procedure Act, OEHHA will only address comments received during this comment period that address the modifications to the text of the proposed regulation or documents added to the record. Details on how to submit comments are provided below.

In the Final Statement of Reasons, OEHHA will respond to all comments received during the comment periods on the original July 2021 proposal and on the modified proposal.

Summary of Proposed Modifications

OEHHA is modifying proposed Section 25607.49, subsection (a)(3) as shown below. Additions and deletions to the proposed text are shown in double-underline (example) and strike-out (example), respectively.

(3) The words, "Using this product can expose you to glyphosate. The International Agency for Research on Cancer classified glyphosate as probably carcinogenic to humans. US EPA has determined that glyphosate is not likely to be carcinogenic to humans; other authorities have made similar determinations. Other authorities, including USEPA, have determined that glyphosate is unlikely to cause cancer, or that the evidence is inconclusive. A wide variety of factors affect your potential personal cancer risk, including the level and duration of exposure to the chemical. For more information, including ways to reduce your exposure, go to www.P65Warnings.ca.gov/glyphosate."

A copy of the full proposed regulatory text (new sections 25607.48 and 25607.49), reflecting the modification, is provided as Attachment 1.

During the comment period on the original proposal, OEHHA received comments regarding the description of the conclusions by various scientific bodies regarding the carcinogenicity of glyphosate. OEHHA is addressing the points raised in these comments by: (1) separating the description of the conclusion reached by the U.S. Environmental Protection Agency (US EPA) from the description of the conclusions reached by other authorities; (2) more closely aligning the description of

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the conclusion reached by US EPA with the language US EPA used in its conclusion; and (3) changing the modifier of the term "risk" in a manner that accounts for the diverging conclusions US EPA and other authorities reached.

Over the years, OEHHA has worked with US EPA to facilitate pesticide registrants receiving permission from US EPA to add Proposition 65 warnings to pesticide product labels. Given this past coordination, OEHHA sought input from US EPA on whether it could approve the warning language as set forth in this modified proposal, if a pesticide registrant requested approval to include such language on labels of products containing glyphosate sold in California. US EPA responded that it could approve the proposed language. Specifically, US EPA indicated that:

"it has determined that the new glyphosate-specific safe harbor language proposed in OEHHA's recent letter is sufficiently clear regarding EPA's position and thus would not be considered false and misleading. Therefore, this revised language could be approved by EPA if pesticide registrants requested it for inclusion on glyphosate product labels, and the products would not be considered misbranded."

OEHHA is adding the correspondence with US EPA referenced above to the rulemaking file as documents relied on for this rulemaking.

Read More

OEHHA, 13-04-22

https://oehha.ca.gov/proposition-65/crnr/notice-modification-proposed-regulation-safe-harbor-warnings-glyphosate-and

ACC Calls for Action After EPA Releases Draft Formaldehyde IRIS Assessment Without Addressing Transparency and Objectivity Issues

2022-04-14

WASHINGTON (April 14, 2022) — Today, the Environmental Protection Agency (EPA) released its draft Integrated Risk Information System (IRIS) assessment on formaldehyde for public comment. The American Chemistry Council (ACC) strongly objects to this decision, as it follows several unheeded calls by industry and lawmakers to address clear process deficiencies and potential issues of bias that undermine public confidence in the assessment.

Year after year, ACC has met with IRIS staff to provide briefings on new scientific findings and to urge for transparency and scientific reliability in the process. Just last week, ACC released an analysis of public documents, obtained through the Freedom of Information Act (FOIA), that revealed a troubling pattern of process irregularities, potential issues of bias and conflicts of interest. ACC called on EPA to take immediate steps to address these concerns and are disappointed that, despite repeated calls for change, EPA is instead choosing to move forward with releasing its assessment.

With ACC's concerns unaddressed, ACC is even more troubled by the possibility that EPA's draft formaldehyde IRIS assessment could be used as a risk communication tool, to guide regulations or to set policy at any level of government.

For decades, industry has invested tens of millions of dollars in research and development on the safety of products that use formaldehyde. ACC is dedicated to contributing to the public discourse on formaldehyde and is committed to any assessment used to guide regulation considers the full weight of scientific evidence. We are carefully reviewing the full assessment and plan to submit public comment by June 13.

"In August 2021, we urged EPA to ensure the draft formaldehyde IRIS assessment relies on the best available data in an objective, transparent way. Last month, we again stressed the importance of independent, sound science. And, just last week, we called on EPA to address process irregularities and transparency concerns," said Dr. Kimberly Wise White, Vice President of Regulatory & Scientific Affairs, ACC. "We are disappointed that, despite our repeated requests for EPA to address these concerns prior to releasing its draft, the agency has decided to move forward without taking the steps necessary to ensure the assessment is scientifically-sound and worthy of public confidence."

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American Chemistry Council, 14-04-22

https://www.americanchemistry.com/chemistry-in-america/news-trends/press-release/2022/acc-calls-for-action-after-epa-releases-draft-formaldehyde-iris-assessment-without-addressing-transparency-and-objectivity-issues

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New Washington State Law Puts Regulation Of PFAS In Products On The Fast Track

2022-04-14

On March 31, Washington Governor Jay Inslee signed HB 1694 into law. The new law gives the Washington State Department of Ecology (DOE or the Department) the authority to address PFAS in "priority products" under the Safer Products for Washington program. This new law is just the latest of state initiatives enacted to address PFAS in consumer products.

The Washington Legislature enacted the Pollution Prevention for Healthy People and Puget Sound Act1 in 2019. The Act directs DOE to implement a program to reduce priority chemicals in consumer products. DOE's regulatory program to implement the 2019 law is called "Safer Products for Washington." The program consists of a four-phase process occurring over the course of a five-year repeating cycle, which begins with identifying priority chemicals to be studied and considered for regulation and concludes with rulemaking. As part of the first iteration of the cyclical program, DOE has been evaluating whether to restrict the use of PFAS in carpet, textile and leather furnishings, and aftermarket stain and water resistance treatments. Washington State defines PFAS as "a class of fluorinated organic chemicals containing at least one fully fluorinated carbon atom," a broad definition that is being adopted in may state legislatures and that includes potentially thousands of substances. In its report sent to the Legislature in November 2021, Washington's DOE recommended that the use of PFAS in these products be restricted.

Also, in November 2021, the Department released a final Per- and Polyfluoroalkyl Substances Chemical Action Plan (PFAS CAP) that sets forth recommended regulatory actions to address PFAS contamination in the environment and potential impacts to animal and human health. The CAP identified additional sources of and uses of PFAS - namely water-resistant clothing and gear, nonstick cookware and kitchen supplies, personal care products (including cosmetics and dental floss), cleaning agents, automotive products, floor waxes and sealants, ski waxes, and car waxes. Accordingly, DOE recommended that these products be considered for regulation in the second Safer Products cycle.

To further enhance the state's already assertive program, HB 1694 allows the Department to identify any product named in the PFAS CAP as a "priority product" for purposes of the Safer Products program. In addition, the bill allows DOE to determine regulatory actions and adopt rules to implement those regulatory determinations without going through the

standard four phase/five-year process. Consequently, HB 1694 requires the DOE to act on more PFAS products in the next few years. The new law is not a complete ban on the use of PFAS; instead, it requires the DOE to determine an initial set of regulatory actions for PFAS in CAP-identified products by June 1, 2024, and then adopt rules to implement the determinations by December 1, 2025. Nevertheless, regulation of PFAS in these products will certainly occur in the near future in the State of Washington, and it will be important to follow closely which PFAS chemicals and which products will be regulated under this new law.

Read More

Arnold & Porter, 14-04-22

https://www.mondaq.com/unitedstates/chemicals/1183272/new-washington-state-law-puts-regulation-of-pfas-in-products-on-the-fast-track

EUROPE

Safety of alpha-arbutin and beta-arbutin in cosmetic products

2022-03-25

Details

Publication date

25 March 2022

Author

Scientific Committee on Consumer Safety (SCCS)

Description

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On request from: European Commission

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SCCS Number: SCCS/1642/22

Adopted on: 15-16 March 2022

Conclusion of the opinion:

(1) In light of the data provided, does the SCCS consider α-arbutin safe when used in face creams up to a maximum concentration of 2% and in body lotions up to a maximum concentration of 0.5 %?

Having considered the data provided, and other relevant information available in scientific literature, the SCCS cannot conclude on the safety of alpha-arbutin when used in face creams up to a maximum concentration of 2% and in body lotions up to a maximum concentration of 0.5%. Relevant data on the degradation/metabolism of alpha-arbutin, exposed to the skin microbiome/enzymes, are not available and the release of hydroquinone and its final fate are not documented. These data are essentially required for safety assessment.

(2) In the event that the estimated exposure to α-arbutin from cosmetic products is found to be of concern, SCCS is asked to recommend safe concentration limits.

For the reasons given under question 1, the SCCS cannot recommend a safe concentration of alpha-arbutin.

(3) In light of the data provided, does the SCCS consider β-arbutin safe when used in face creams up to a maximum concentration of 7%?

No information was provided during the call for data. The SCCS has, therefore, considered the information available in scientific literature but regarded it insufficient to conclude on the safety of beta-arbutin when used in face cream up to a maximum concentration of 7%. Also, relevant data on the fate of beta-arbutin, when applied to human skin and its microbiome/enzymes, are not available and the release of hydroquinone and its final fate are not documented.

(4) In the event that the estimated exposure to β-arbutin from cosmetic products is found to be of concern, SCCS is asked to recommend safe concentration limits.

For the reasons given under question 3, the SCCS cannot recommend a safe concentration of beta-arbutin.

(5) In light of the data provided, does the SCCS consider that the presence of hydroquinone in the cosmetic formulations must remain below 1 ppm for both α- and β arbutin containing products?

Hydroquinone should remain as low as possible in formulations containing alpha-or beta arbutin and should not be higher than the unavoidable traces in both arbutins. In the new studies, submitted by the applicant, 3ppm was the LOQ/LOD of the methodology used.

(6) Does the SCCS have any further scientific concerns regarding the use of a- and β arbutin in cosmetic products in relation to aggregate exposure from such substances in cosmetics?

Safe concentrations for either of the arbutins in cosmetic products cannot be established without the data on the release of hydroquinone and their final fate.

Read More

European Commission, 25-03-22

https://ec.europa.eu/health/publications/safety-alpha-arbutin-and-beta-arbutin-cosmetic-products_en

Germany AwSV List of published WGK classifications updated

2022-04-05

On 5 April 2022, the German Ordinance on Facilities Handling Substances That Are Hazardous to Water (AwSV) List of published water hazard class (WGK) classifications was updated. The following substances were newly assigned a WGK:

2. Amines, C12-14-tert-alkyl, mixed sec-Bu and iso-Bu phosphates
   WGK 2 (obviously hazardous to water)
3. Cyclohexane, 1,1′-methylenebis[4-isocyanato-, homopolymer, 2-butoxyethanol- and polyethylene glycol mono-Me ether-blocked
   WGK 1 (slightly hazardous to water)
4. 5′,5′′′-(1,1,1-trifluoropropane-2,2-diyl)bis(1,1′:3′,1′′-terphenyl-2′-ol)
   WGK 1 (slightly hazardous to water)
5. Amines, C10-14-branched and linear alkyl, bis[2-[(4,5-dihydro-3-methyl-5-oxo-1-phenyl-1H-pyrazol-4-yl)azo]benzoato(2-)]chromate(1-)
   WGK 2 (obviously hazardous to water)

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6. Sodium 3,3′-(9,10-dioxoanthracene-1,4-diyldiimino)bis(2,4,6-trimethylbenzenesulphonate)
   WGK 1 (slightly hazardous to water)
7. 3,6-Dimethyl-3H-benzofuran-one
   WGK 3 (highly hazardous to water)
8. Tetramethyl orthosilicate
   WGK 1 (slightly hazardous to water)
9. Tetrapropyl orthosilicate
   WGK 1 (slightly hazardous to water)
10. Triethoxypropylsilane
    WGK 1 (slightly hazardous to water)
11. Trichloro(3-chloropropyl)silane
    WGK 1 (slightly hazardous to water)
12. Dihydrogen (ethyl)[4-[4-[ethyl(3-sulphonatobenzyl)amino](4-hydroxy-2-sulphonatobenzhydrylidene]cyclohexa-2,5-dien-1-ylidene](3-sulphonatobenzyl)ammonium, disodium salt
    WGK 1 (slightly hazardous to water)
13. N-hydroxyoctanamide
    WGK 1 (slightly hazardous to water)
14. 13. Heptyl undec-10-enoate
    WGK 3 (highly hazardous to water)
15. 14. 4-(Butoxymethyl)-2-methoxy-phenol
    WGK 1 (slightly hazardous to water)

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Yordas Hive, 05-04-22

https://www.yordashive.com/news/e9mtaa9j52cska96c5xjze92jlkhhw

Intellectual property: Commission boosts protection of European craft and industrial products in the EU and beyond

2022-04-13

Today, the Commission has proposed a first-ever framework to protect the intellectual property for craft and industrial products that rely on the originality and authenticity of traditional practices from their regions. This framework will cover products such as Murano glass, Donegal tweed, Porcelaine de Limoges, Solingen cutlery and Boleslawiec pottery. While these products benefit from a European and sometimes global reputation

and standing, producers have so far lacked an EU indication protection linking their products' origin and reputation to their quality.

Drawing on the success of the geographical indication system for wine-spirit drinks and agricultural products, with today's proposal for a Regulation, the Commission aims to enable producers to protect craft and industrial products associated with their region and their traditional know-how, with effects in Europe and beyond. The Regulation, providing for an EU indication protection, will make it easier for consumers to recognise the quality of such products and make more informed choices. It will help to promote, attract and retain skills and jobs in Europe's regions, contributing to their economic development. The proposal would also ensure that traditional craft and industrial products are put on an equal footing with protected geographical indications that already exist in the agricultural area.

Executive Vice-President Margrethe Vestager for A Europe Fit for the Digital Age said: "Many European regions hold an untapped potential for jobs and growth. Notably in the crafts and industrial sector, many SMEs have developed and refined manufacturing skills over generations, but lack incentives and resources to project them, especially across borders. The protection granted by geographical indications for craft and industrial products will encourage both regions and producers in their competition at a continental and global level."

Commissioner Thierry Breton, responsible for the Internal Market, said: "Europe has an exceptional legacy of world-renown crafts and industrial products. It is time that these producers benefit from a new intellectual property right, like food and wine producers, that will increase trust and visibility for their products, guaranteeing authenticity and reputation. Today's initiative will contribute to the creation of skilled jobs especially for SMEs and to the development of tourism also in the more rural or economically weak areas."

Today's proposal for a Regulation will:

- Establish an EU-wide protection for geographical indications of craft and industrial products to help producers protect and enforce the intellectual property rights of their products across the EU. The new Regulation will also facilitate action against fake products, including those sold online. It will address the currently fragmented and partial protections that exist at national level.

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- Enable simple and cost-efficient registration of GIs for craft and industrial products by establishing a two-level application process. This would require producers to file their GI applications to designated Member States' authorities, who will then submit successful applications for further evaluation and approval to the European Union Intellectual Property Office (EUIPO). A direct application procedure to EUIPO will also be possible for Member States that do not have a national evaluation procedure in place. The proposal also offers the possibility for producers to self-declare compliance of their products with the product specifications, making the system lighter and less costly.

Read More

European Commission, 13-04-22

https://ec.europa.eu/commission/presscorner/detail/en/ip_22_2406

Accession countries need targeted support to prepare for EU chemicals laws

2022-04-13

A recent study finds that Albania, Bosnia and Herzegovina, Kosovo, North Macedonia and Turkey need more resources to implement the EU's chemicals laws. ECHA is supporting them through capacity building and training.

Helsinki, 13 April 2022 - For the past 10 years, Albania, Bosnia and Herzegovina, Kosovo, North Macedonia and Turkey have worked to harmonise their legal frameworks for managing chemicals with EU regulations. ECHA has aided their progress under the Instrument for Pre-accession Assistance on behalf of the European Commission.

A new study, commissioned by ECHA on behalf of the European Commission, has generated national action plans and identified gaps and shortcomings in the capacity of the five candidates and pre-candidates to EU accession to enact EU chemicals legislation. They would need more financial, human and IT resources to successfully implement and enforce the REACH, CLP, BPR, PIC and POPs regulations. The study also recommends them to strengthen cooperation with academia, increase communications activities and devote more resources to IT.

To enable future membership, the study suggests that the five candidates and pre-candidates to EU accession, ECHA and EU Member States will need to intensify their work through several actions listed in the national plans. ECHA stands ready to continue supporting Albania, Bosnia and Herzegovina, Kosovo, North Macedonia and Turkey by providing training to their authorities on risk assessment, IT security and tools, as well as enforcement.

Read More

ECHA, 13-04-22

https://echa.europa.eu/nl/-/accession-countries-need-targeted-support-to-prepare-for-eu-chemicals-laws

Five substances added to REACH Authorisation List

2022-04-12

Companies that want to continue using these substances after the agreed sunset dates will need to apply for authorisation. The Authorisation List now contains 59 entries.

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Helsinki, 12 April 2022 – ECHA identified the five substances as substances of very high concern due to their reprotoxic, carcinogenic or endocrine disrupting properties and recommended for the European Commission to add them to the Authorisation List in 2019. The five substances are:

- Tetraethyllead (TEL) (EC 201-075-4, CAS 78-00-2);
- 4,4'-bis(dimethylamino)-4"-(methylamino)trityl alcohol [with ≥ 0.1% w/w of Michler's ketone (EC 202-027-5) or Michler's base (EC 202-959-2)] (EC 209-218-2, CAS 561-41-1);
- Reaction products of 1,3,4-thiadiazolidine-2,5-dithione, formaldehyde and 4-heptylphenol, branched and linear (RP-HP) [with ≥ 0,1% w/w 4-heptylphenol, branched and linear (4-HPbl)] (EC -, CAS -);
- 2-ethylhexyl 10-ethyl-4,4-dioctyl-7-oxo-8-oxa-3,5-dithia-4-stannatetradecanoate (DOTE) (EC 239-622-4, CAS 15571-58-1); and
- Reaction mass of 2-ethylhexyl 10-ethyl-4,4-dioctyl-7-oxo-8-oxa-3,5-dithia-4-stannatetradecanoate and 2-ethylhexyl 10-ethyl-4-[[2-[(2-ethylhexyl)oxy]-2-oxoethyl]thio]-4-octyl-7-oxo-8-oxa-3,5-dithia-4-stannatetradecanoate (reaction mass of DOTE and MOTE) (EC -, CAS -).

These substances are used, for example, as fuel additives, in formulation of inks, in lubricants, and as a stabiliser in the production of polymers.

The amendment of the Authorisation List (Annex XIV to REACH) was published on 11 April in the EU's Official Journal.

Read More

ECHA, 12-04-22

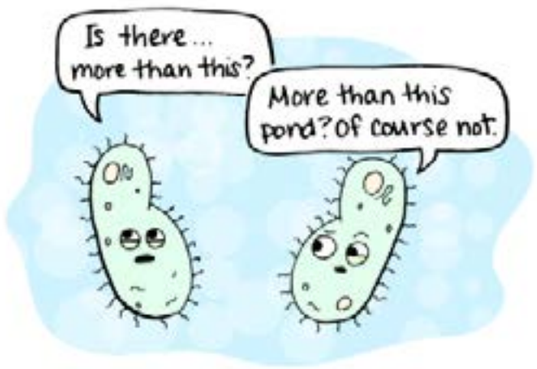
https://echa.europa.eu/nl/-/five-substances-added-to-reach-authorisation-list

Janet's Corner

APR. 22, 2022

Paremecium Thoughts

2022-04-22



http://www.beatricebiologist.com/2022/04/paremecium-thoughts/

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Trichloroethylene

2022-04-22

The chemical compound trichloroethylene is a chlorinated hydrocarbon commonly used as an industrial solvent. It is a clear non-flammable liquid with a sweet smell. The IUPAC name is trichloroethene. [1]

USES[2]

Trichloroethylene was once used as an extractant in food processing and has been used as an anaesthetic and analgesic for medical purposes. Currently, it is widely used as a solvent in the industrial degreasing of metals, with secondary solvent uses in adhesive paint and polyvinyl chloride production. Trichloroethylene is used as a solvent in the textile industry, as a solvent for adhesives and lubricants, and as a low-temperature heat transfer fluid. In addition, it is implemented in the manufacturing of pesticides and other chemicals.

TRICHLOROETHYLENE IN THE ENVIRONMENT AND POTENTIAL EXPOSURE

Trichloroethylene dissolves a little in water, but it can remain in ground water for a long time. Upon contact with surface water it quickly evaporates, so it is commonly found as a vapour in the air. Trichloroethylene evaporates less easily from the soil than from surface water. It may stick to particles and remain for a long time. Furthermore, it may stick to particles in water, which will cause it to eventually settle to the bottom sediment. It does not build up significantly in plants and animals. [3] Trichloroethylene has been detected in ambient air at levels less than 1 part per billion (ppb). Because of its moderate water solubility, trichloroethylene in soil has the potential to migrate into groundwater. The relatively frequent detection of trichloroethylene in groundwater confirms its mobility in soils. Drinking water supplies relying on contaminated groundwater sources may contain trichloroethylene. Workers may be exposed to trichloroethylene in the factories where it is manufactured or used. In addition, persons breathing air around these factories may be exposed to trichloroethylene. Persons may be exposed to trichloroethylene through the use of products containing the chemical and from evaporation and leaching from waste disposal sites. [4]

The chemical compound trichloroethylene is a chlorinated hydrocarbon commonly used as an industrial solvent.

HEALTH HAZARD INFORMATION [4]

Acute Effects

Central nervous system effects are the primary effects noted from acute inhalation exposure to trichloroethylene in humans, with symptoms including sleepiness, fatigue, headache, confusion, and feelings of euphoria.

Effects on the liver, kidneys, gastrointestinal system, and skin have also been noted. Neurological, lung, kidney, and heart effects have been reported in animals acutely exposed to trichloroethylene.

Tests involving acute exposure of rats and mice have shown trichloroethylene to have low toxicity from inhalation exposure and moderate toxicity from oral exposure.

Chronic Effects

As with acute exposure, chronic exposure to trichloroethylene by inhalation also affects the human central nervous system. Case reports of intermediate and chronic occupational exposures included effects such as dizziness, headache, sleepiness, nausea, confusion, blurred vision, facial numbness, and weakness. Effects to the liver, kidneys, and immune and endocrine systems have also been seen in humans exposed to trichloroethylene occupationally or from contaminated drinking water. Research has demonstrated that simultaneous alcohol consumption and trichloroethylene inhalation increases the toxicity of trichloroethylene in humans. Neurological, liver, and kidney effects were reported in chronically-exposed animals.

Reproductive/Developmental Effects

A study of nurses occupationally exposed by inhalation to trichloroethylene along with other chemicals in operating rooms, and another epidemiological study of women exposed occupationally or non-occupationally to trichloroethylene and other solvents, have reported increases in the incidence of miscarriages. The presence of other chemicals, however, limits the ability to draw conclusions specific to trichloroethylene. An epidemiological study of 2,000 male and female workers exposed to trichloroethylene via inhalation found no increase in malformations in babies born following exposure. Several studies have evaluated and not found an association between adverse reproductive effects in humans and exposure to trichloroethylene in contaminated drinking water. An association was found between

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the occurrence of congenital heart disease in children and a drinking water supply contaminated with trichloroethylene and other similar chemicals; however, no causal relationship with trichloroethylene could be concluded. Animal studies have reported developmental effects from exposure to trichloroethylene and its metabolites (trichloroacetic acid [TCA] and dichloroacetic acid [DCA]).

Cancer Risk

The cancer epidemiology for trichloroethylene has grown in recent years with several large, well-designed studies being published. A recent analysis of available epidemiological studies reports trichloroethylene exposure to be associated with several types of cancers in humans, especially kidney, liver, cervix, and lymphatic system. Consistency across epidemiological studies is strongest for an association between trichloroethylene exposure and kidney cancer. These results are supported by recent molecular epidemiology studies showing specific renal cell mutations found primarily in renal cell carcinoma patients exposed to trichloroethylene. Animal studies have reported increases in lung, liver, kidney, and testicular tumours and lymphoma from inhalation and oral exposures in rats and mice.

SAFETY

First Aid Measures [8]

- Eye Contact: Check for and remove any contact lenses. Immediately flush eyes with running water for at least 15 minutes, keeping eyelids open. Cold water may be used. Do not use an eye ointment. Seek medical attention.
- Skin Contact: After contact with skin, wash immediately with plenty of water. Gently and thoroughly wash the contaminated skin with running water and non-abrasive soap. Be particularly careful to clean folds, crevices, creases and groin. Cover the irritated skin with an emollient. If irritation persists, seek medical attention. Wash contaminated clothing before reusing.
- Serious Skin Contact: Wash with a disinfectant soap and cover the contaminated skin with an anti-bacterial cream. Seek medical attention.
- Inhalation: Allow the victim to rest in a well ventilated area. Seek immediate medical attention.

- Serious Inhalation: Evacuate the victim to a safe area as soon as possible. Loosen tight clothing such as a collar, tie, belt or waistband. If breathing is difficult, administer oxygen. If the victim is not breathing, perform mouth-to-mouth resuscitation. Seek medical attention.
- Ingestion: Do not induce vomiting. Loosen tight clothing such as a collar, tie, belt or waistband. If the victim is not breathing, perform mouth-to-mouth resuscitation. Seek immediate medical attention.

Exposure Controls and Personal Protection [7]

Exposure Controls

- Trichloroethylene should only be used in areas from which all naked lights and other sources of ignition have been excluded.
- Ventilation hoods and fans required when working with organic solvents or in hot melt applications.
- Trichloroethylene should be kept away from food, drink and animal feeding stuffs. Wash hands and face before breaks and immediately after handling the products.

Personal Protective Equipment

The following personal protective equipment is recommended when handling trichloroethylene:

- Respiratory protection: In the case of insufficient ventilation, wear suitable respiratory equipment.
- Hand protection: Solvent-resistant gloves (butyl rubber).
- Eye protection: Goggles giving complete protection to eyes.
- Skin and body protection: Chemical resistant apron/flame retardant antistatic protecting clothing, heavy duty work shoes.

REGULATION

United States [9]

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

- General Industry: 29 CFR 1910.1000 Z-2 Table -- 100 ppm TWA; Also, exposures shall not exceed 200 ppm (ceiling) with the following exception: exposures may exceed 200 ppm, but not more than 300 ppm (peak), for a single time period up to 5 minutes in any 2 hours.

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- Construction Industry: 29 CFR 1926.55 Appendix A -- 100 ppm (535 mg/m^3) TWA
- Maritime: 29 CFR 1915.1000 Table Z-Shipyards -- 100 ppm (535 mg/m^3) TWA

ACGIH: American Conference of Governmental Industrial Hygienists has set a Threshold Limit Value (TLV) (2006) for trichloroethylene of 10 ppm (54 mg/m^3) TWA; 25 ppm (135 mg/m^3) STEL; A2; BEI.

NIOSH: National Institute for Occupational Safety and Health has set a Recommended Exposure Limit (REL):Appendix A - NIOSH Potential Occupational Carcinogens; Appendix C - supplementary Exposure Limits - 2 ppm 1-hour Ceiling as an anaesthetic agent and 25 ppm 10-hour TWA all other exposures.

Australia [6]

In Australia, any product containing more than 0.1% trichloroethylene is classed as a Hazardous Substance. Trichloroethylene is Class 6.1. under the Australian Dangerous Goods Code. Where trichloroethylene is used for vapour degreasing, the degreasers should be made to Australian Standard AS 2661. In addition, the Australian Standard 2865: Safe working in a confined space should be strictly followed for trichloroethylene. The current national exposure standards are an average exposure limit of 50 ppm TWA and a short-term exposure limit of 200 ppm STEL.

European Union [5]

EU legislation includes: Directive 76/464 Pollution of the aquatic environment by dangerous substances (plus daughter directives). It is also regulated under the EC Solvents Directive (VOC emissions). [5]

International [5]

As a VOC it is regulated internationally by the UNECE Convention on Long-Range Transboundary Air Pollution and by the Basel Convention on the Transboundary Movements of Hazardous Wastes and their Disposal. It is also listed as a candidate substance for selection, assessment and prioritisation under the OSPAR and Helsinki Conventions. [5]

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Hydrogen 11 times worse than CO2 for climate, says new report

2022-04-11

Hydrogen will be one of humanity's key weapons in the war against carbon dioxide emissions, but it must be treated with care. New reports show how fugitive hydrogen emissions can indirectly produce warming effects 11 times worse than those of CO2.

Hydrogen can be used as a clean energy carrier, and running it through a fuel cell to produce electricity produces nothing but water as a by-product. It carries far more energy for a given weight than lithium batteries, and it's faster to refill a tank than to charge a battery, so hydrogen is viewed as a very promising green option in several hard-to-decarbonize applications where batteries won't cut the mustard – for example, aviation, shipping and long-haul trucking.

But when it's released directly into the atmosphere, hydrogen itself can interact with other gases and vapors in the air to produce powerful warming effects. Indeed, a new UK Government study has put these interactions under the microscope and determined that hydrogen's Global Warming Potential (GWP) is about twice as bad as previously understood; over a 100-year time period, a tonne of hydrogen in the atmosphere will warm the Earth some 11 times more than a tonne of CO2, with an uncertainty of ± 5.

Over a 100-year time period, a tonne of hydrogen in the atmosphere will warm the Earth some 11 times more than a tonne of CO2.

How does hydrogen act like a greenhouse gas?

One way is by extending the lifetime of atmospheric methane. Hydrogen reacts with the same tropospheric oxidants that "clean up" methane emissions. Methane is an incredibly potent greenhouse gas, causing some 80 times more warming than an equivalent weight of CO2 over the first 20 years. But hydroxyl radicals in the atmosphere clean it up relatively quickly, while CO2 remains in the air for thousands of years, so CO2 is worse in the long run.

When hydrogen is present, however, those hydroxyl radicals react with the hydrogen instead. There are fewer cleanup agents to go around, so there's a direct rise in methane concentrations, and the methane stays in the atmosphere longer.

What's more, the presence of hydrogen increases the concentration of both tropospheric ozone and stratospheric water vapor, boosting a "radiative forcing" effect that also pushes temperatures higher.

How does hydrogen escape into the atmosphere?

A lot of it is leakage, according to a second report from Frazer-Nash Consultancy. Store hydrogen in a compressed gas cylinder, and you can assume you'll lose between 0.12 percent and 0.24 percent of it every day. It'll leak out of pipes and valves if you distribute it that way, losing some 20 percent more volume than the methane gas that's now running through municipal pipelines – although since hydrogen is so much lighter than methane, this larger volume equates to just 15 percent of the weight.

Where hydrogen is transported as a cryogenic liquid, boil-off is unavoidable, and you can expect to lose an average of about 1 percent of it per day. Currently, this is vented to the atmosphere.

Indeed, venting and purging operations are currently common across the hydrogen life cycle. They occur during electrolysis, during compression, during refueling, and during the process of conversion back into electricity through a fuel cell.

Where there is venting or purging, the percentages tend to dwarf what's lost through simple leakage – for example, current electrolysis procedures using venting and purging are assumed to lose between 3.3-9.2 percent of all hydrogen produced, depending largely on how often the process starts up and shuts down – this is a bit of a worry in situations where hydrogen production is seen as a way to store excess renewable energy that's not being snapped up by immediate demand.

Purging and venting emissions can be cleaned up significantly by adding systems to recombine the vented or purged hydrogen back into water and feed it back into the process – but it'll be a while before these kinds of operations are economically viable.

In all, the Frazer-Nash report expects that between 1-1.5 percent of all hydrogen in its central modeling scenario will be emitted into the atmosphere, with transport emissions responsible for around half of that, and emissions at the production and consumption ends taking up roughly a quarter each.

Meanwhile, operating under different assumptions, the first report linked expects somewhere between 1 percent and 10 percent of all hydrogen in its global scenario will be emitted into the atmosphere,

Does this mean "green hydrogen" should be avoided in the race to zero emissions?

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No. The UK Government report explains that "the increase in equivalent CO2 emissions based on 1 percent and 10 percent H2 leakage rate offsets approximately 0.4 and 4 percent of the total equivalent CO2 emission reductions respectively," so even assuming the worst leakage scenario, it's still an enormous improvement.

"Whilst the benefits from equivalent CO2 emission reductions significantly outweigh the disbenefits arising from H2 leakage," it continues, "they clearly demonstrate the importance of controlling H2 leakage within a hydrogen economy."

Source: Atmospheric Implications of Increased Hydrogen Use/Fugitive Hydrogen Emissions in a Future Hydrogen Economy via Recharge News

New Atlas, 11 April 2022

https://newatlas.com

Study shows regular blood donation could remove PFAS from firefighters' bodies

2022-04-11

A world-first study involving hundreds of Victorian firefighters shows regular blood donations could reduce the level of potentially harmful chemicals in their bodies.

The trial, conducted by Macquarie University over 12 months, measured the effect of blood donation on levels of per-fluoroalkyl and poly-fluoroalkyl substances (PFAS) in the body.

PFAS is a broad name for 4,700 chemicals that have widespread use in everyday life, from non-stick cookware to carpets and clothing.

Historically, PFAS have also been used in firefighting foams, meaning firefighters are the most occupationally exposed cohort to the chemicals.

Previously there was no way to reduce the amount of PFAS in the body.

Fire Rescue Victoria (FRV) Assistant Chief Fire Officer Mick Tisbury said the results of the study were a triumph against the odds.

"We've done it. Everybody said it couldn't be done and we've been able to get these toxic chemicals out of our bodies," Mr Tisbury said.

PFAS is a broad name for 4,700 chemicals that have widespread use in everyday life, from non-stick cookware to carpets and clothing.

"Don't ever tell a firefighter something is too hard to achieve, because that's what we do every single day of the week, we come up with solutions and that's what we've done here."

PFAS have been correlationally linked to thyroid issues, low fetus weight, endocrine disruption and various forms of cancer.

Firefighter describes 'time bomb' of PFAS exposure

Environmental scientist Mark Taylor, who co-authored the study, said the health benefits of PFAS removal were still to be determined, but the psychological impact on firefighters was immeasurable.

"They don't focus on the clinical outcomes, they take a precautionary approach," Professor Taylor said.

"They say 'we don't want these chemicals in our body, we don't want to be guinea pigs to see what's going to happen to us in 10, 20, 30 years. Let's get them out'."

Mr Tisbury said the mental pressure of having high PFAS levels after years of exposure was immense.

"As a firefighter that's been exposed to this stuff for 33 years, my levels of anxiety are already through the roof," Mr Tisbury said.

"It feels like we've got a time bomb in our body."

While PFAS firefighting foams have been phased out in the past decade — and outright banned in Queensland, South Australia and New South Wales — the long half-life of the compound means it remains in the environment for years.

Many FRV fire trucks were still contaminated with the substance years after the foam had been phased out of use.

While trucks and equipment are able to be decontaminated, removal of PFAS from the body represents the final hurdle.

No national legislation around the use of PFAS exists, with the compounds still in use in industrial settings.

Plasma donations cut PFAS levels by a third

The $1.2 million clinical trial involved 285 FRV staff and contractors with elevated levels of perfluorooctane sulfonate, a commonly detected type of PFAS, in their systems.

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Trial participants donated blood or plasma at either six or 12 week intervals for a year, with their PFAS levels measured before, during and after the 12-month period.

The results showed a 10 per cent decrease in PFAS levels after blood donation, and a 30 per cent reduction following plasma donations.

"It's not an instant solution because it's got to be spread out of a period of time to be efficacious, but we can see the results from the study," Professor Taylor said.

While decontamination efforts continue at fire stations around the country for appliances and vehicles, the trial represents a breakthrough in intervention for people exposed to high levels of PFAS.

In cases where firefighters have high levels of PFAS in their system, therapeutic donations where blood is drawn and then discarded may be considered.

In March, a Senate joint standing committee recommended the government examine the team's research on PFAS, stating:

The Committee recommends that the Australian Government consider the research, with a view to examining suitable options for a mechanism for people with high levels of PFAS, who are otherwise unable to donate blood or plasma, to make therapeutic donations as an intervention to reduce their levels of PFAS.

The trial team has been asked to present the results of their work to the United Nations.

Mr Tisbury said he was enthusiastic about sharing the study's results with fire services at home and abroad.

"The world is interested," he said.

"There are no solutions on the table [and] we've developed the solutions."

ABC News, 11 April 2022

https://abc.net.au

MIT Scientists Develop New Regenerative Drug That Reverses Hearing Loss

2022-04-09

Frequency Therapeutics, a biotechnology company, is working to repair hearing loss using a novel kind of regenerative treatment rather than hearing aids or implants. The company programs progenitor cells, a descendent of stem cells in the inner ear, to make the tiny hair cells that enable humans to hear, using small molecules.

When exposed to loud sounds or medicines, such as certain chemotherapies and antibiotics, hair cells die. The medication candidate developed by Frequency is intended to be injected into the ear to rebuild these cells inside the cochlea. The organization has already enhanced people's hearing in clinical trials, as judged by speech perception tests – the capacity to interpret and distinguish words.

"Speech perception is the No. 1 goal for improving hearing and the No. 1 need we hear from patients," Frequency co-founder and Chief Scientific Officer Chris Loose PhD '07 states.

After a single injection, several subjects showed statistically significant improvements in speech perception, with some responses lasting almost two years in Frequency's first clinical research.

To date, the company has dosed over 200 people and found clinically significant improvements in speech perception in three different clinical investigations. Another study found no difference in hearing between the treatment group and the placebo group, however, the manufacturer attributes this to problems in the trial's design.

Now Frequency is recruiting for a 124-person trial from which preliminary results should be available early next year.

The company's founders, including Loose, MIT Institute Professor Robert Langer, CEO David Lucchino MBA '06, Senior Vice President Will McLean PhD '14, and Harvard-MIT Health Sciences and Technology affiliate faculty member Jeff Karp, are already gratified to have been able to help people improve their hearing through the trials. They also believe they're making important contributions toward solving a problem that impacts more than 40 million people in the U.S. and hundreds of millions more around the world.

"Hearing is such an important sense; it connects people to their community and cultivates a sense of identity," says Karp, who is also a

MIT spinout Frequency Therapeutics' drug candidate stimulates the growth of hair cells in the inner ear.

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professor of anesthesia at Brigham and Women's Hospital. "I think the potential to restore hearing will have enormous impact on society."

From the lab to patients

In 2005, Lucchino was an MBA student in the MIT Sloan School of Management and Loose was a PhD candidate in chemical engineering at MIT. Langer introduced the two aspiring entrepreneurs, and they started working on what would become Semprus BioSciences, a medical device company that won the MIT $100K Entrepreneurship Competition and later sold at a deal valued at up to $80 million.

"MIT has such a wonderful environment of people interested in new ventures that come from different backgrounds, so we're able to assemble teams of people with diverse skills quickly," Loose says.

Eight years after playing matchmaker for Lucchino and Loose, Langer began working with Karp to study the lining of the human gut, which regenerates itself almost every day.

With MIT postdoc Xiaolei Yin, who is now a scientific advisor to Frequency, the researchers discovered that the same molecules that control the gut's stem cells are also used by a close descendant of stem cells called progenitor cells. Like stem cells, progenitor cells can turn into more specialized cells in the body.

"Every time we make an advance, we take a step back and ask how this could be even bigger," Karp says. "It's easy to be incremental, but how do we take what we learned and make a massive difference?"

Progenitor cells reside in the inner ear and generate hair cells when humans are in utero, but they become dormant before birth and never again turn into more specialized cells such as the hair cells of the cochlea. Humans are born with about 15,000 hair cells in each cochlea. Such cells die over time and never regenerate.

In 2012, the research team was able to use small molecules to turn progenitor cells into thousands of hair cells in the lab. Karp says no one had ever produced such a large number of hair cells before. He still remembers looking at the results while visiting his family, including his father, who wears a hearing aid.

"I looked at them and said, 'I think we have a breakthrough,'" Karp says. "That's the first and only time I've used that phrase."

The advance was enough for Langer to play matchmaker again and bring Loose and Lucchino into the fold to start Frequency Therapeutics.

The founders believe their approach — injecting small molecules into the inner ear to turn progenitor cells into more specialized cells — offers advantages over gene therapies, which may rely on extracting a patient's cells, programming them in a lab, and then delivering them to the right area.

"Tissues throughout your body contain progenitor cells, so we see a huge range of applications," Loose says. "We believe this is the future of regenerative medicine."

Advancing regenerative medicine

Frequency's founders have been thrilled to watch their lab work mature into an impactful drug candidate in clinical trials.

"Some of these people [in the trials] couldn't hear for 30 years, and for the first time they said they could go into a crowded restaurant and hear what their children were saying," Langer says. "It's so meaningful to them. Obviously more needs to be done, but just the fact that you can help a small group of people is really impressive to me."

Karp believes Frequency's work will advance researchers' ability to manipulate progenitor cells and lead to new treatments down the line.

"I wouldn't be surprised if in 10 or 15 years, because of the resources being put into this space and the incredible science being done, we can get to the point where [reversing hearing loss] would be similar to Lasik surgery, where you're in and out in an hour or two and you can completely restore your vision," Karp says. "I think we'll see the same thing for hearing loss."

The company is also developing a drug for multiple sclerosis (MS), a disease in which the immune system attacks the myelin in the brain and central nervous system. Progenitor cells already turn into the myelin-producing cells in the brain, but not fast enough to keep up with losses sustained by MS patients. Most MS therapies focus on suppressing the immune system rather than generating myelin.

Early versions of that drug candidate have shown dramatic increases in myelin in mouse studies. The company expects to file an investigational new drug application for MS with the FDA next year.

"When we were conceiving of this project, we meant for it to be a platform that could be broadly applicable to multiple tissues. Now we're moving

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into the remyelination work, and to me it's the tip of the iceberg in terms of what can be done by taking small molecules and controlling local biology," Karp says.

For now, Karp is already thrilled with Frequency's progress, which hit home the last time he was in Frequency's office and met a speaker who shared her experience with hearing loss.

"You always hope your work will have an impact, but it can take a long time for that to happen," Karp says. "It's been an incredible experience working with the team to bring this forward. There are already people in the trials whose hearing has been dramatically improved and their lives have been changed. That impacts interactions with family and friends. It's wonderful to be a part of."

SciTech Daily, 9 April 2022

This startup fights climate change by growing algae in the desert

2022-04-13

Per unit area, the company claims to capture as much carbon as a rainforest can.

In the Sahara Desert along the coastline in Morocco, more than 300 miles from the nearest city, a green pond now sits in the middle of the sand. It's a test site for Brilliant Planet, a startup that plans to fight climate change by growing vast quantities of carbon-capturing algae in the world's deserts.

"Per unit area, we can fix as much carbon—or more carbon, depending on where we are in the seasonality—as a rainforest," says Raffael Jovine, cofounder and chief scientist at Brilliant Planet. "The difference is, when a rainforest tree falls down, it returns 97% of the carbon back to the atmosphere, whereas we can sequester all of it." The production at the test site varies, as the company runs different trials. But when it builds the first commercial-scale plant, covering 1,000 acres, it expects to remove 40,000 tons of CO_2 per year, roughly the equivalent emissions of using 92,000 barrels of oil. Scaled up to cover available desert land on coasts, the system could hypothetically remove 2 gigatons of CO_2 a year.

The company pumps seawater from the nearby coast into its facility, taking advantage of the fact that the water is filled both with nutrients that algae needs to grow and with CO_2; the ocean has absorbed tens of billions of tons of CO_2 emissions over the last few decades. As the water flows through a series of containers and ponds, algae grows in

the startup's proprietary system and captures carbon. When the algae is ready to be harvested—a process that takes between 18 and 30 days—it's filtered out of the water, which is returned to the ocean. (The process also makes the water less acidic, helping solve another problem caused by climate change.) Then the algae is dried and buried under the sand, where the carbon it captures can be permanently stored.

It's one example of something that climate science says is necessary: Tackling climate change involves not only moving away from fossil fuels and eliminating other emissions, but also removing CO2 from the air. The latest IPCC report says that carbon removal—both through technology and natural solutions like planting trees— is essential and will have to massively grow for the world to have any chance of limiting global warming to 1.5 or 2 degrees Celsius.

Other companies growing algae, including biofuel startups that failed in the past, focused on a different approach, growing algae inside bioreactors that were expensive and complex to run. Jovine compares the old approach to growing in a test tube. "Instead of upscaling a test tube, we're downscaling the ocean," he says. "What that really means is that, fundamentally, we have taken natural processes, natural algal blooms, that are the basis of the food chain in the ocean. And we have taken those and brought them on land in a very large scale."

In the ocean, large algae blooms happen seasonally, but the company developed a process that can grow algae quickly year-round. The system can capture CO2 at far less cost than direct air capture plants that suck carbon from the air. The algae facility costs less than $50 per ton of captured CO2 to operate; direct air capture can cost 10 times as much. As with direct air capture plants, the company will sell carbon credits to companies that need to offset their carbon footprints. "The issue on the direct air capture side is simply that it's so expensive," says CEO Adam Taylor. "There's just an inherent amount of energy required to separate CO2 out of the atmosphere in such minuscule quantities."

The approach also has advantages to carbon removal in nature—it's hard to measure exactly how much CO2 a forest is storing, or to know that the trees might not later be cut down or lost in a fire. Another startup plans to grow kelp in the ocean and then sink it to capture the carbon, but will also face a challenge in showing that the carbon is permanently stored. Brilliant Planet will bury the algae close to the surface of the sand; because of the salty, dry environment, it won't decompose.

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"It's just a shallow burial, one or three meters under the ground," says Taylor. "So if anybody ever questioned, did you really bury the algae? Is it still there? Did it decompose? You could sort of say, Well, there's the GPS coordinates of where we were burying on that day that we made your credit. Bring your shovel, and you're welcome to verify it."

Companies that have goals to reach net zero emissions or to become "carbon negative," like Microsoft, are looking for high-quality carbon credits to buy—solutions that are permanent, scalable, affordable, and proven to add a new benefit rather than double-counting something that would have happened anyway. Brilliant Planet is currently considering whether it may "pre-sell" any of its carbon credits to these companies. Full operation will begin soon.

The startup has been running its test site in Morocco, leased from the government, for nearly five years to prove that the system works, following earlier pilots in South Africa and Oman. Now, after raising $12 million in a Series A round of funding, the company will be beginning construction on a larger demonstration facility in 2023; a commercial facility will be built in 2024.

There are half a million square kilometers (more than 300,000 square miles) of flat, coastal desert land in the world—from Africa to South America to Australia—that the company says could be ideally suited to this work. "One of the key benefits of this system is the huge scalability because we are using otherwise unused desert land that has no real alternative farming or agricultural or economic use," Taylor says.

Fast Company, 13 April 2022

https://fastcompany.com

Engineered bacteria could help protect 'good' gut microbes from antibiotics

2022-04-11

Antibiotics are life-saving drugs, but they can also harm the beneficial microbes that live in the human gut. Following antibiotic treatment, some patients are at risk of developing inflammation or opportunistic infections such as Clostridiodes difficile. Indiscriminate use of antibiotics on gut microbes can also contribute to the spread of resistance to the drugs.

In an effort to reduce those risks, MIT engineers have developed a new way to help protect the natural flora of the human digestive tract.

Researchers have engineered a strain of bacteria that can help protect the natural flora of the human digestive tract from antibiotics and curb the emergence of antimicrobial resistance.

They took a strain of bacteria that is safe for human consumption and engineered it to safely produce an enzyme that breaks down a class of antibiotics called beta-lactams. These include ampicillin, amoxicillin, and other commonly used drugs.

When this "living biotherapeutic" is given along with antibiotics, it protects the microbiota in the gut but allows the levels of antibiotics circulating in the bloodstream to remain high, the researchers found in a study of mice.

"This work shows that synthetic biology can be harnessed to create a new class of engineered therapeutics for reducing the adverse effects of antibiotics," says James Collins, the Termeer Professor of Medical Engineering and Science in MIT's Institute for Medical Engineering and Science (IMES) and Department of Biological Engineering, and the senior author of the new study.

Andres Cubillos-Ruiz PhD '15, a research scientist at IMES and the Wyss Institute for Biologically Inspired Engineering at Harvard University, is the lead author of the paper, which appears today in Nature Biomedical Engineering. Other authors include MIT graduate students Miguel Alcantar and Pablo Cardenas, Wyss Institute staff scientist Nina Donghia, and Broad Institute research scientist Julian Avila-Pacheco.

Protecting the gut

Over the past two decades, research has revealed that the microbes in the human gut play important roles in not only metabolism but also immune function and nervous system function.

"Throughout your life, these gut microbes assemble into a highly diverse community that accomplishes important functions in your body," Cubillos-Ruiz says. "The problem comes when interventions such as medications or particular kinds of diets affect the composition of the microbiota and create an altered state, called dysbiosis. Some microbial groups disappear, and the metabolic activity of others increases. This unbalance can lead to various health issues."

One major complication that can occur is infection of C. difficile, a microbe that commonly lives in the gut but doesn't usually cause harm. When antibiotics kill off the strains that compete with C. difficile, however, these bacteria can take over and cause diarrhea and colitis. C. difficile infects about 500,000 people every year in the United States, and causes around 15,000 deaths.

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Doctors sometimes prescribe probiotics (mixtures of beneficial bacteria) to people taking antibiotics, but those probiotics are usually also susceptible to antibiotics, and they don't fully replicate the native microbiota found in the gut.

"Standard probiotics cannot compare to the diversity that the native microbes have," Cubillos-Ruiz says. "They cannot accomplish the same functions as the native microbes that you have nurtured throughout your life."

To protect the microbiota from antibiotics, the researchers decided to use modified bacteria. They engineered a strain of bacteria called Lactococcus lactis, which is normally used in cheese production, to deliver an enzyme that breaks down beta-lactam antibiotics. These drugs make up about 60 percent of the antibiotics prescribed in the United States.

When these bacteria are delivered orally, they transiently populate the intestines, where they secrete the enzyme, which is called beta-lactamase. This enzyme then breaks down antibiotics that reach the intestinal tract. When antibiotics are given orally, the drugs enter the bloodstream primarily from the stomach, so the drugs can still circulate in the body at high levels. This approach could also be used along with antibiotics that are injected, which also end up reaching the intestine. After their job is finished, the engineered bacteria are excreted through the digestive tract.

Using engineered bacteria that degrade antibiotics poses unique safety requirements: Beta-lactamase enzymes confer antibiotic resistance to harboring cells and their genes can readily spread between different bacteria. To address this, the researchers used a synthetic biology approach to recode the way the bacterium synthetizes the enzyme. They broke up the gene for beta-lactamase into two pieces, each of which encodes a fragment of the enzyme. These gene segments are located on different pieces of DNA, making it very unlikely that both gene segments would be transferred to another bacterial cell.

These beta-lactamase fragments are exported outside the cell where they reassemble, restoring the enzymatic function. Since the beta-lactamase is now free to diffuse in the surrounding environment, its activity becomes a "public good" for the gut bacterial communities. This prevents the engineered cells from gaining an advantage over the native gut microbes.

"Our biocontainment strategy enables the delivery of antibiotic-degrading enzymes to the gut without the risk of horizontal gene transfer to other

bacteria or the acquisition of an added competitive advantage by the live biotherapeutic," Cubillos-Ruiz says.

Maintaining microbial diversity

To test their approach, the researchers gave the mice two oral doses of the engineered bacteria for every injection of ampicillin. The engineered bacteria made their way to the intestine and began releasing beta-lactamase. In those mice, the researchers found that the amount of ampicillin circulating the bloodstream was as high as that in mice who did not receive the engineered bacteria.

In the gut, mice that received engineered bacteria maintained a much higher level of microbial diversity compared to mice that received only antibiotics. In those mice, microbial diversity levels dropped dramatically after they received ampicillin. Furthermore, none of the mice that received the engineered bacteria developed opportunistic C. difficile infections, while all of the mice who received only antibiotics showed high levels of C. difficile in the gut.

"This is a strong demonstration that this approach can protect the gut microbiota, while preserving the efficacy of the antibiotic, as you're not modifying the levels in the bloodstream," Cubillos-Ruiz says.

The researchers also found that eliminating the evolutionary pressure of antibiotic treatment made it much less likely for the microbes of the gut to develop antibiotic resistance after treatment. In contrast, they did find many genes for antibiotic resistance in the microbes that survived in mice who received antibiotics but not the engineered bacteria. Those genes can be passed to harmful bacteria, worsening the problem of antibiotic resistance.

The researchers now plan to begin developing a version of the treatment that could be tested in people at high risk of developing acute diseases that stem from antibiotic-induced gut dysbiosis, and they hope that eventually, it could be used to protect anyone who needs to take antibiotics for infections outside the gut.

"If the antibiotic action is not needed in the gut, then you need to protect the microbiota. This is similar to when you get an X-ray, you wear a lead apron to protect the rest of your body from the ionizing radiation," Cubillos-Ruiz says. "No previous intervention could offer this level of protection. With our new technology we can make antibiotics safer

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by preserving beneficial gut microbes and by reducing the chances of emergence of new antibiotic resistant variants."

The research was funded by the Defense Threat Reduction Agency, the Paul G. Allen Frontiers Group, the Wyss Institute, and a National Science Foundation graduate research fellowship.

Science Daily, 11 April 2022

https://sciencedaily.com

Smell significantly enhances sense of realism in virtual reality, researchers find

2022-04-11

You walk along a dark winding path deep in a forest. There is a swamp you must wade through. You spot an old wooden shack and walk to it past a smoldering fire. Its broken shutters and verandah sag under vines and neglect.

And so begins your terrifying journey inside the dilapidated haunted house in Resident Evil 7, the survival horror virtual reality (VR) game.

You enter the rundown house through the only doorway not boarded over. Darkness. The door creaks closed behind you, then bangs shut. You turn on your torch…

Impact of odor on a VR environment

While fighting zombies in survival mode, smell is likely the last thing on your mind. But our research has shown that the sense least associated with virtual reality actually holds the key to a more immersive experience. Participants in our study felt that smell gave them a greater sense of really "being there" in the virtual environment.

Surely a sweet-smelling game like Animal Crossing would be a better candidate for testing this theory? Well, as it turns out, bad smells may enhance the VR experience much more than good smells.

With this in mind, the research team used Resident Evil 7 in their study, recently published in PLOS ONE. This game includes scenes with gory artifacts like rotten food and a rotten head to maximize players' potential responses.

The study participants played a short segment from the beginning of the game, twice, with and without smell. While they were immersed in playing,

The research team were able to use a precise way to deliver smells. They found odour significantly enhances a person's sense of presence in virtual reality.

researchers administered a blend of four specific odors—forest, smoke, rotten and dank. We developed forest, rotten and dank to match the scenes, using industrial flavor compounds.

One compound we used in the concoction for dank was 1-octen-3-ol, which has an earthy, mushroom odor character. We used dimethyl trisulfide in the rotten mix, which is a product of human decomposition and attracts blowflies.

The smoke smell was a commercially available smoky BBQ marinade sauce.

Fleshing out the smells

In the research, we used our prototype "olfactometer" to deliver the odors. An olfactometer sends specific smells along a soft plastic tube fixed underneath the wearers' nose. As the player worked their way through the VR environment, the olfactometer allowed us to accurately deliver the associated smells.

In one scene players walk through a dark basement in chest-high murky water. A rotten head suddenly appears. High-intensity rotten and dank smells were delivered to match what the player sees. In the forest scene, the players smell a green woody odor and smoke while passing the smoldering fire.

Throughout the experience, we also measured the players' physiological responses—heart rate, electrodermal activity and temperature—via a smart wristband.

Virtual and augmented reality is usually all about visuals and sound. There has been previous research on whether smell enhances the VR experience, but with mixed results. We were able to use a more precise way to deliver the smells, in a well-developed VR environment. This contributed to the successful results. It took a combination of our tech to deliver smells and flavor expertise, and UTS's VR research experience, to crack it.

Who knew the zombie apocalypse could help industry?

The work has broader implications for virtual reality beyond use in gaming. The findings provide evidence that smell could help enhance the effectiveness of VR simulations used in training or therapy. For example, VR environments could be made more immersive when used to train firefighters, defense personnel and emergency workers. Emergency response personnel who are confronted with hazardous situations

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involving bushfires or chemical spills, for example, could benefit from more realistic and immersive training environments which include odors.

The importance of odor in our everyday lives is recognized by the food, cosmetics and cleaning product sectors who invest considerable time and resources in the creation of fragrances that best suit their products. More research is needed into how these findings could be further developed. But they could potentially help industries like these develop and test new products.

So, while in one sense it seems like a bit of a crazy idea, there is a really serious side to this research.

Tech Xplore, 11 April 2022

https://techxplore.com

Emerging tech in the food, transport and energy sector can help counter the effects of climate change

2022-04-08

The latest report from the Intergovernmental Panel on Climate Change (IPCC) — which one of us (Arunima) contributed to — has emphasised the need for enormous change if we are to keep within the 1.5 warming limit.

This Paris Agreement goal is currently beyond our reach. Achieving it would require drastic emissions reductions across all sectors and at all scales.

Here are some emerging technologies in the food, transport and energy sectors with great potential to address the climate challenge.

1. Alternative protein sources

The IPCC report highlights the potential of plant-based diets, not only for achieving emissions reductions but also improving our collective well-being more generally.

Plant-based protein sources, including "fake meat" products, are increasingly being produced to mimic the appearance, flavour and texture of animal meat.

Traditionally, alternative proteins such as tofu were made from simple coagulation of soybean milk. A few decades ago we saw the emergence of mycoprotein, which is derived from fungus (and has been popularised by the brand Quorn).

The IPCC report highlights the potential of plant-based diets, not only for achieving emissions reductions but also improving our collective well-being more generally.

More novel alternative proteins require advanced extrusion techniques and artificial colours and flavours to mimic the texture and flavour of animal protein.

Then there are cell-based meat alternatives, also called "lab-grown", cultured" or "in-vitro" meats. These are made using advanced bioengineering techniques to grow meat cells from a sample (starter cells) extracted from an animal, inside a device called a "bioreactor".

Cell-grown meat is an emerging technology. It went on sale for the first time in 2020, in Singapore. It's not commercially available in Australia yet, but according to reports work has begun behind the scenes.

Compared with livestock meat, plant-based meats produce 30–90% less greenhouse gas emissions, require 40-98% less land, 70-80% less water, and release 85–94% less reactive nitrogen (which can lead to excessive algal growth that starves marine life of oxygen).

Australia is the third fastest-growing vegan market in the world. Australia's main industry research organisation, CSIRO, estimates the sustainable food market here alone will be worth A$25 billion by 2030.

Moreover, alternative proteins have the second-biggest market potential of all the categories in the food and agribusiness sector. They are expected to deliver some A$5.4 billion in savings in carbon and water by 2030.

2. Edible and biodegradable packaging

As the name suggests, edible or biodegradable food packaging is designed to be eaten or to biodegrade efficiently. Edible packaging is made of natural polymers extracted from plant sources, which can be made into various films and coatings. Some examples are:

- chitosan-based packaging, made mostly from seafood industry waste
- whey-based packaging, made from dairy industry waste
- seaweed polysaccharides extracted from seaweed.

Besides being environmentally friendly, edible packaging could enhance the nutritional value of packaged food, by incorporating compounds known as "nutraceuticals" which can improve the nutrient composition of packaged food. Adding antioxidants and antimicrobials to packaging can also increase the shelf life of food.

Much work needs to be done to make edible packaging mainstream, but it has proven a good alternative to plastic bottles for marathon runners.

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In 2020, Australia only recycled 16% of plastics. Globally, only about 17% of plastics were recycled in 2015. The rest ended up in landfill, oceans and rivers — damaging land and marine systems — or generated carbon dioxide and other harmful emissions during incineration.

Fossil-fuel based plastics can take 20-500 years to decompose, whereas biodegradable packaging decomposes within three to six months depending on the material.

It's estimated the global biodegradable packaging market will grow by 17% each year, and be valued at US$12.06 billion by 2025.

Australia has set a target for 70% of plastic packaging to be recycled or composted by 2025, and to phase out single-use plastics by 2025. Innovation in edible and biodegradable packaging could go a long way to support these reduction targets.

3. Electric vehicles

While they've been a hot topic for a while now, electric vehicles can't be overlooked.

The IPCC identified electric vehicles as having the largest decarbonisation potential for land-based transport. Why? Because increased uptake of electric vehicles, facilitated by falling costs, has already delivered emissions reductions. And market shares for electric vehicles have tripled in two years.

In Australia, the energy and transport sectors account for more than 50% of carbon emissions. Research shows electric vehicles could transform the transportation sector, if coupled with a 100% renewable electricity system where all energy used is produced from renewable sources.

What's more, if all vehicles were electric and we had a 100% renewable electricity system, consumers could expect to save around A$1,000-2,000 per year (based on petrol prices of A$1.40-2.00 per litre).

Electric vehicles need to be charged, but this can be controlled or uncontrolled. Uncontrolled charging lets the user charge their vehicle any time of the day, while controlled charging relies on maximising benefits by charging during the day, for example, when sunlight is abundant. Running about 16 million electric vehicles on Australian roads would require 205 gigawatts of installed capacity to provide the electricity for charging, if based on a 100% renewable electricity system.

According to the Australian Bureau of Statistics, there were 23,000 electric vehicles registered in Australia in 2021, out of about 20 million vehicles in total. Australia is falling behind other developed countries in the race to take up this technology.

4. Hydrogen's vast potential

Solar and wind power are both well-established and feasible options for reducing emissions — and are even cheaper than non-renewable sources.

But at the same time, both are variable energy sources which are dependent on weather, season, geography and time of day. This can lead to supply gaps, for which alternative sources need to be considered.

Hydrogen, which produces no carbon emissions when burned, is a potential option. It can be produced by splitting water using electricity from wind and solar sources. It also provides a way to store renewable energy for later use.

With the declining cost of renewables, and the scaling-up of hydrogen deployment, hydrogen production costs are expected to fall by 30% by 2030. Increasing hydrogen energy storage technologies could lead to further reductions in the cost of variable renewable electricity systems.

The IPCC report also flags the potential for hydrogen in achieving emissions reductions in the aviation sector, but notes this will first require improvements in technology and cost reductions.

The Conversation, 8 April 2022

https://theconversation.com

Epigenetic Treatments May Bolster Chemotherapies

2022-04-11

Cancer cells that resist chemotherapy and become "persisters" remain a daunting clinical challenge. They appear to attain and retain their staying power largely through nongenetic mechanisms, which remain poorly defined. To understand these mechanisms better, scientists at the Curie Institute in Paris have studied cancer cells that occur in triple-negative breast cancer types associated with the highest risk of recurrence. Specifically, the scientists monitored epigenomes, transcriptomes, and lineages with single-cell resolution.

This work enabled the scientists to demonstrate that the repressive histone mark H3K27me3 (trimethylation of histone H3 at lysine 27) regulates cell fate at the onset of chemotherapy. Essentially, the scientist showed that epigenetic landscapes play a crucial role in shaping the potential of cancer cells to respond to initial therapy.

Epigenetic marks are chemical modifications of the DNA or associated proteins that determine the expression of the genes and thus a cell's identity.

Detailed results appeared in Nature Genetics, in an article titled, "H3K27me3 conditions chemotolerance in triple-negative breast cancer."

"We report that a persister expression program is primed with both H3K4me3 (trimethylation of histone H3 at lysine 4) and H3K27me3 in unchallenged cells, with H3K27me3 being the lock to its transcriptional activation," the article's authors wrote. "We further demonstrate that depleting H3K27me3 enhances the potential of cancer cells to tolerate chemotherapy."

The scientists, who were led by Leïla Perié, PhD, and Céline Vallot, PhD, used the word "lock" advisedly. They found that in the absence of treatment, epigenomic marks "lock" genes, preventing them from being expressed. However, in some cells, after treatment commences, the lock "jumps," and the cells become insensitive to treatment. If the lock can be prevented from jumping, all cancer cells remain sensitive to treatment.

In their article, the scientists presented evidence for this phenomenon. "Preventing H3K27me3 demethylation [during chemotherapy]," they reported, "inhibits the transition to a drug-tolerant state, and delays tumor recurrence in vivo."

This finding could inform the development of epigenetic drugs (epi-drugs). In animal models, epi-drugs have been shown to inhibit the removal of epigenetic marks. The epi-drugs that have shown promise in animal models still need to be adapted for human use.

Epigenetic marks are chemical modifications of the DNA or associated proteins that determine the expression of the genes and thus a cell's identity. This information, which is central from the development of the embryo onwards, leads to changes in how our genes are expressed without affecting their sequence. By modifying its epigenome, the cell can adapt quickly to its environment.

The epigenome's involvement in resistance to cancer treatment has been clearly demonstrated by the scientists involved in the current study. They are now actively seeking how to apply their epigenomic findings to the development of new epi-drugs. If future clinical trials are convincing,

scientists imagine that these epi-drugs could be used in conjunction with chemotherapies to prolong their effectiveness in patients.

Genetic Engineering News, 11 April 2022

https://genengnews.com

Stem Cells Restore Lost Function in Traumatic Brain Injury

2022-04-07

Stem cell therapy improves motor impairment and is safe and well tolerated in patients with traumatic brain injury (TBI), results from a phase 2 trial indicate.

"We proved for the first time that we can affect outcomes in moderately to severely disabled patients with TBI using stem cells," study investigator Peter McAllister, MD, co-founder and medical director of the New England Center for Neurology and Headache, Stamford, Connecticut, told Medscape Medical News.

"I think the potential of regenerative medicine was always out there, but we are now getting to the point where we're living up to that potential," said McAllister, who is also an associate professor of neurology at Yale University School of Medicine in New Haven.

The findings were presented at the American Academy of Neurology (AAN) 2022 Annual Meeting.

No Effective Treatment To-Date

TBI can lead to motor deficits and chronic disability and currently there are no effective drugs to treat these deficits.

Researchers are increasingly focused on using somatic stem cells to restore lost function. Stem cells can differentiate or proliferate into different types of cells and are thought to promote repair and regeneration of tissues or organs damaged due to illness or injury.

The study included 61 patients with TBI with an average age of 34 years (70% male and 69% White). The mean time from injury was about 8 years and Glasgow Outcome Scale Extended (GOS-E) ranged from 3-6.

A total of 46 participants were randomly assigned to receive the stem cell therapy and 15 a sham procedure. In the treatment group, there were three different doses of cells (2.5 x 106, 5 x 106, 10 x 106).

"I think the potential of regenerative medicine was always out there, but we are now getting to the point where we're living up to that potential"

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The treatment involved an investigational regenerative cell medicine comprised of bone marrow-derived mesenchymal stem cells (SB623). The allogeneic cells came from a male donor.

For the 20-minute procedure, a neurosurgeon drilled a tiny hole in the skull and, guided by MRI, injected the stem cells into the area of the lesion.

Patients receiving a surgical sham procedure were brought to the operating room, anesthetized, and had a hole drilled into their head over the area of their lesion. However, the surgeon only went halfway through the skull bone.

Participants were instructed to do specific physiotherapy exercises at home every morning and afternoon for the first 6 months of the study.

The primary efficacy endpoint was change in the Fugl-Meyer Motor Scale score (FMMS). This scale is widely used for clinical assessment of motor function, including range of motion, walking, lower limb movement, and dexterity.

At 24 weeks, the change in FMMS score for SB623-treated patients (least square [LS] mean increase 8.3) compared with controls (LS increase 2.3) was significant (P = .04).

"When we looked at all the data at 6 months, the folks who got the stem cells did statistically significantly better than the group that got the sham," and that improvement began within the first week or two, said McAllister.

MedScape, 7 April 2022

https://medscape.com

The pill made from donated gut bacteria that could prove significant for people who have severe reactions to even traces of certain foods

2022-04-12

Pills containing donated gut bacteria could help treat people with food allergies, a trial suggests.

The treatment is based on the theory that having the 'wrong' type of gut bacteria triggers an over-reaction of the immune system, which is the basis of an allergy.

It's thought introducing 'healthy' bacteria from someone without allergies could reduce the over-reaction or even eliminate it.

It's thought introducing 'healthy' bacteria from someone without allergies could reduce the over-reaction or even eliminate it.

Early data from a small trial has found that the bacteria capsules increased the amount of peanut the allergic participants could be safely exposed to — with one able to tolerate as much as eight times more than before.

Such an improvement could prove significant for people who have a severe reaction even to minute traces of certain foods.

An allergic reaction is typically triggered by foods which the immune system recognises as being 'foreign'.

This causes the release of chemicals called histamines that lead to inflammation and symptoms such as itchiness, nausea, swollen lips and diarrhoea.

In some cases the reaction can cause difficulty breathing as airways narrow, and blood pressure can plummet (histamine causes blood vessels to rapidly expand) — which can be life-threatening.

The only 'cure' currently is immunotherapy, where small amounts of the allergen are given to patients in slowly increasing quantities to build tolerance. This doesn't deal with the cause of the disease, it only trains the body to react differently.

It's hoped that the pill could treat the underlying cause to lower or eradicate the chance of reaction.

It's based on the theory that allergies are linked to the gut microbiome, the trillions of organisms inside us that play a vital role in our immune system; an imbalance in the types of bacteria in the gut may alter our immune responses.

Previous studies have found that mice given gut bacteria from human babies with allergies then develop allergic reactions. This approach, which uses bacteria taken from stool samples, is known as faecal-microbiota therapy (FMT).

The pills used for the trial were made with bacteria from samples donated by healthy volunteers who didn't have an allergy. The material was filtered to remove pollutants and checked for harmful bacteria and viruses. It was then put into capsules to be swallowed.

The trial involved 15 adults (aged 18 to 33) with a peanut allergy severe enough to cause a reaction to just half a peanut.

Five were given an antibiotic to clear the existing bacteria in their gut, as well as the new treatment. The rest only had the capsules.

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In the antibiotic group, after FMT, 60 per cent had a higher tolerance to peanuts, compared with 30 per cent in the pill-only group — although one person among these was then able to eat four whole peanuts.

The researchers also found that the participants whose tolerance improved also had higher levels of cells that prevent an allergic reaction and lower levels of those linked to an allergic response.

The results from the study carried out by Boston Children's Hospital in the U.S. have yet to be published. However, FMT has previously been used to treat the bowel infection clostridium difficile successfully.

Professor Graham Roberts, a consultant in paediatric allergy at University Hospital Southampton NHS Trust, says: 'We know that the immune system is affected by the bacteria in your gut. But the research is at a very early stage.'

He adds that the amount patients can tolerate varies — sometimes it might be half a peanut, other times up to four.

'So it may just be a false positive. More research is needed.'

Daily Mail, 12 April 2022

https://dailymail.co.uk

Giant space telescopes could be made out of liquid

2022-04-22

The Hubble space telescope has a primary mirror of 2.4 meters. The Nancy Grace Roman telescope also has a mirror measuring 2.4 meters, and the James Webb Space Telescope has a whopping 6.5 meter primary mirror. They get the job done that they were designed to do, but what if… we could have even bigger mirrors?

The larger the mirror, the more light is collected. This means that we can see farther back in time with bigger mirrors to observe star and galaxy formation, image exoplanets directly, and work out just what dark matter is.

But the process for creating a mirror is involved and takes time. There is casting the mirror blank to get the basic shape. Then you have to toughen the glass by heating and slow cooling. Grinding the glass down and polishing it into its perfect shape comes next followed by testing and coating the lens. This isn't so bad for smaller lenses, but we want bigger. Much bigger.

Enter the idea for using fluids to create lenses in space that are 10x–100x bigger. And the time it would take to make them would be significantly less than a glass-based lens.

FLUTE, or the Fluidic Telescope Experiment is run by principal investigator Edward Balaban at Ames Research Center in California's Silicon Valley. Collaborators on the experiment include researchers at Ames at the Goddard Space Flight Center in Greenbelt, Maryland, along with researchers from Technion, the Israeli Institute of Technology.

Their goal is to make possible the fabrication of fluid lenses in space that are not only bigger than their glass counterparts, but also just as high quality or better optically as making an earth-based lens. And this can be done in a fraction of the time.

In space, liquids eventually form a perfect spherical shape. In order to test the process first though, they stayed closer to home and used water as a medium to create fluid lenses. They had to make sure the water had the same density as the liquid polymers they were using to make the lenses so that the effects of gravity were effectively canceled out. Leaving out any mechanical processes, the polymers were injected into circular frames submerged in water and then solidified, creating comparable or better lenses than using standard techniques.

Their goal is to make possible the fabrication of fluid lenses in space that are not only bigger than their glass counterparts, but also just as high quality or better optically as making an earth-based lens.

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Next the team boarded two ZeroG parabolic flights to further test the process. Synthetic oils of varying viscosities were tested to determine which would work better. These oils were pumped into circular frames about the size of a dollar coin while the plane was in freefall, and again the researchers were able to make free-standing liquid lenses, though once the plane started lifting up again and the effects of gravity were felt the liquids lost their shape.

This experiment will be performed on the ISS (International Space Station) next and is already onboard, waiting for the arrival of Axiom-1 with Mission Specialist Eytan Stibbe slated to perform the experiment. There they will add the step of using either UV light or temperature to harden the liquid so that the lenses can be examined and tested by the researchers back at Ames on Earth.

A successful experiment will be the first time an optical component is made in space. If it succeeds, this will be the start of a new way to build telescopes, out in space. This would be a revolution in space-based manufacturing and the time needed to build one will be greatly reduced. And oh the sights we will see.

Phys Org, 11 April 2022

https://phys.org

"Time jump" anti-aging method gives specialized cells a 30-year refresh

2022-04-07

Through experimentation with a highly promising anti-aging technique, scientists at the UK's Babraham Institute have demonstrated a new way of turning back the clock in human skin cells. These cells functioned like cells 30 years younger, but in what represents an exciting advance in the field, were able to still retain some of their specialized functions acquired through age.

In 2012, Japanese researcher Shinya Yamanaka earned a Nobel Prize for his work in developing what are known as induced pluripotent stem cells (iPSCs). These start out as regular adult tissue cells that are harvested and exposed to four molecules called Yamanaka factors, which return them to an immature state. From here, the stem cells can theoretically develop into any cell type in the body.

Scientists have discovered a new way to rejuvenate aging skin cells while retaining some of their specialized functions.

We've seen scientists explore this potential in a number of exciting ways, implanting them in rabbits to restore vision, addressing dopamine deficiencies in animal models of Parkinson's disease and repairing damaged heart muscles in pigs. The full reprogramming process involves subjecting the cells to the Yamanaka factors for around 50 days, but the Babraham scientists have found that shortening this process might bring some significant benefits to the table.

When the cells undergo full reprogramming, they forego some of the specialized capabilities they've developed through maturation. In the case of skin cells this includes producing collagen for use in tendons, ligaments, bones and to aid in wound healing. The idea was to restore these cells to a youthful state, but not erase their identity entirely.

Called "maturation phase transient reprogramming," the team's new technique exposes the cells to the Yamanaka factors for only 13 days. This was found to remove the age-related changes and erase their identity, but only temporarily. Allowed to grow under natural conditions, these rejuvenated cells again took on the characteristics of skin cells, but with a fresh outlook on life.

This addresses a problem in this field of research, because while the stem cells can theoretically develop into any cell type in the body, creating the conditions where they do so with reliability has proven difficult so far. The new technique outlined in this research appears to hit a sweet spot, where the cells are refreshed but still go on to perform a distinct and important role.

By looking at chemical markers making up what's known as the epigenetic clock and the molecules expressed by the cells, the scientists confirmed that the reprogrammed cells matched the profile of cells 30 years younger. These cells also produced more collagen than control cells, and reacted more effectively in lab experiments designed to replicate wound healing.

"Our results represent a big step forward in our understanding of cell reprogramming," said study author Dr Diljeet Gill. "We have proved that cells can be rejuvenated without losing their function and that rejuvenation looks to restore some function to old cells."

Interestingly, the scientists also found that the technique also appeared to have anti-aging effects on genes associated with Alzheimer's disease and cataracts, two of which showed signs of returning to more youthful levels of activity.

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"This work has very exciting implications," said study author Professor Wolf Reik. "Eventually, we may be able to identify genes that rejuvenate without reprogramming, and specifically target those to reduce the effects of aging. This approach holds promise for valuable discoveries that could open up an amazing therapeutic horizon."

The research was published in the journal eLife.

New Atlas, 7 April 2022

https://newatlas.com

Should we worry about the XE variant? Maybe not yet, but 'hybrids' will become more frequent as COVID evolves

2022-04-11

A new hybrid COVID-19 variant dubbed XE has sparked fresh concerns recently.

XE is a combination of the highly transmissible BA.1 and BA.2 Omicron variants and was first detected in the UK in mid-January. Its spike protein derives from BA.2, which is potentially good news for New Zealand since this is the dominant variant (more than 90% of recent infections) and people who have been infected should have some protection against XE.

Globally, around 700 viral genomes have been assigned XE so far. The variant has mainly been detected in the UK and now in a handful of cases elsewhere, including Thailand and US, most likely due to travel-related spread.

According to current estimates from the UK, XE has a slight (5-10%) transmission advantage over BA.2, which would make it the most transmissible subvariant of Omicron identified to date. Any time a new more transmissible variant emerges, it has the chance of becoming the dominant variant over time.

XE has not been assigned its own Greek letter yet. For the moment, it belongs to Omicron until significant differences in transmission and disease characteristics, including severity, are identified.

So far there is not enough evidence to draw solid conclusions about XE's transmissibility and there is almost no data about its severity or ability to evade immunity.

There are two main types of recombinants now frequently detected: mixtures of Delta and Omicron (dubbed Deltacron) and mixtures of Omicron subvariants.

How hybrid variants emerge

Usually every individual virus is a near exact copy of its single parent virus. But viruses also undergo a process called recombination – they can have two parents.

Recombinant viruses can emerge when two or more variants infect the same cell in an individual, allowing the variants to interact during replication. This can result in a mix-up of their genetic material, forming new virus combinations.

Some viruses, such as influenza, have segmented genomes and can mix up whole segments through a process called reassortment. Viral recombination and reassortment are common among viruses but rates vary markedly, depending on the type of virus and the chance of co-infection.

More than two years into the pandemic and with high infection rates globally, SARS-CoV-2 recombination is both more likely and more easily detectable than during earlier stages. The global Omicron wave has seen a rapid increase in COVID prevalence, which increases the chances of co-infection and gives the virus more chances to recombine.

We are also more able to detect recombination than we were previously. Early in the pandemic, there was little genetic diversity in the SARS-CoV-2 virus and recombinants looked much like non-recombinants because the two parent virus were close to identical.

But now there are several genomically distinct variants infecting people in the same area, making recombinant genomes a lot easier to spot among the millions of genomes generated to date. Viral recombination will likely play an important role in the ongoing evolution of SARS-CoV-2.

Known viral recombinants

Recently there have been several recombinant SARS-CoV-2 variants identified, named XA, XB, XC etc, right through to XS. Some of these variants were sequenced as early as mid-2020. Some have only been seen a few times, while others have several hundreds of genomes assigned to them.

There are two main types of recombinants now frequently detected: mixtures of Delta and Omicron (dubbed Deltacron) and mixtures of Omicron subvariants.

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A few of these recombinants are being watched closely. They include XD and XF, which consist of genetic material from Delta and the BA.1 Omicron subvariant.

XD was first detected in France and contains a mixture of the spike protein from BA.1 and the rest of the genome from Delta. There was some concern it would inherit BA.1's ability to evade our immune defences and Delta's high virulence. To date, XD does not appear to be spreading widely or rapidly.

Should we be concerned?

There isn't yet evidence suggesting recombinant viruses are more of a public health threat than any other variants. But recombinants should be closely monitored so that we can understand if they induce changes to the virus' transmissibility, disease severity or ability to escape vaccine-induced immune protection.

At this point, there's no need to be overly concerned about XE. But we need to continue surveillance of SARS-CoV-2 on a global scale to spot new variants and understand the risks they might pose.

Our best approach to limiting the rate of new recombinants or other variants emerging is limiting the spread of the virus. Despite widespread acceptance around the world that SARS-CoV-2 will be with us for the foreseeable future, we can still employ protective measures to slow and suppress the virus.

These include regular testing, isolating when we are infectious, wearing good quality masks and improved ventilation. All these measures reduce the chances of getting co-infected and becoming a host to a new recombinant.

The Conversation, 11 April 2022

https://theconversation.com

Are we part of nature, or separate from it? How you answer matters

2022-04-11

Think about a river.

Now, imagine that river is one you know. Maybe it's near your home, or perhaps it's in a place you've visited.

Solutions to environmental issues are "often not technically difficult," says Brian Helmuth, "The tricky part comes in to get the buy-in from people and in the willingness to act."

Take it a step further: That river is now the water source that nourishes your community. It is the reason your backyard garden yields juicy tomatoes.

As you moved through this thought exercise, the psychological distance between you and the river likely lessened. Did that make you feel more connected to the river?

It probably did, according to new research by Northeastern psychology and environmental science researchers. And, they found, that also makes you more likely to want to take care of the river ecosystem and prevent or clean up pollution there.

"It really matters, the way people understand and represent what they know about the world," says John Coley, professor of psychology at Northeastern and first author on the paper published in the journal Land.

"So what we sought to show is that the degree to which people saw the relationship between humans and nature as reciprocal or as one-sided had implications for things like stewardship. Those who had this more reciprocal model indicated more likelihood to invest, more willingness to be a steward of the environment."

Solutions to environmental issues are "often not technically difficult," says Brian Helmuth, professor of marine and environmental sciences. "The tricky part comes in to get the buy-in from people and in the willingness to act."

So Coley, Helmuth and their colleagues decided to test how differently framed questions affected people's beliefs about stewardship and environmental responsibility. They employed an online survey which centered around a hypothetical polluted river in an urban area. Participants were presented with the scenario framing the polluted river as either having local impacts or global impacts, and they were asked about how responsible humans were for restoring the river, and what relationship humans have to nature and vice versa.

We found that most people understood that humans impacted the river, but fewer understood that the river impacts humans," Helmuth says. "And that dynamic was then correlated with the willingness to spend time or money or taxes."

But, think back to how your mindset changed when you shifted from envisioning a generic river to one in your neighborhood. "For the people who were presented with the local context, that asymmetry was reduced,"

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Coley says. "They were more likely to say that the river has an impact on people, as well as people having an impact on the river. And the size of that asymmetry had downstream consequences for people's behaviors."

Ultimately, what the psychology professor and environmental sciences professor would like to determine is how to use this knowledge to shift how people see nature, from something separate from ourselves that must be protected to a system that humans are very much a part of—even in an urban setting.

"Understanding where people are right now can help inform how we help them to see the world in a different way, in one where nature is something that deserves to be protected both in its own right but also for motivated self-preservation as well," Helmuth says.

Phys Org, 11 April 2022

https://phys.org

What can we do about extreme weather?

2022-04-11

Even without climate change, more people would be faced with the challenges of extreme weather events. That is because the human population continues to grow, our patterns of land use continue to change, and more and more of us are in the pathway of extreme weather events. A recent New York Times piece reported on a Gallup poll finding that one-third of all Americans had been exposed to extreme weather events since 2020. According to New York Times reporter Derrick Bryson Taylor:

"Thirty-three percent of U.S. adults said they had been affected by extreme weather since 2020… according to the survey, which was based on interviews conducted last month with about 1,000 adults living in all 50 states and Washington, D.C. Hurricanes and winter weather, such as snow, ice storms and blizzards, were the most common extreme weather events cited, followed by extreme heat and floods."

While we experienced extreme weather events before climate change, climate change has made extreme weather more frequent and intense. Climate models in the late twentieth and early twenty-first century predicted impacts such as sea-level rise and extreme weather, but unlike other environmental problems such as toxic waste and air pollution, the causes were global, and the impacts were in the future. The resulting climate denial created a different type of environmental politics than the

Since extreme weather events are happening more frequently, we can expect the impact of these events on concern about climate change will increase over time. (Talk about learning a lesson the hard way…)

traditional politics that resulted from pollution with a visible local impact. In the 1970s, environmental policy was forged by consensus politics fueled by a threat that was obvious and undeniable. Today, it appears that there is a growing acceptance of "climate attribution science," with more and more people accepting the notion that all this wacky weather is somehow related to climate change. That connection by the public could change the politics of climate change. The Gallup poll indicates that those who experience extreme weather tend to see climate change differently than those who have not. According to Taylor:

"…researchers found that attitudes about climate change were closely associated with personal experience with an extreme weather event. Sixty-three percent of those who had been affected by extreme weather said they worried "a great deal" about global warming, compared with 33 percent who had not been affected by extreme weather. Sixty-four percent of those who had been affected by extreme weather said that climate change would pose "a serious threat" to their way of life during their lifetime, compared with 36 percent who had not been affected by extreme weather. Sixty-seven percent of people who had lived through an extreme weather event, and 48 percent of those who had not, said that the government was not doing enough to protect the environment."

The massive disruption caused by extreme weather and the climate-related explanation for these events may change the politics of climate change, and climate may start to act more like traditional environmental issues. The connection between cause and impact is being made because the impacts can now be seen and felt. However, unlike traditional environmental problems, the causes are not only local. The policy prescriptions called for are more complex than those required by traditional environmental issues. Most forms of air pollution, water pollution and toxic releases can be addressed through rules and technology that are local, state-wide, and national. They are largely within the borders of sovereign nations. Climate change crosses borders because we share a common atmosphere, and greenhouse gasses created in one place impact the entire world.

One of Gallup's most interesting findings is that the impact of experiencing extreme weather on attitudes toward climate change cuts across party lines. According to Gallup's Jeffrey M. Jones:

"…when respondents' partisanship is taken into account, victims of extreme weather are more likely than nonvictims to express concern about climate change. In most cases, there is a double-digit gap in

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climate-change attitudes between victims and nonvictims within each party group. For example, 79% of Democrats and Democratic-leaning independents who have personally been affected by an extreme weather event worry a great deal about global warming, compared with 60% of Democrats who have not had such an experience. Republicans and Republican leaners are far less likely to be concerned about global warming, but there is a 15-percentage-point gap in concern between Republicans who have (28%) and have not (13%) experienced extreme weather."

Since extreme weather events are happening more frequently, we can expect the impact of these events on concern about climate change will increase over time. (Talk about learning a lesson the hard way…) While this indicates that support for climate policy will increase, what can we actually do to respond to this concern about climate and extreme weather?

The approach to climate policy cannot be limited to prevention as it might in some areas of environmental policy because no single jurisdiction can prevent the problem. Still, America's role as a global leader requires that we set an example and work to mitigate greenhouse gas pollution and develop technologies that can achieve that goal throughout the world. But in the short run, we also need to adapt to the new conditions caused by climate change. We must develop institutional mechanisms that enable communities to recover and rebuild in the aftermath of extreme weather events. We need to reconceptualize these events as routine occurrences requiring a predictable response, not as emergencies that are treated as rare and unusual.

Part of the issue of storm recovery is that our homes are more connected and more dependent on collective infrastructure than ever. While some homes might own a water well and water pump and possibly a septic tank or septic field, most Americans are connected to central water, sewage, communication, and electrical systems. Our homes, particularly due to the use of drywall are easily damaged by floods. An absence of electricity can cause many crucial home systems to fail, leaving homes uninhabitable. The creature comforts we take for granted make recovery from extreme weather events complicated and expensive.

Due to the increasing frequency of extreme weather events, we need to develop private and publicly subsidized systems of insurance that pay the costs of reconstruction after disasters occur. Inevitably this will raise the already high cost of housing- which includes growing fees for insurance and taxes. Enacting a system of federally subsidized reconstruction

insurance is politically infeasible at present but inevitable if current patterns of extreme weather persist. When such a system is finally put in place, it is critical that rates are progressive and guard against anything that increases homelessness.

In addition to private household and business reconstruction, we must also develop programs and revenue streams for infrastructure resilience and reconstruction. Schools, libraries, transportation, energy, water, communication, waste, and sewage infrastructure need to be made more weather-proof and, when damaged or destroyed, must be eligible for federal reconstruction grants. And yes, our federal tax rates must go up to pay for all of this.

Currently, weather disasters are treated as special rather than routine events. When disaster strikes, federal funding must be allocated through the theatrical spectacle of our dysfunctional Congress while victims sleep in shelters or on the couches of friends or family. The delay in funding causes pain and hardship. Children suffer as schooling is disrupted and the security of home is suddenly upended. While we have no control over nature and storms, we have a great deal of control over how we respond, recover, and rebuild.

As Mark Twain used to say (quoting someone named Charles Dudley Warner), "Everybody talks about the weather, but nobody does anything about it." Well, we still can't do anything to change weather, and hopefully, we are never arrogant enough to try that type of geoengineering, but we do need to predict weather, prepare for it, respond to it and learn how to rebuild after its destruction passes. The experience of extreme weather affects our view of how the world works. Objective facts that we experience personally are resistant to disinformation or ideology. Air pollution policy was a response to smog, and water pollution policy was a response to rivers that smelled bad and even caught fire. Perhaps climate change policy will be a response to our growing experience with extreme weather events.

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Certain personality traits associated with cognitive functioning late in life

2022-04-11

The research, published in the Journal of Personality and Social Psychology, focused on the role three of the so-called "Big Five" personality traits (conscientiousness, neuroticism and extraversion) play in cognitive functioning later in life.

"Personality traits reflect relatively enduring patterns of thinking and behaving, which may cumulatively affect engagement in healthy and unhealthy behaviors and thought patterns across the lifespan," said lead author Tomiko Yoneda, PhD, of the University of Victoria. "The accumulation of lifelong experiences may then contribute to susceptibility of particular diseases or disorders, such as mild cognitive impairment, or contribute to individual differences in the ability to withstand age-related neurological changes."

Individuals who score high in conscientiousness tend to be responsible, organized, hard-working and goal-directed. Those who score high on neuroticism have low emotional stability and have a tendency toward mood swings, anxiety, depression, self-doubt and other negative feelings. Extraverts draw energy from being around others and directing their energies toward people and the outside world. They tend to be enthusiastic, gregarious, talkative and assertive, according to Yoneda.

To better understand the relationship between personality traits and cognitive impairment later in life, researchers analyzed data from 1,954 participants in the Rush Memory and Aging Project, a longitudinal study of older adults living in the greater Chicago metropolitan region and northeastern Illinois. Participants without a formal diagnosis of dementia were recruited from retirement communities, church groups, and subsidized senior housing facilities beginning in 1997 and continuing to the present. Participants received a personality assessment and agreed to annual assessments of their cognitive abilities. The study included participants who had received at least two annual cognitive assessments or one assessment prior to death.

Participants who scored either high on conscientiousness or low in neuroticism were significantly less likely to progress from normal cognition to mild cognitive impairment over the course of the study.

"Scoring approximately six more points on a conscientiousness scale ranging 0 to 48 was associated with a 22% decreased risk of transitioning

People who are organized, with high levels of self-discipline, may be less likely to develop mild cognitive impairment as they age

from normal cognitive functioning to mild cognitive impairment," said Yoneda. "Additionally, scoring approximately seven more points on a neuroticism scale of 0 to 48 was associated with a 12% increased risk of transition."

Researchers found no association between extraversion and ultimate development of mild cognitive impairment, but they did find that participants who scored high on extraversion -- along with those who scored either high on conscientiousness or low in neuroticism -- tended to maintain normal cognitive functioning longer than others.

For example, 80-year-old participants who were high in conscientiousness were estimated to live nearly two years longer without cognitive impairment compared with individuals who were low in conscientiousness. Participants high in extraversion were estimated to maintain healthy cognition for approximately a year longer. In contrast, high neuroticism was associated with at least one less year of healthy cognitive functioning, highlighting the harms associated with the long-term experience of perceived stress and emotional instability, according to Yoneda.

Additionally, individuals lower in neuroticism and higher in extraversion were more likely to recover to normal cognitive function after receiving a previous diagnosis of mild cognitive impairment, suggesting that these traits may be protective even after an individual starts to progress to dementia. In the case of extraversion, this finding may be indicative of the benefits of social interaction for improving cognitive outcomes, according to Yoneda.

There was no association between any of the personality traits and total life expectancy.

Yoneda noted that the findings are limited due to the primarily white (87%) and female (74%) makeup of the participants. Participants were also highly educated, with nearly 15 years of education on average. Future research is necessary on more diverse samples of older adults and should include the other two of the big five personality traits (agreeableness and openness) to be more generalizable and provide a broader understanding of the impact of personality traits on cognitive processes and mortality later in life, she said.

Science Daily, 11 April 2022

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The power of kindness in improving brain health

2022-04-11

Kindness is powerful and does not just affect the recipient's feelings—kindness can also impact an entire family's brain health. A cross-disciplinary team of researchers and clinicians from Center for BrainHealth at The University of Texas at Dallas sought to understand whether an online kindness training program improves preschooler's prosocial behaviors and their parents' resilience during the COVID-19 pandemic.

The findings were published recently in Frontiers in Psychology by BrainHealth researchers Maria Johnson, MA, director of Youth & Family Innovations; Julie Fratantoni, Ph.D., cognitive neuroscientist and head of operations for The BrainHealth Project; Kathleen Tate, MA, clinician; and Antonia Moran, a graduate student at UT Dallas. The team discovered that teaching and practicing kindness at home improves both parents' resilience and children's empathy.

The researchers studied the impact of an online kindness training program, adapted from the curriculum of Children's Kindness Network, founded by Ted Drier, on 38 mothers and their 3- to 5-year-old children. The program, "Kind Minds with Moozie," features five short modules where a digital cow ("Moozie") describes creative exercises that parents can do with their kids to teach kindness.

"We aim to encourage parents to engage in practical, brain-healthy interactions with their children that aid in a better understanding of one another, especially during times of stress," said Johnson. "Research shows that kindness is a strong potentiator of vibrant social engagement, which in turn is a critical component of overall brain health."

"Research shows that kindness is a strong potentiator of vibrant social engagement, which in turn is a critical component of overall brain health."

To determine how kindness influences brain health, the team asked parents to survey their own resilience and report on their kids' empathy before and after the training program. They found that parents are more resilient and preschoolers are more empathetic after kindness training. Both resilience and empathy require cognitive skills like responding well to stressors or considering different perspectives. Their findings therefore support the idea that kindness can influence cognitive function and overall brain health.

Surprisingly, the researchers found that children's empathy levels remained below average despite the noticeable improvement after training. This might be because COVID-19 safety measures significantly limited kids' normal social and emotional learning.

The researchers also tested whether understanding the science behind the kindness training program affects parents' resilience. A random group of 21 participating mothers received a few additional paragraphs to read on the brain's flexibility and plasticity, but the researchers did not find any differences in the parents' level of resilience, or their children's empathy, with the addition of brain science teachings.

Parents can learn simple strategies for practicing kindness effectively, right in their own home, to create a brain healthy environment for their kids. "In times of stress, taking a moment to practice kindness for yourself and model it for your children can boost your own resilience and improve your child's prosocial behaviors," said Fratantoni. "Do not underestimate the power of kindness, because it can ultimately change and shape brain health."

The impacts of kindness may even extend beyond families. "Kindness can be a powerful brain health booster that raises resilience, not only for parents and families, but for society as a whole," said Johnson.

Medical Xpress, 11 April 2022

https://medicalxpress.com

How QR codes work and what makes them dangerous – a computer scientist explains

2022-04-07

Among the many changes brought about by the pandemic is the widespread use of QR codes, graphical representations of digital data that can be printed and later scanned by a smartphone or other device.

QR codes have a wide range of uses that help people avoid contact with objects and close interactions with other people, including for sharing restaurant menus, email list sign-ups, car and home sales information, and checking in and out of medical and professional appointments.

QR codes are a close cousin of the bar codes on product packaging that cashiers scan with infrared scanners to let the checkout computer know what products are being purchased.

Bar codes store information along one axis, horizontally. QR codes store information in both vertical and horizontal axes, which allows them to hold significantly more data. That extra amount of data is what makes QR codes so versatile.

While it is easy for people to read Arabic numerals, it is hard for a computer. Bar codes encode alphanumeric data as a series of black and white lines of various widths.

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Anatomy of a QR code

While it is easy for people to read Arabic numerals, it is hard for a computer. Bar codes encode alphanumeric data as a series of black and white lines of various widths. At the store, bar codes record the set of numbers that specify a product's ID. Critically, data stored in bar codes is redundant. Even if part of the bar code is destroyed or obscured, it is still possible for a device to read the product ID.

QR codes are designed to be scanned using a camera, such as those found on your smartphone. QR code scanning is built into many camera apps for Android and iOS. QR codes are most often used to store web links; however, they can store arbitrary data, such as text or images.

When you scan a QR code, the QR reader in your phone's camera deciphers the code, and the resulting information triggers an action on your phone. If the QR code holds a URL, your phone will present you with the URL. Tap it, and your phone's default browser will open the webpage.

QR codes are composed of several parts: data, position markers, quiet zone and optional logos.

The data in a QR code is a series of dots in a square grid. Each dot represents a one and each blank a zero in binary code, and the patterns encode sets of numbers, letters or both, including URLs. At its smallest this grid is 21 rows by 21 columns, and at its largest it is 177 rows by 177 columns. In most cases, QR codes use black squares on a white background, making the dots easy to distinguish. However, this is not a strict requirement, and QR codes can use any color or shape for the dots and background.

Position markers are squares placed in a QR code's top-left, top-right, and bottom-left corners. These markers let a smartphone camera or other device orient the QR code when scanning it. QR codes are surrounded by blank space, the quiet zone, to help the computer determine where the QR code begins and ends. QR codes can include an optional logo in the middle.

Like barcodes, QR codes are designed with data redundancy. Even if as much as 30% of the QR code is destroyed or difficult to read, the data can still be recovered. In fact, logos are not actually part of the QR code; they cover up some of the QR code's data. However, due to the QR code's redundancy, the data represented by these missing dots can be recovered by looking at the remaining visible dots.

Are QR codes dangerous?

QR codes are not inherently dangerous. They are simply a way to store data. However, just as it can be hazardous to click links in emails, visiting URLs stored in QR codes can also be risky in several ways.

The QR code's URL can take you to a phishing website that tries to trick you into entering your username or password for another website. The URL could take you to a legitimate website and trick that website into doing something harmful, such as giving an attacker access to your account. While such an attack requires a flaw in the website you are visiting, such vulnerabilities are common on the internet. The URL can take you to a malicious website that tricks another website you are logged into on the same device to take an unauthorized action.

A malicious URL could open an application on your device and cause it to take some action. Maybe you've seen this behavior when you clicked a Zoom link, and the Zoom application opened and automatically joined a meeting. While such behavior is ordinarily benign, an attacker could use this to trick some apps into revealing your data.

It is critical that when you open a link in a QR code, you ensure that the URL is safe and comes from a trusted source. Just because the QR code has a logo you recognize doesn't mean you should click on the URL it contains.

There is also a slight chance that the app used to scan the QR code could contain a vulnerability that allows malicious QR codes to take over your device. This attack would succeed by just scanning the QR code, even if you don't click the link stored in it. To avoid this threat, you should use trusted apps provided by the device manufacturer to scan QR codes and avoid downloading custom QR code apps.

The Conversation, 7 April 2022

https://theconversation.com

Animals often work together to get ahead in life. It's something humans could learn from

2022-04-12

Humans could learn a lot from observing animal behaviour.

Like us, animals are capable of problem solving, empathising and communicating, according to Dr Ashley Ward.

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And they have much to teach us about living together harmoniously.

Dr Ward is a professor of Animal Behaviour at the University of Sydney. His research focuses on the behaviour of fish, birds, krill and other mammals.

It's been his lifelong passion, he tells ABC RN's Late Night Live.

"When I was a child, I would be looking under logs, stones and in streams and ponds just to find any kind of animal to peer at. And that eventually, of course, became my career," he says.

It has taken him all around the world. One highlight was a trip to the Azores, a group of islands in the North Atlantic, where he observed and swam with the world's largest predator – sperm whales.

"This group of five sperm whales turned up, it was absolutely incredible. A large matriarch with potentially her daughter and … also her grandchildren," he recalls.

"They started frolicking around us and it was absolutely spellbinding."

There was also a dolphin with the pod of whales.

"These species occupy very different ecologies, they have different foods … [and] this particular dolphin had scoliosis, had a severely bent spine, and yet it was interacting very freely with the group of sperm whales," he says.

Working smarter

While some animals are instinctively social creatures, staying with the herd is usually important for survival in the animal kingdom.

"If you were to go your own way every time danger threatened, then the only certain thing is that you would get eaten," Dr Ward says.

"By using the wisdom of the crowd, the collective intelligence of the group, that's an excellent way to actually solve the big problems in life."

He points to birds as good example of social cohesion among animals.

For instance, Harris's hawks look across the landscape for their next meal by standing on each other's backs. The topmost bird can gain a better view of their surroundings to scout for prey and then they hunt together in groups.

"By using the wisdom of the crowd, the collective intelligence of the group, that's an excellent way to actually solve the big problems in life."

And the V formation some birds create during flight helps them all to conserve energy, in the same way that cyclists draft behind one another on the road.

"Some birds will take that position for a period, and then they'll swap out. But it's not in any way enforced, they simply seem to opt to take that position, and then others replace them when they become tired," he says.

"By doing this, they don't save a huge amount of energy between [them] — five and 10 per cent of the energy perhaps they save [flying in a V formation] — but on a long migration, that can mean the difference between life and death."

Other ways in which animals interact can provide inspiration for humans.

For example, when car manufacturer Nissan was working on their first generation of self-driving cars, developers turned to shoals of fish to try and replicate their collision avoidance techniques, he says.

"The animals are simply following a few basic rules … if you're too close to your near neighbour, move apart; if you're too far away from your near neighbour, move together. And if you're the perfect sort of Goldilocks distance apart, then copy what [your neighbour is] doing," he says.

He says Nissan realised that evolution had given these animals the perfect system for traffic.

"And so robotic cars, if they adopt these rules, can effectively move in the kind of perfection animals do, if done correctly," he says.

Observing empathy

Some animals, including elephants, appear to mourn death.

Dr Ward remembers a story he heard from a ranger in Kenya's Masai Mara National Park about an elderly matriarch elephant making her way across the plains flanked by two members of her herd.

It was clear to the ranger, as well as the other elephants, that she was approaching her last days.

And when she died one evening, the elephants accompanying her, stayed with her body and covered it with branches.

"A few days later, the whole herd returned … and appeared to undertake some kind of solemn animal ceremony," he says,

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"It's difficult to ascribe emotions to animals — we don't know what they're thinking — but there seems to be [a] sense in which they understand death and mourn."

Another creature that has scientists debating its capability to show empathy is the rat.

Often rats are used as a byword for cunning and for dirtiness, but that reputation may not be deserved.

A study published in 2015 studied two cages with rats that were positioned side-by-side.

"One [cage] has a rat, which is delightfully happy, where it's warm and it's dry, and it's got everything that a rat could possibly require," he explains.

In the next cage, the rat is wet, cold and doesn't have anything.

There's an adjoining door between the cages, so the rat in the dry cage is able to open the door and offer his mate a safe haven.

"[That rat] can just sit there enjoying itself in its luxury cage and ignore the other, or it can open the other door," he says.

In almost every experiment, the rat in the dry side of the cage opened the door and let the wet rat in, he says.

The researchers of the study suggest that this was an example of empathy.

"There were some opponents of this who said, quite correctly, we don't know what the rat was thinking. We don't know whether it's empathy," he says.

But Dr Ward would like to think it is.

"Although the debate goes on, I think one of the things that really convinced me was the fact that when the rat in the dry cage had previously had its own experience of being in that wet cage, after undergoing that deprivation, it was much quicker and much more likely to open the cage door to the wet rat," he says.

It seemed to empathise, he says, even though often we can only ever speculate about an animal's motivation to do anything.

ABC News, 12 April 2022

https://abc.net.au

MicroRNA can regrow 90% of lost hair, study finds

2022-04-13

Researchers from North Carolina State University have identified a microRNA (miRNA) that could promote hair regeneration. This miRNA – miR-218-5p – plays an important role in regulating the pathway involved in follicle regeneration, and could be a candidate for future drug development.

Hair growth depends on the health of dermal papillae (DP) cells, which regulate the hair follicle growth cycle. Current treatments for hair loss can be costly and ineffective, ranging from invasive surgery to chemical treatments that don't produce the desired result. Recent hair loss research indicates that hair follicles don't disappear where balding occurs, they just shrink. If DP cells could be replenished at those sites, the thinking goes, then the follicles might recover.

A research team led by Ke Cheng, Randall B. Terry, Jr. Distinguished Professor in Regenerative Medicine at NC State's College of Veterinary Medicine and professor in the NC State/UNC Joint Department of Biomedical Engineering, cultured DP cells both alone (2D) and in a 3D spheroid environment. A spheroid is a three-dimensional cellular structure that effectively recreates a cell's natural microenvironment.

In a mouse model of hair regeneration, Cheng looked at how quickly hair regrew on mice treated with 2D cultured DP cells, 3D spheroid-cultured DP cells in a keratin scaffolding, and the commercial hair loss treatment Minoxidil. In a 20-day trial, mice treated with the 3D DP cells had regained 90% of hair coverage at 15 days.

"The 3D cells in a keratin scaffold performed best, as the spheroid mimics the hair microenvironment and the keratin scaffold acts as an anchor to keep them at the site where they are needed," Cheng says. "But we were also interested in how DP cells regulate the follicle growth process, so we looked at the exosomes, specifically, exosomal miRNAs from that microenvironment." Exosomes are tiny sacs secreted by cells that play an important role in cell to cell communication. Those sacs contain miRNAs.

MiRNAs are small molecules that regulate gene expression. Cheng and his team measured miRNAs in exosomes derived from both 3D and 2D DP cells. In the 3D DP cell-derived exosomes, they pinpointed miR-218-5p, a miRNA that enhances the molecular pathway responsible for promoting hair follicle growth. They found that increasing miR-218-5p promoted hair follicle growth, while inhibiting it caused the follicles to lose function.

Current treatments for hair loss can be costly and ineffective, ranging from invasive surgery to chemical treatments that don't produce the desired result.

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"Cell therapy with the 3D cells could be an effective treatment for baldness, but you have to grow, expand, preserve and inject those cells into the area," Cheng says. "MiRNAs, on the other hand, can be utilized in small molecule-based drugs. So potentially you could create a cream or lotion that has a similar effect with many fewer problems. Future studies will focus on using just this miRNA to promote hair growth."

The research appears in Science Advances, and was supported by the National Institutes of Health and the American Heart Association. Cheng is corresponding author. Postdoctoral researcher Shiqi Hu is first author.

The Brighter Side of News, 13 April 2022

https://thebrighterside.news

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