

Bulletin Board

Contents

SEP. 02, 2022

(click on page numbers for links)

REGULATORY UPDATE

ASIA PACIFIC

New legislative instrument – Agricultural and Veterinary Chemicals Code (Allowable Variation in Concentrations of Constituents in Agricultural Chemical Products) Standard 2022.....	4
APVMA Gazette No. 17, 23 August 2022.....	5
Australia's AICIS extends deadline for evaluation of dechlorane plus	6
India to harmonize Chemical Safety Regulation.....	6
Food packaging leachates impact gut microbiome and metabolites.....	7

AMERICA

Chemical Sector Next in Line for White House Plan to Incentivize Cybersecurity.....	8
Can California Stop Selling Polluting Cars by 2035? Yes It Can.....	9

EUROPE

Where are we with 'forever chemicals'.....	10
EU Revises Regulations for Ethylene Oxide in Food Additives	11
Switzerland Submission deadline for exemption applications for 4 substances of very high concern.....	11

INTERNATIONAL

UN's Ecosoc: Dangerous goods regulations require update to increase use of recycled plastic.....	12
--	----

REACH UPDATE

Current Consultations.....	14
----------------------------	----

JANET'S CORNER

Proxy Variable	16
----------------------	----

HAZARD ALERT

Toluene.....	17
--------------	----

CONTACT US

subscribers@chemwatch.
net
tel +61 3 9572 4700
fax +61 3 9572 4777

1227 Glen Huntly Rd
Glen Huntly
Victoria 3163 Australia

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Bulletin Board

Contents

SEP. 02, 2022

GOSSIP

Non-nutritive sweeteners affect human microbiomes and can alter glyceic responses.....	20
Sulfur shortage: A potential resource crisis looming as the world decarbonises.....	21
Solid-state refrigerant works under pressure for greener cooling	23
Scientists have traced Earth's path through the galaxy via tiny crystals found in the crust.....	24
Tattoo ink can contain cancer causing chemicals that mutate in sunlight or are so small they can get into cells, experts warn	27
Gene therapy for completely color blind children partly restores cone function.....	30
Your next wooden chair could arrive flat, then dry into a 3D shape	32
No More Needles: Inhalable COVID-19 Vaccine Shows Promise	34
'Drug factory' implants eradicate advanced-stage cancers in just 6 days..	36
Astronauts going to Mars will receive many lifetimes worth of radiation..	38

CURIOSITIES

Your taste for weird food may be down to your genes	41
Are indoor vertical farms really 'future-proofing agriculture'?	42
Turning wind turbine blades into gummy bears.....	48
An extrasolar world covered in water?	49
The chemical secrets behind vanilla's allure	52
Your Brain Wakes Up Over 100 Times a Night – But Don't Worry, This Is a Good Thing.....	54
Rechargeable aluminum: The cheap solution to seasonal energy storage?	57
Created from food waste, these solar panels generate energy without sunlight	60
The Netherlands Is Building an Ark for Its Bees.....	61
Antibody "master key" discovery could neutralize all COVID variants	64

TECHNICAL NOTES

(Note: Open your Web Browser and click on Heading to link to section) ..	67
CHEMICAL EFFECTS.....	67

Bulletin Board

Contents

SEP. 02, 2022

ENVIRONMENTAL RESEARCH.....	67
PHARMACEUTICAL/TOXICOLOGY	67
OCCUPATIONAL.....	67

Bulletin Board

Regulatory Update

SEP. 02, 2022

ASIA PACIFIC

New legislative instrument – Agricultural and Veterinary Chemicals Code (Allowable Variation in Concentrations of Constituents in Agricultural Chemical Products) Standard 2022

2022-08-23

The Agricultural and Veterinary Chemicals Code (Allowable Variation in Concentrations of Constituents in Agricultural Chemical Products) Standard 2022 is a new legislative instrument made on 9 August 2022 under section 6E of the Agvet Code. The instrument commenced on 16 August 2022, the day after it was registered on the Federal Register of Legislation.

As required by regulation 8AF(1) of the Agricultural and Veterinary Chemicals Code Regulations (the Regulations), the proposal to establish the new standard was released for public consultation on the Australian Pesticides and Veterinary Medicines Authority (APVMA) website and in the APVMA Gazette on 3 May 2022. Comments received in response to the public consultation were generally supportive of the new standard and were published on the APVMA website. Some minor changes from the draft standard were made in response to the comments.

Under regulation 8AF(4) of the Regulations, the APVMA must publish a notice in the APVMA Gazette and on its website when it makes a standard under section 6E of the Code, stating that the standard has been made. This notice was published in the APVMA Gazette, 23 August 2022.

Under recent changes made to the Agvet Code, section 5AA states that concentrations of constituents in registered chemical products must not differ from the concentrations entered into the Register at the time of product registration by more than the extent prescribed by the Regulations (the prescribed extent).

Regulation 41(2) of the Regulations states that the prescribed extent is the extent permitted by the standards prescribed by Regulation 42.

In turn, Regulation 42(3) specifies the standard prescribed for a chemical product as being the standard published in any of a 'cascade' of publications, with a publication higher in the cascade taking precedence over one lower down. The publications are, in order, a standard specified in an Order made under section 7 of the Agricultural and Veterinary

Bulletin Board

Regulatory Update

SEP. 02, 2022

Chemicals Code Act 1994 (of which there are none currently), a standard made under section 6E of the Code (as has been done), a standard published for a listed chemical product, a monograph in the British, European or US Pharmacopoeia, or a specification published by the Food and Agriculture Organization (FAO) and/or the World Health Organisation (WHO).

Read More

APVMA, 23-08-22

<https://apvma.gov.au/>

APVMA Gazette No. 17, 23 August 2022

2022-08-23

Contents

- Agricultural chemical products and approved labels – 1
- Veterinary chemical products and approved labels – 11
- Approved active constituents – 16
- Amendments to the APVMA MRL Standard – 20
- Proposal to amend Schedule 20 in the Australian New Zealand Food Standards Code – 21
- Proposed variation to Schedule 20 in the Australia New Zealand Food Standards Code – 22
- Variations to Schedule 20 of the Australian New Zealand Food Standards Code – 25
- New legislative instrument – Agricultural and Veterinary Chemicals Code (Allowable Variation in Concentrations of Constituents in Agricultural Chemical Products) Standard 2022 – 30
- Notice of cancellation at the request of the holder – 32

Content last updated:

23 August 2022

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23 August 2022

Bulletin Board

Regulatory Update

SEP. 02, 2022

Read More

APVMA, 23-08-22

<https://apvma.gov.au/node/104121>

Australia's AICIS extends deadline for evaluation of dechlorane plus

2022-08-25

Australia's Industrial Chemicals Introduction Scheme has pushed back its timeframe for evaluating dechlorane plus by a year. Originally scheduled on the regulator's rolling action plan for publication in June, it is now not expected until 30 June 2023.

Dechlorane plus – a flame retardant mainly used in motor vehicles – is being considered for global action for its “associated harmful impacts, including oxidative damage, neurodevelopmental toxicity and endocrine disruption”, according to the Persistent Organic Pollutants (POPs) Review Committee of the Stockholm Convention.

The AICIS said that it has extended the deadline to allow it to take into account the outcome of a critical long-term aquatic toxicity study, the UK is currently conducting. It expects the release of the study's findings to coincide with the international meeting that informs decisions under the Stockholm Convention.

It said that timeframes are only relevant to substances subject to evaluations initiated by the regulator's executive director, and listed on its rolling action plan. With the exception of dechlorane plus, “no substances that are subjects of Stockholm-related proposals or processes have been initiated for evaluation at this time,” the AICIS added.

Read More

Chemical Watch, 25-08-22

<https://chemicalwatch.com/551240/australias-aicis-extends-deadline-for-evaluation-of-dechlorane-plus>

India to harmonize Chemical Safety Regulation

2022-08-25

To prevent workplace accidents and diseases, India's Department of Chemicals and Petrochemicals has decided to provide international chemical safety cards (ICSCs) to workers.

Bulletin Board

Regulatory Update

SEP. 02, 2022

The workers will also receive training in using the cards and companies will be stimulated to implement the ICSCs through risk assessments and safety exercises.

The ICSCs contain concise hazard and health information for people working with chemicals. So far almost 1,800 ICSCs have been developed by the International Labour Organization and the World Health Organisation, with support from the European Commission.

The information in the ICSCs is in line with the UN GHS. By using the ICSCs India prepares for its intended adoption of the UN GHS.

Read More

Safety4sea, 25-08-22

<https://safety4sea.com/india-to-harmonize-chemical-safety-regulation/>

Food packaging leachates impact gut microbiome and metabolites

2022-08-17

In an article published on July 16, 2022, in the Journal of Hazardous Materials, Naifan Hu and co-authors from Ningxia Medical University, Yinchuan, China, investigated the effects of food contact material (FCM) leachates on the mice gut microbiome and metabolome.

The scientists purchased three types of commonly used food packaging, non-woven tea bags, food-grade plastic bags, and disposable paper cups, in supermarkets in Yinchuan and put them in boiling tap water for 10 minutes to leach the chemicals contained in them. The cooled-off leachates were given to mice as drinking water for six months. Ten mice each were exposed to samples of the three packaging types and another ten to untreated drinking water as control. Subsequently, the feces and urine of the mice were used for the analysis of the gut microbiome and metabolomics. Besides, liver and renal tissues were investigated for histological changes, inflammation, and oxidative stress.

Hu and co-authors reported inflammation in both tissue types as well as an altered cell morphology compared to the control mice. Furthermore, plastic leachates were found to change the diversity and composition of the gut microbiota at the genus level. For instance, the dominant microbiota in each exposure group changed compared to the control group but for each of the exposure groups in a different manner. Differences were also observed between male and female

Bulletin Board

Regulatory Update

SEP. 02, 2022

mice. Metabolomics showed an enrichment of pathways related to immune function and inflammatory responses with glycosaminoglycan degradation and arginine biosynthesis being affected the most. Based on their findings, Hu et al. concluded that “changes in gut microbiota and metabolites are mainly associated with oxidative stress, immunity, and inflammatory responses.”

Read More

Food Packaging Forum, 17-08-22

<https://www.foodpackagingforum.org/news/food-packaging-leachates-impact-gut-microbiome-and-metabolites>

AMERICA

Chemical Sector Next in Line for White House Plan to Incentivize Cybersecurity

2022-08-24

Operators of chemical facilities will follow those of electric utilities, gas pipelines and water treatment plants in being asked to facilitate visibility into their systems.

The Biden administration’s voluntary-first approach to cybersecurity is set to target the chemical sector in a fourth 100-day sprint to gain insights into the cybersecurity posture of the nation’s critical infrastructure, and to ultimately improve its resilience.

“We were asked last year by the White House through a national security memorandum to focus on protection of industrial control systems, and I think the chemical sector is next in line,” said Cybersecurity and Infrastructure Security Agency Director Jen Easterly, adding, “we’re going to kick off a 100-day sprint with probably many of you here.”

Easterly was addressing participants Wednesday at a 3-day chemical security conference the agency is hosting on the issue.

The national security memo published last summer was in response to the attack on Colonial Pipeline and focussed attention on the vulnerability of critical industrial control systems. Rolling out the initiative, administration officials said the sprints aim to encourage operators to install tools that would help them detect and respond to cyber incidents.

Bulletin Board

Regulatory Update

SEP. 02, 2022

Ideally, pilot programs under the sprints would tap an existing CyberSentry program run by CISA, the officials said, but they were unclear on how or if the operators would be compensated for implementing sensors in their environments. Regardless, they say, more than 150 utilities have installed—or have committed to installing—the technology.

Read More

Nextgov, 24-08-22

<https://www.nextgov.com/cybersecurity/2022/08/chemical-sector-next-line-white-house-plan-incentivize-cybersecurity/376265/>

Can California Stop Selling Polluting Cars by 2035? Yes It Can.

2022-08-22

California’s air pollution regulator, the Air Resources Board, is poised to adopt one of the most important steps that the state has ever taken to reduce exposure to air pollution and limit climate changing emissions. The Advanced Clean Cars II (ACCI) regulations are the newest version of clean air rules for passenger vehicles and are the culmination of over 50 years of work to address the harm from tailpipe pollution in the state.

California is already experiencing climate change with extreme drought and destructive wildfires. We also have the worst air quality in the nation, causing avoidable suffering from disease and early deaths. If we want to clean our air and slow global warming, we need to greatly reduce emissions from passenger cars and trucks. In California, these vehicles produce more than one quarter of the state’s human-caused emissions, more than agriculture and commercial and residential buildings combined.

Read More

The Equation, 22-08-22

<https://blog.ucsusa.org/dave-reichmuth/can-california-stop-selling-polluting-cars-by-2035-yes-it-can/>

Bulletin Board

Regulatory Update

SEP. 02, 2022

EUROPE

Where are we with 'forever chemicals'

2022-08-22

Regulatory measures are welcomed progress as concerns over PFAS in the global food chain increase in Europe.

Per- and poly-fluoroalkyl substances (PFAS) are a vast group of over anthropogenic (man-made) organic chemicals. The group consists of a hydrophobic fluorinated alkyl chain (R) of varying length (typically, C₄-C₁₆) and a hydrophilic functional group (X). The hydrophobic part may be fully [R=F(CF₂)_n-] or partially fluorinated. When fully fluorinated, the molecules are also called perfluoroalkyl substances. Over 4,730 PFAS related CAS numbers have been identified. Due to their unique water, grease and dirt repellent properties, they have been widely used in industrial processes since the 1950s. PFAS are also extensively used in consumer products such as paper, textiles, non-stick coated cooking utensils and cosmetics, and as such, we are exposed to them through a range of everyday scenarios.

Many of the PFAS are resistant to biological, chemical and physical transformation because of the chemical stability imparted by the carbon-fluorine (C-F) bond. As a result, PFAS are extremely long lived and widely detected in the environment (water, air, soil, sediments and biota).

Long half-lives, in the range of years, have been reported, depending on the PFAS and matrix combination. Two of the most commonly used PFAS, perfluorooctane sulfonic acid (PFOS) and perfluorooctanoic acid (PFOA) have been listed in the annexes of the UNEP Stockholm Convention on Persistent Organic Pollutants (POPs) with the aim of eliminating their production and uses. In addition, perfluorohexane sulfonic acid (PFHxS) is also considered for listing in the Stockholm Convention. Last month, the governments of Denmark, Germany, the Netherlands, Sweden and Norway formally proposed to the European Chemicals Agency (ECHA) that these chemicals be restricted under Reach (Registration, evaluation, authorisation and restriction of chemicals) legislation. The proposal aims to prohibit the production, marketing, and use of these substances throughout Europe. Exceptions will be considered for certain established uses, such as medical applications. After summer 2022, ECHA's scientific bodies and socio-economic analysis committee will assess the Reach restriction dossier and deliver an opinion by 2023. A final agreement by EU member states could be possible as early as 2025.

Bulletin Board

Regulatory Update

SEP. 02, 2022

Read More

New Food Magazine, 22-08-22

<https://www.newfoodmagazine.com/article/166945/pfas-regulations/>

EU Revises Regulations for Ethylene Oxide in Food Additives

2022-08-24

The European Commission has recently published revisions to its regulation on the use of ethylene oxide in food additives. The revisions have been made to provide clarity on the allowable levels of ethylene oxide present in food additives, as uncertainty surrounding regulation of the substance has led to enforcement challenges and recall incidents.

Ethylene oxide is a chemical substance with many applications, such as for the sterilization of raw materials in food production. However, the substance has been identified as a carcinogenic, mutagenic, and reproductive toxin.

Citing Rapid Alert System for Food and Food Network (RASFF) notifications, the European Commission explains that there have been several recent incidents concerning the presence of ethylene oxide in food products from food additives that contain the substances. The difficulty of discerning the source of ethylene oxide that is present in foods—be it through the unlawful sterilization of food additives or any other reason—has made enforcement of the substance in food challenging.

Read More

Food Safety Magazine, 24-08-22

<https://www.food-safety.com/articles/7962-eu-revises-regulations-for-ethylene-oxide-in-food-additives>

Switzerland Submission deadline for exemption applications for 4 substances of very high concern

2022-08-23

The substances mentioned below are listed in annex 1.17 of the chemical risk reduction ordinance (ORRChem). After the expiry of the transitional period (2.8.2024) it is fundamentally prohibited to use them and to place them on the market for use in Switzerland. Until the 2.2.2023, an

Bulletin Board

Regulatory Update

SEP. 02, 2022

application for exemption can be submitted to the Notification Authority for Chemicals.

[Read More](#)

Chemycal, 23-08-22

https://chemycal.com/news/5d2dd622-c253-45c6-b3ee-c078731d0084/Switzerland__Submission_deadline_for_exemption_applications_for_4_substances_of_very_high_concern

INTERNATIONAL

UN's Ecosoc: Dangerous goods regulations require update to increase use of recycled plastic

2022-08-25

Delegates at a recent meeting of a UN sub-committee on the transport of dangerous goods have agreed on further work to facilitate the use of recycled plastic in the transport of dangerous goods.

The July meeting of the Economic and Social Council (Ecosoc) Sub-Committee of Experts on the Transport of Dangerous Goods did not, however, lead to any changes in regulation.

Belgium requested the informal session, which discussed the ISO standard for recycled plastics in dangerous goods packaging (ISO 16103:2005), currently under review. It was proposed the sub-committee work in parallel with the ISO working group to ensure consistency with possible amendments to the UN Model Regulations.

The sub-committee suggested national standards bodies be informed to participate in the ISO working group and that the latter make regular reports on potential changes.

In a later session of the Ecosoc meeting, three trade associations issued a call for specific amendments to the Model Regulations that would promote the increased use of recycled plastic for transporting dangerous goods. Currently, there are strict requirements that only allow the use of resins from industrial packaging.

The proposal, put forward by the International Confederation of Plastics Packaging Manufacturers (ICPP), the International Confederation of Container Reconditioners (ICCR) and the International Confederation of

Bulletin Board

Regulatory Update

SEP. 02, 2022

Intermediate Bulk Container Associations (ICIBCA), included removing packaging marks indicating recycled material and restrictions on its use.

[Read More](#)

Chemical Watch, 25-08-22

<https://chemicalwatch.com/550782/uns-ecosoc-dangerous-goods-regulations-require-update-to-increase-use-of-recycled-plastic>

Bulletin Board

REACH Update

SEP. 02, 2022

Current Consultations

2022-08-26

Applications for authorisation

Consultations: 16

- Start date: 17/08/2022
- Deadline: 12/10/2022

Calls for comments and evidence

Substances: 1

- Start date: 10/06/2022
- Deadline: 30/09/2022

ECHA's Executive Director Requests to the Committees

EFSA datasets used by ECHA to assess the risks to human health from the use of lead in ammunition: 1

- Start date: 06/07/2022
- Deadline: 06/10/2022

Restrictions

Consultations on SEAC draft opinion: 1

- Start date: 29/06/2022
- Deadline: 29/08/2022

Restriction proposals: 1

- Start date: 23/03/2022
- Deadline: 23/09/2022

Restriction proposals: 2

- Start date: 20/06/2022
- Deadline: 20/12/2022

Testing proposals

Testing proposals: 5

- Start date: 15/07/2022
- Deadline: 29/08/2022

Bulletin Board

REACH Update

SEP. 02, 2022

Read More

ECHA, 26-08-22

<https://echa.europa.eu/consultations/current>

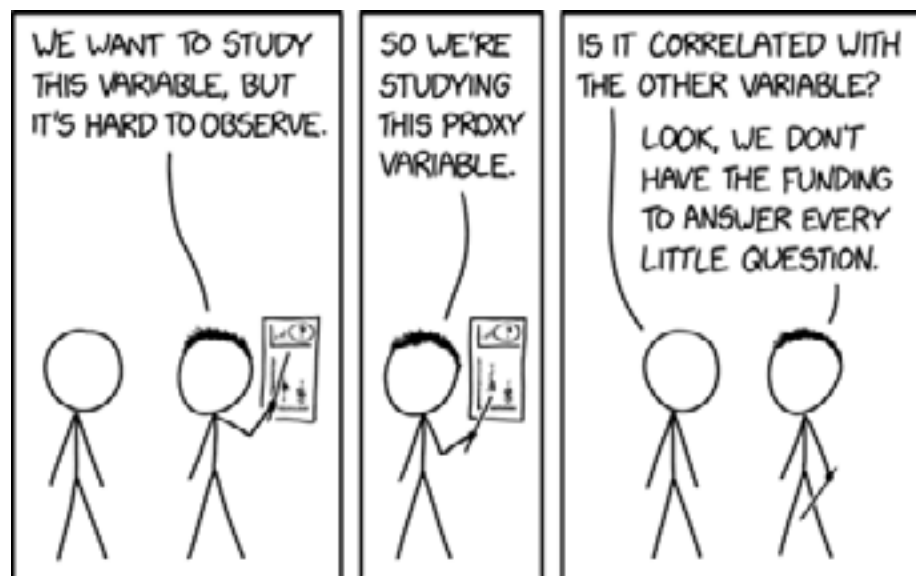
Bulletin Board

Janet's Corner

SEP. 02, 2022

Proxy Variable

2022-09-02



<https://xkcd.com/2652/>

Bulletin Board

Hazard Alert

SEP. 02, 2022

Toluene

2022-09-02

Toluene is a clear colourless liquid with a distinctive odour—also known as an aromatic hydrocarbon. It occurs naturally in crude oil and in the tolu tree, and can be produced in the process of making gasoline. Toluene is insoluble in water and its vapours are heavier than air. It is a methylbenzene and is the simplest member of the class toluenes. [1,2]

USES [1,2]

Toluene is used in many different applications, including aviation, as a solvent and as an industrial feedstock. For airplanes and cars, toluene is used as an octane booster in fuel. It is also used as a solvent in paints, nail polish, adhesives, permanent markers and certain types of glue. It is also sometimes used in leather and printing processes and as a recreational inhalant.

ROUTES OF EXPOSURE [3]

- The most common route of exposure for toluene in the ambient air is in automobile emissions.
- Common household products, such as paints, nail polish and adhesives are the highest source of toluene in indoor air.
- Cigarette smoke is also a source of toluene.
- Levels of toluene are highest in indoor areas, followed by urban areas and then rural.
- People can be exposed to formaldehyde by skin contact, inhalation, by eye contact, or by ingestion.

HEALTH EFFECTS

Toluene poisoning can affect a range of systems, including the nervous, respiratory and cardiovascular systems.

Acute Effects [3]

Severity of symptoms depends on the level and type of exposure.

- The Central Nervous System (CNS) is the primary target organ for toluene exposure.
- Other acute effects include: narcosis, CNS dysfunction, fatigue, sleepiness, headache and nausea.

Toluene is a clear colourless liquid with a distinctive odour—also known as an aromatic hydrocarbon.

Bulletin Board

Hazard Alert

SEP. 02, 2022

- Inhalation of toluene has a low chemical toxicity.
- Ingestion of toluene can lead to a swollen liver, depression of the CNS, congestion and hemorrhage of the lungs and necrosis of myocardial fibres.
- Acute exposure to it may cause cardiac arrhythmia.

Chronic Effects [3]

Toluene is toxic to multiple body systems. Long-term exposure to the liquid can cause neurological damage, including CNS depression, ataxia, cerebral atrophy, nystagmus and neurobehavioural effects. It can also result in respiratory difficulties, such as irritation of the respiratory tract, a sore throat, headaches, and inflammation and degeneration of the nasal and respiratory epithelium. Pregnant women who are exposed to toluene could see developmental delays, CNS dysfunction, minor limb abnormalities and attention deficits in their children. Additionally, children who were born to toluene abusers have been known to show temporary renal tubular acidosis.

SAFETY

First Aid Measures [4]

- Ingestion: If ingested, rinse mouth and DO NOT induce vomiting. Immediately call a doctor or a poison centre. In victim vomits while lying on their back, put them in a recovery position.
- Skin contact: In case of skin or hair contact, shower/wash immediately for at least 15 minutes with water. Remove all contaminated clothing and shoes while washing. Wash contaminated clothing before re-wear. Consult doctor.
- Eye contact: Flush eyes carefully with water for 15 minutes. Do not forget to wash underneath the eyelids. Call a doctor immediately.
- Inhaled: Take contaminated person to nearest fresh air source and monitor their breathing. If they are not breathing, perform CPR. If victim is struggling to breathe, they can be given oxygen.

Exposure Controls/Personal Protection [4]

- Engineering controls: Safety showers and emergency eyewash fountains should be accessible in the immediate area of the potential exposure. Ensure there is adequate ventilation. Use toluene with local exhaust ventilation. Whenever possible, material should be handled in a laboratory.

Bulletin Board

Hazard Alert

SEP. 02, 2022

- Personal protection: Safety glasses, solvent-protective apron, safety glasses with side shields and solvent-protective gloves.

REGULATION [5]

United States:

The Occupational Safety and Health Administration (OSHA) has set an 8-hour time-weighted average (TWA) concentration for toluene of 200ppm, with an acceptable ceiling concentration of 300ppm.

Australia [6]

Safe Work Australia: Safe Work Australia has set an 8-hour TWA concentration for toluene of 50ppm, and a short-term exposure limit—usually 15 minutes—of 150ppm.

REFERENCES

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2. <https://en.wikipedia.org/wiki/Toluene>
3. <https://www.epa.gov/sites/production/files/2016-09/documents/toluene.pdf>
4. <https://www.chemsupply.com.au/documents/347M.pdf>
5. <https://www.osha.gov/SLTC/toluene/standards.html>
6. <https://www.safeworkaustralia.gov.au/system/files/documents/1705/workplace-exposure-standards-airborne-contaminants-v2.pdf>

Bulletin Board

Gossip

SEP. 02, 2022

Non-nutritive sweeteners affect human microbiomes and can alter glycemic responses

2022-08-19

Since the late 1800s non-nutritive sweeteners have promised to deliver all the sweetness of sugar with none of the calories. They have long been believed to have no effect on the human body, but researchers publishing in the journal *Cell* on August 19 challenge this notion by finding that these sugar substitutes are not inert, and, in fact, some can alter human consumers' microbiomes in a way that can change their blood sugar levels.

In 2014, senior author Eran Elinav an immunologist and microbiome researcher at the Weizmann Institute of Science and the German National Cancer Center (DKFZ) and his team found that non-nutritive sweeteners affected the microbiomes of mice in ways that could impact their glycemic responses. The team was interested in whether these results would also be found in humans.

To address this important question, the research team carefully screened over 1,300 individuals for those who strictly avoid non-nutritive sweeteners in their day-to-day lives, and identified a cohort of 120 individuals. These participants were broken into six groups: two controls and four who ingested well below the FDA daily allowances of either aspartame, saccharin, stevia, or sucralose.

"In subjects consuming the non-nutritive sweeteners, we could identify very distinct changes in the composition and function of gut microbes, and the molecules they secrete into peripheral blood. This seemed to suggest that gut microbes in the human body are rather responsive to each of these sweeteners," says Elinav. "When we looked at consumers of non-nutritive sweeteners as groups, we found that two of the non-nutritive sweeteners, saccharin and sucralose, significantly impacted glucose tolerance in healthy adults. Interestingly, changes in the microbes were highly correlated with the alterations noted in people's glycemic responses."

To establish causation, the researchers transferred microbial samples from the study subjects to germ-free mice—mice that have been raised in completely sterile conditions and have no microbiome of their own.

"The results were quite striking," says Elinav. "In all of the non-nutritive sweetener groups, but in none of the controls, when we transferred into these sterile mice the microbiome of the top responder individuals collected at a time point in which they were consuming the respective

Bulletin Board

Gossip

SEP. 02, 2022

non-nutritive sweeteners, the recipient mice developed glycemic alterations that very significantly mirrored those of the donor individuals. In contrast, the bottom responders' microbiomes were mostly unable to elicit such glycemic responses," he adds. "These results suggest that the microbiome changes in response to human consumption of non-nutritive sweetener may, at times, induce glycemic changes in consumers in a highly personalized manner."

Elinav says that he expects the effects of the sweeteners will vary person to person because of the incredibly unique composition of our microbiome. "We need to raise awareness of the fact that non-nutritive sweeteners are not inert to the human body as we originally believed. With that said, the clinical health implications of the changes they may elicit in humans remain unknown and merit future long-term studies."

"In the meantime, we need to continue searching for solutions to our sweet tooth craving, while avoiding sugar, which is clearly most harmful to our metabolic health," says Elinav. "In my personal view, drinking only water seems to be the best solution."

Medical Xpress, 19 August 2022

<https://medicalxpress.com>

Sulfur shortage: A potential resource crisis looming as the world decarbonises

2022-08-22

A projected shortage of sulfuric acid, a crucial chemical in our modern industrial society, could stifle green technology advancement and threaten global food security, according to a new study led by UCL researchers.

The study, published in the Royal Geographical Society (with the Institute of British Geographers) journal *The Geographical Journal*, highlights that global demand for sulfuric acid is set to rise significantly from '246 to 400 million metric tons' by 2040—a result of more intensive agriculture and the world moving away from fossil fuels.

The researchers estimate that this will result in a shortfall in annual supply of between 100 and 320 million metric tons—between 40% and 130% of current supply—depending on how quickly decarbonization occurs.

A vital part of modern manufacturing, sulfuric acid is required for the production of phosphorus fertilizers that help feed the world, and for

"Research is urgently needed to develop low-cost, low environmental impact methods of extracting large quantities of elemental sulfur."

Bulletin Board

Gossip

SEP. 02, 2022

extracting rare metals from ores essential to the rapidly required green economy transition, like cobalt and nickel used in high-performance Li-ion batteries.

Currently, over 80% of the global sulfur supply is in the form of sulfur waste from the desulfurization of crude oil and natural gas that reduces the sulfur dioxide gas emissions that cause acid rain. However, decarbonization of the global economy to deal with climate change will significantly reduce the production of fossil fuels—and subsequently the supply of sulfur.

This study, led by researchers at University College London (UCL), is the first to identify this major issue. The authors suggest that unless action is taken to reduce the need for this chemical, a massive increase in environmentally damaging mining will be required to fill the resulting resource demand.

Study lead author, Professor Mark Maslin (UCL Geography), said: “Sulfur shortages have occurred before, but what makes this different is that the source of the element is shifting away from being a waste product of the fossil fuel industry.

“What we’re predicting is that as supplies of this cheap, plentiful, and easily accessible form of sulfur dry up, demand may be met by a massive increase in direct mining of elemental sulfur. This, by contrast, will be dirty, toxic, destructive, and expensive.

“Research is urgently needed to develop low-cost, low environmental impact methods of extracting large quantities of elemental sulfur from the abundant deposits of sulfate minerals in the Earth’s crust. The international community should consider supporting and regulating sulfur mining to minimize the impacts of the transition and also to avoid cheap unethical production from distorting the market.”

Study co-author Dr. Simon Day (UCL Institute for Risk & Disaster Reduction) said: “Our concern is that the dwindling supply could lead to a transition period when green tech outbids the fertilizer industry for the limited more expensive sulfur supply, creating an issue with food production particularly in developing countries.”

To determine their findings, the researchers estimated three sulfuric acid demand scenarios from 2021 to 2040, based on historic and forecast demand, with annual growth rates ranging from 1.8% to 2.4%.

Bulletin Board

Gossip

SEP. 02, 2022

The authors also explore several ways that demand for sulfur could be reduced as part of the transition to post-fossil fuel economies, including recycling phosphorus in wastewater for the fertilizer industry, by increasing the recycling of lithium batteries, or by using lower energy capacity/weight ratio batteries, as these require less sulfur for their production.

In addition, they prompt crucial questions about whether it would make economic sense to invest in alternative production methods, given it is not currently possible to predict how quickly the supply of sulfur as a waste product from oil and gas desulfurization will decrease as decarbonization of the global economy is only just starting.

However, they conclude that by recognizing the sulfur crisis now, national and international policies can be developed to manage future demand, increase resource recycling, and develop alternative cheap supplies

Phys Org, 22 August 2022

<https://phys.org>

Solid-state refrigerant works under pressure for greener cooling

2022-08-23

As useful as refrigerators and air conditioners are, the gases they use as refrigerants can leak into the atmosphere and become major contributors to climate change. Now engineers at Harvard have demonstrated a new prototype cooling device that uses a solid-state material as a refrigerant.

Devices like fridges and AC units get their cooling power from cycles of phase changes in a material. In its gaseous form, the refrigerant, usually a hydrofluorocarbon (HFC), will absorb heat from its surroundings, thus cooling a room or the inside of a fridge. This gas then passes into a compressor that, well, compresses it, turning it into a liquid and releasing the stored heat, which is vented outside. With the pressure off, the liquid is then allowed to expand back into a gas to start the cycle again. This is known as the barocaloric effect.

It’s an efficient process that’s served us well for decades, but these HFCs can leak out of the devices during use, if damaged, and when being moved or disposed of. Once in the atmosphere, they’re a far more potent driver of climate change than CO₂, so finding ways to reduce these emissions is a key part of environmental action plans.

Once in the atmosphere, [HFCs are] a far more potent driver of climate change than CO₂

Bulletin Board

Gossip

SEP. 02, 2022

Solid refrigerants that can still undergo the barocaloric effect could help solve the problem. The new study has found a promising material from a class called metal-halide perovskites, which are already excelling as a new generation of solar cell materials. In this case, the material can be used for cooling in much the same way as those that switch between liquid and gas phases, except it remains a solid for both phases.

The secret to these barocaloric solids is their atomic structure. Normally they're made up of long flexible chains of molecules that are disordered and somewhat floppy, but when under pressure they stiffen up into a more ordered state, which releases heat in the process. Release the pressure and they can once again absorb heat from their surroundings. While both states are solid, the team likens the transition to partially melting wax.

The team demonstrated the idea with a prototype device. The solid refrigerant is packed into a metal tube, along with an inert liquid like water or oil. A hydraulic piston applies pressure to the liquid, which in turn passes it along to the refrigerant. The liquid also helps transfer the heat out of the system.

The system shows promise, but the team says there are still a few kinks to iron out. For one, the pressures involved are possible with hydraulics, but are a bit too high for consumer devices – around 2,900 psi, compared to the 150 psi that a conventional AC tops out at. Other specific materials might also conduct heat better.

Other scientists have investigated using plastic crystals or shape-memory alloys as potential solid state refrigerants. With more work, this new class of materials could help make cooling devices more environmentally friendly.

New Atlas, 23 August 2022

<https://newatlas.com>

Scientists have traced Earth's path through the galaxy via tiny crystals found in the crust

2022-08-24

"To see a world in a grain of sand", the opening sentence of the poem by William Blake, is an oft-used phrase that also captures some of what geologists do.

Bulletin Board

Gossip

SEP. 02, 2022

We observe the composition of mineral grains, smaller than the width of a human hair. Then, we extrapolate the chemical processes they suggest to ponder the construction of our planet itself.

Now, we've taken that minute attention to new heights, connecting tiny grains to Earth's place in the galactic environment.

Looking out to the universe

At an even larger scale, astrophysicists seek to understand the universe and our place in it. They use laws of physics to develop models that describe the orbits of astronomical objects.

Although we may think of the planet's surface as something shaped by processes entirely within Earth itself, our planet has undoubtedly felt the effects of its cosmic environment. This includes periodic changes in Earth's orbit, variations in the Sun's output, gamma ray bursts, and of course meteorite impacts.

Just looking at the Moon and its pockmarked surface should remind us of that, given Earth is more than 80 times more massive than its grey satellite. In fact, recent work has pointed to the importance of meteorite impacts in the production of continental crust on Earth, helping to form buoyant "seeds" that floated on the outermost layer of our planet in its youth.

We and our international team of colleagues have now identified a rhythm in the production of this early continental crust, and the tempo points to a truly grand driving mechanism. This work has just been published in the journal *Geology*.

The rhythm of crust production on Earth

Many rocks on Earth form from molten or semi-molten magma. This magma is derived either directly from the mantle – the predominantly solid but slowly flowing layer below the planet's crust – or from re-cooking even older bits of pre-existing crust. As liquid magma cools, it eventually freezes into solid rock.

Through this cooling process of magma crystallisation, mineral grains grow and can trap elements such as uranium that decay over time and produce a sort of stopwatch, recording their age. Not only that, but crystals can also trap other elements that track the composition of their parental magma, like how a surname might track a person's family.

With these two pieces of information – age and composition – we can then reconstruct a timeline of crust production. Then, we can decode

This [mathematical wizardry] basically decodes the frequency of events, much like unscrambling ingredients that have gone into the blender for a cake.

Bulletin Board

Gossip

SEP. 02, 2022

its main frequencies, using the mathematical wizardry of the Fourier transform. This tool basically decodes the frequency of events, much like unscrambling ingredients that have gone into the blender for a cake.

Our results from this approach suggest an approximate 200-million-year rhythm to crust production on the early Earth.

Our place in the cosmos

But there is another process with a similar rhythm. Our Solar System and the four spiral arms of the Milky Way are both spinning around the supermassive black hole at the galaxy's centre, yet they are moving at different speeds.

The spiral arms orbit at 210 kilometres per second, while the Sun is speeding along at 240km per second, meaning our Solar System is surfing into and out of the galaxy's arms. You can think of the spiral arms as dense regions that slow the passage of stars much like a traffic jam, which only clears further down the road (or through the arm).

This model results in approximately 200 million years between each entry our Solar System makes into a spiral arm of the galaxy.

So, there seems to be a possible connection between the timing of crust production on Earth and the length of time it takes to orbit the galactic spiral arms – but why?

Strikes from the cloud

In the distant reaches of our Solar System, a cloud of icy rocky debris named the Oort cloud is thought to orbit our Sun.

As the Solar System periodically moves into a spiral arm, interaction between it and the Oort cloud is proposed to dislodge material from the cloud, sending it closer to the inner Solar System. Some of this material may even strike Earth.

Earth experiences relatively frequent impacts from the rocky bodies of the asteroid belt, which on average arrive at speeds of 15km per second. But comets ejected from the Oort cloud arrive much faster, on average 52km per second.

We argue it is these periodic high-energy impacts that are tracked by the record of crust production preserved in tiny mineral grains. Comet impacts excavate huge volumes of Earth's surface, leading to decompression

Bulletin Board

Gossip

SEP. 02, 2022

melting of the mantle, not too dissimilar from popping a cork on a bottle of fizz.

This molten rock, enriched in light elements such as silicon, aluminium, sodium and potassium, effectively floats on the denser mantle. While there are many other ways to generate continental crust, it's likely that impacting on our early planet formed buoyant seeds of crust. Magma produced from later geological processes would adhere to those early seeds.

Harbingers of doom, or gardeners for terrestrial life?

Continental crust is vital in most of Earth's natural cycles – it interacts with water and oxygen, forming new weathered products, hosting most metals and biological carbon.

Large meteorite impacts are cataclysmic events that can obliterate life. Yet, impacts may very well have been key to the development of the continental crust we live on.

With the recent passage of interstellar asteroids through the Solar System, some have even gone so far as to suggest they ferried life across the cosmos.

However we came to be here, it is awe-inspiring on a clear night to look up at the sky and see the stars and the structure they trace, and then look down at your feet and feel the mineral grains, rock and continental crust below – all linked through a very grand rhythm indeed.

The Conversation, 24 August 2022

<https://theconversation.com>

Tattoo ink can contain cancer causing chemicals that mutate in sunlight or are so small they can get into cells, experts warn

2022-08-25

Tattoo ink may contain toxic cancer-causing chemicals, a new study finds.

Scientists at State University of New York (SUNY) found that nearly half of a 56-sample of tattoo inks they investigated had azo-compounds, which degenerate under ultra-violet light — emitted in sunlight — into cancer-causing chemicals.

Bulletin Board

Gossip

SEP. 02, 2022

Many also contained particles below 100 nanometers (nm) in size, which they said could get into a cell's nucleus and trigger cancerous mutations.

The tattoo industry is largely unmonitored in the United States, researchers say, despite up to three in ten Americans having one. In Europe blue and green pigments have now been outlawed over concerns they could cause cancer.

Someone getting a tattoo is already at risk of a bacterial infection because the skin is breached, or contracting a bloodborne disease — like hepatitis B and C — if equipment is not cleaned properly. Over time, recipients may also develop nodules or granulomas around the tattoo or scar tissue.

The process causes a small amount of bleeding and pain in most recipients. But health bodies also warn people to be aware of the risks.

About two in five Americans already have a tattoo, with the numbers continuing to rise as body art gains social acceptance.

Little is known about what is actually in the inks used, researchers say, as the Food and Drug Administration (FDA) is not keeping a close eye on the industry.

The SUNY researchers investigated several popular tattoo inks and presented their findings Wednesday at the fall meeting of the American Chemical Society in Chicago, Illinois.

A tattoo is made up of two parts. The main piece is the pigment, which can be a molecular compound — like blue pigment — or a solid compound — such as titanium dioxide.

They also contain carrier fluids — typically alcohol-based — that bring the pigment into position between two layers of skin.

In the study, the scientists tested 56 inks and found several had substances that were not listed on the label.

In one case, ethanol — which can help thin blood — was spotted in the tattoo ink. It was unclear whether this posed any health risks.

Some 23 pigments — typically blues and greens — were also found to contain azo-compounds, which can become 'carcinogenic' if they are exposed to too much sunlight or lots of bacteria.

Researchers found that nearly half of tattoo inks contain azo-compounds, which can degenerate under ultra-violet light into a chemical that could cause cancer.

Bulletin Board

Gossip

SEP. 02, 2022

Dr. John Swierk, the chemist who led the study, told DailyMail.com: 'We don't necessarily know what the pigments break down into and so that's the real concern.'

'It's possible that you might have pigments that by themselves are safe, but that photodecompose into something of concern.'

For the second part of the study, the scientists also investigated the size of particles in 16 inks used in tattoos.

This showed that half — including black pigments — had particles below 100 nm, which were 'concerning' because they could 'get through the cell membrane and potentially cause harm.'

Speaking at a press conference today, Swierk said: 'When you get down to that size regime you start to have concerns about nanoparticles penetrating cells, getting into the nucleus of cells, and doing damage and causing problems like cancer that way.'

He added: 'Big companies manufacture pigments for everything, such as paint and textiles. These same pigments are used in tattoo inks.'

The scientists are now aiming to build the first comprehensive database of ingredients in different tattoo inks in the United States.

They have yet to investigate the impact of having a tattoo removed, which is typically done via a laser.

Specific concern was raised over two pigments — blue 15:3 and green 7 — which potentially caused cancer in 2020 amid warnings from some scientists. The European Union — which includes 27 European countries but not the UK — banned their use in tattoos in January.

But some authorities including those in Germany warned the ban was 'too far', saying more evidence was needed that they were potentially toxic. Tests by German regulators found both had a 'low level' of toxicity.

These colors remain in use in the United States, and there is no sign that authorities are moving to ban them.

American health authorities warn that getting a tattoo already poses several other health risks because the skin is pierced — opening up a risk of bacterial or bloodborne infection.

They also say in rare cases the tattoo can cause problems with an MRI scan, making it harder for doctors to diagnose conditions like cancer.

Bulletin Board

Gossip

SEP. 02, 2022

There may also be problems with having a tattoo removed, with the lasers potentially causing pain, blistering and crusting.

Swierck added: 'We have the same concerns [of cancer risks] about laser tattoo removal, since we don't understand how the laser is transforming the pigments.'

Daily Mail, 25 August 2022

<https://dailymail.co.uk>

Gene therapy for completely color blind children partly restores cone function

2022-08-23

Gene therapy has partly restored the function of the retina's cone receptors in two children who were born completely color blind, reports a new study led by University College London (UCL) researchers.

The findings, published in *Brain*, provide hope that the treatment is effectively activating previously dormant communication pathways between the retina and the brain, drawing on the plastic nature of the developing adolescent brain.

The academically-led study has been running alongside a phase 1/2 clinical trial in children with achromatopsia, using a new way to test whether the treatment is changing the neural pathways specific to the cones.

Achromatopsia is caused by disease-causing variants to one of a few genes. It affects cone cells, which (along with rods) are one of two types of photoreceptors in the eyes. As cones are responsible for color vision, people with achromatopsia are completely color blind, while they also have very poor vision overall and find bright light uncomfortable (photophobia). Their cone cells do not send signals to the brain, but many remain present, so researchers have been seeking to activate the dormant cells.

Lead author Dr. Tessa Dekker, UCL Institute of Ophthalmology, said, "Our study is the first to directly confirm widespread speculation that gene therapy offered to children and adolescents can successfully activate the dormant cone photoreceptor pathways and evoke visual signals never previously experienced by these patients.

Bulletin Board

Gossip

SEP. 02, 2022

"We are demonstrating the potential of leveraging the plasticity of our brains, which may be particularly able to adapt to treatment effects when people are young."

The study involved four young people with achromatopsia aged 10 to 15 years old, who were taking part in two trials led by Professor James Bainbridge at UCL and Moorfields Eye Hospital, sponsored by MeiraGTx-Janssen Pharmaceuticals.

The two trials are testing gene therapies targeting specific genes known to be implicated in achromatopsia (the two trials are each targeting a different gene). Their primary aim is to test that the treatment is safe, while also testing for improved vision. Their results have not yet been fully compiled so the overall effectiveness of the treatments remains to be determined.

The accompanying academic study used a novel functional magnetic resonance imaging (fMRI, a type of brain scan) mapping approach to separate emerging post-treatment cone signals from existing rod-driven signals in patients, allowing the researchers to pinpoint any changes in visual function, after treatment, directly to the targeted cone photoreceptor system. They employed a "silent substitution" technique using pairs of lights to selectively stimulate cones or rods. The researchers also had to adapt their methods to accommodate nystagmus (involuntary eye oscillations, or "dancing eyes"), another symptom of achromatopsia. The results were compared to tests involving nine untreated patients and 28 volunteers with normal vision.

Each of the four children was treated with gene therapy in one eye, enabling doctors to compare the treatment's effectiveness with the untreated eye.

For two of the four children, there was strong evidence for cone-mediated signals in the brain's visual cortex coming from the treated eye, six to 14 months after treatment. Before the treatment, the patients showed no evidence of cone function on any tests. After treatment, their measures closely resembled those from normal-sighted study participants.

The study participants also completed a psychophysical test of cone function, which assesses the ability of the eyes to distinguish between different levels of contrast. This showed there was a difference in cone-supported vision in the treated eyes in the same two children.

"We are demonstrating the potential of leveraging the plasticity of our brains, which may be particularly able to adapt to treatment effects when people are young."

Bulletin Board

Gossip

SEP. 02, 2022

The researchers say they cannot confirm whether the treatment was ineffective in the other two study participants, or if there may have been treatment effects that were not picked up by the tests they used, or if effects are delayed.

Co-lead author Dr. Michel Michaelides (UCL Institute of Ophthalmology and Moorfields Eye Hospital), who is also co-investigator on both clinical trials, said, "In our trials, we are testing whether providing gene therapy early in life may be most effective while the neural circuits are still developing. Our findings demonstrate unprecedented neural plasticity, offering hope that treatments could enable visual functions using signaling pathways that have been dormant for years.

"We are still analyzing the results from our two clinical trials, to see whether this gene therapy can effectively improve everyday vision for people with achromatopsia. We hope that with positive results, and with further clinical trials, we could greatly improve the sight of people with inherited retinal diseases."

Dr. Dekker added, "We believe that incorporating these new tests into future clinical trials could accelerate the testing of ocular gene therapies for a range of conditions, by offering unparalleled sensitivity to treatment effects on neural processing, while also providing new and detailed insight into when and why these therapies work best."

One of the study participants commented, "Seeing changes to my vision has been very exciting, so I'm keen to see if there are any more changes and where this treatment as a whole might lead in the future.

"It's actually quite difficult to imagine what or just how many impacts a big improvement in my vision could have, since I've grown up with and become accustomed to low vision, and have adapted and overcome challenges (with a lot of support from those around me) throughout my life."

MedicalXpress, 23 August 2022

<https://medicalxpress.com>

Your next wooden chair could arrive flat, then dry into a 3D shape

2022-08-23

Wooden objects are usually made by sawing, carving, bending or pressing. That's so old school! Today, scientists will describe how flat wooden shapes

Bulletin Board

Gossip

SEP. 02, 2022

extruded by a 3D printer can be programmed to self-morph into complex 3D shapes. In the future, this technique could be used to make furniture or other wooden products that could be shipped flat to a destination and then dried to form the desired final shape.

The researchers will present their results at the fall meeting of the American Chemical Society (ACS).

In nature, plants and some animals can alter their own shapes or textures. Even after a tree is cut down, its wood can change shape as it dries. It shrinks unevenly and warps because of variations in fiber orientation within the wood. "Warping can be an obstacle," says Doron Kam, a graduate student who is presenting the work at the meeting, "but we thought we could try to understand this phenomenon and harness it into a desirable morphing."

Unlike some natural objects, artificial structures can't typically shape themselves, says Eran Sharon, Ph.D., one of the project's principal investigators. But scientists in recent years have begun printing flat sheets that could form themselves into 3D shapes after a stimulus, such as a change in temperature, pH or moisture content, says Sharon. However, these self-morphing sheets were made from synthetic materials, such as gels and elastomers, he notes.

"We wanted to go back to the origin of this concept, to nature, and do it with wood," says Sharon. He and Kam—as well as Shlomo Magdassi, Ph.D., and Oded Shoseyov, Ph.D., the other principal investigators who took on this challenge with Ido Levin, Ph.D., who was a graduate student at the time—are at The Hebrew University of Jerusalem.

A few years ago, the team developed an environmentally friendly water-based ink composed of wood-waste microparticles known as "wood flour" mixed with cellulose nanocrystals and xyloglucan, which are natural binders extracted from plants. The researchers then began using the ink in a 3D printer. They recently discovered that the way the ink is laid down, or the "pathway," dictates the morphing behavior as the moisture content evaporates from the printed piece. For instance, a flat disk printed as a series of concentric circles dries and shrinks to form a saddle-like structure reminiscent of a Pringles potato chip, and a disk printed as a series of rays emanating from a central point turns into a dome or cone-like structure.

The ultimate shape of the object can also be controlled by adjusting print speed, the team found. That's because shrinkage occurs perpendicular to the wood fibers in the ink, and print speed changes the degree of

Scientists in recent years have begun printing flat sheets that could form themselves into 3D shapes.

Bulletin Board

Gossip

SEP. 02, 2022

alignment of those fibers. A slower rate leaves the particles more randomly oriented, so shrinkage occurs in all directions. Faster printing aligns the fibers with one another, so shrinkage is more directional.

The scientists learned how to program the print speed and pathway to achieve a variety of final shapes. They found that stacking two rectangular layers that are printed in different orientations yields a helix after drying. In their latest work, they found that they can program the printing pathway, speed and stacking to control the specific direction of shape change, such as whether rectangles twist into a helix that spirals clockwise or counterclockwise.

Further refinement will allow the team to combine the saddles, domes, helices and other design motifs to produce objects with complicated final shapes, such as a chair. Ultimately, it could be possible to make wood products that are shipped flat to the end user, which could reduce shipping volume and costs, Kam says. "Then, at the destination, the object could warp into the structure you want." Eventually, it might be feasible to license the technology for home use so consumers could design and print their own wooden objects with a regular 3D printer, Sharon says.

The team is also exploring whether the morphing process could be made reversible. "We hope to show that under some conditions we can make these elements responsive—to humidity, for example—when we want to change the shape of an object again," Sharon says.

PhysOrg, 23 August 2022

<https://phys.org>

No More Needles: Inhalable COVID-19 Vaccine Shows Promise

2022-08-25

Researchers have developed an inhalable COVID-19 vaccine that can be administered by the patient themselves using an inhaler and is shelf stable at room temperature for up to three months. The delivery mechanism for this vaccine, a lung-derived exosome known as LSC-Exo, was also shown to be more successful than the presently utilized lipid-based nanoparticles in evading the lung's mucosal lining and can work effectively with protein-based vaccines.

Along with colleagues from UNC-Chapel Hill and Duke University, Ke Cheng, the Randall B. Terry Jr. Distinguished Professor in Regenerative

Bulletin Board

Gossip

SEP. 02, 2022

Medicine at North Carolina State University and a professor in the NC State/UNC-Chapel Hill Joint Department of Biomedical Engineering, oversaw the development of the vaccine prototype from proof-of-concept to animal studies.

"There are several challenges associated with vaccine delivery we wanted to address," Cheng says. "First, taking the vaccine via intramuscular shot is less efficient at getting it into the pulmonary system, and so can limit its efficacy. Inhaled vaccines would increase their benefit against COVID-19.

"Second, mRNA vaccines in their current formulation require cold storage and trained medical personnel to deliver them. A vaccine that is stable at room temperature and that could be self-administered would greatly reduce wait times for patients as well as stress on the medical profession during a pandemic. However, reformulating the delivery mechanism is necessary for it to work through inhalation."

Exosomes (Exo) released by lung spheroid cells (LSCs) were employed by the researchers to deliver the vaccine straight to the lungs. Nanosized vesicles known as exosomes have recently gained recognition as an effective drug delivery method.

First, the researchers looked at whether LSC-Exo was able to deliver protein or mRNA "cargos" throughout the lungs. The researchers compared the distribution and retention of LSC-Exo to nanoparticles similar to lipid nanoparticles currently used with mRNA vaccines. In a paper in *Extracellular Vesicle*, the researchers demonstrated that lung-derived nanoparticles were more effective at delivering mRNA and protein cargo to bronchioles and deep lung tissue than synthetic liposome particles.

Next, the researchers created and tested an inhalable, protein-based, virus-like particle (VLP) vaccine by decorating the exterior of LSC-Exo with a portion of the spike protein – known as the receptor binding domain, or RBD – from the SARS-CoV-2 virus. A paper describing the research is published in *Nature Biomedical Engineering*.

"Vaccines can work through various means," Cheng says. "For example, mRNA vaccines deliver a script to your cell that instructs it to produce antibodies to the spike protein. This VLP vaccine, on the other hand, introduces a portion of the spike protein to the body, triggering the immune system to produce antibodies to the spike protein."

In rodent models, the RBD-decorated LSC-Exo vaccine (RBD-Exo) elicited the production of antibodies specific to the RBD, and protected the

Bulletin Board

Gossip

SEP. 02, 2022

rodents, after two vaccine doses, from infection with live SARS-CoV-2. Additionally, the RBD-Exo vaccine remained stable at room temperature for three months.

The researchers note that while the work is promising, there are still challenges associated with large-scale production and purification of the exosomes. LSCs, the cell type used for generating RBD-Exo, are currently in a Phase I clinical trial by the same researchers for treating patients with degenerative lung diseases.

“An inhalable vaccine will confer both mucosal and systemic immunity, it’s more convenient to store and distribute, and could be self-administered on a large scale,” Cheng says. “So while there are still challenges associated with scaling up production, we believe that this is a promising vaccine worthy of further research and development.”

SciTechDaily, 25 August 2022

<https://scitechdaily.com>

‘Drug factory’ implants eradicate advanced-stage cancers in just 6 days

2022-08-24

Rice University and Baylor College of Medicine researchers have shown they can eradicate advanced-stage mesothelioma tumors in mice in just a few days with a treatment combining Rice’s cytokine “drug factory” implants and a checkpoint inhibitor drug.

The researchers administered the drug-producing beads, which are no larger than the head of a pin, next to tumors where they could produce continuous, high doses of interleukin-2 (IL-2), a natural compound that activates white blood cells to fight cancer.

The study, published online today in *Clinical Cancer Research*, is the latest in a string of successes for the drug-factory technology invented in the lab of Rice bioengineer Omid Veisheh, including Food and Drug Administration (FDA) approval to begin clinical trials of the technology this fall in ovarian cancer patients.

“From the beginning, our objective was to develop a platform therapy that can be used for multiple different types of immune system disorders or different types of cancers,” said Rice graduate student Amanda Nash, who spent several years developing the implant technology with study co-lead author Samira Aghlara-Fotovat, a fellow student in Veisheh’s lab.

Bulletin Board

Gossip

SEP. 02, 2022

The cytokine factories consist of alginate beads loaded with tens of thousands of cells that are genetically engineered to produce natural IL-2, one of two cytokines the FDA has approved for treatment of cancer. The factories are just 1.5 millimeters wide and can be implanted with minimally invasive surgery to deliver high doses of IL-2 directly to tumors. In the mesothelioma study, the beads were placed beside tumors and inside the thin layer of tissue known as the pleura, which covers the lungs and lines the interior wall of the chest.

“I take care of patients who have malignant pleural mesothelioma,” said Dr. Bryan Burt, professor and chief of Baylor’s Division of Thoracic Surgery in the Michael E. DeBakey Department of Surgery. “This is a very aggressive malignancy of the lining of the lungs. And it’s very hard to treat completely by surgical resection. In other words, there is often residual disease that is left behind. The treatment of this residual disease with local immunotherapy — the local delivery of relatively high doses of immunotherapy to that pleural space — is a very attractive way to treat this disease.”

Veisheh said the mesothelioma study began when Burt and Baylor surgeon and associate professor Dr. Ravi Ghanta heard about the early results of ovarian cancer animal tests Veisheh’s team was conducting with collaborators at the University of Texas MD Anderson Cancer Center. In March, Veisheh and MD Anderson collaborators published a study showing IL-2-producing beads could eradicate advanced-stage ovarian and colorectal tumors in mice in less than a week.

“They were really impressed by the preclinical data we had in ovarian cancer,” Veisheh said of Burt and Ghanta. “And they asked the question, ‘Could we actually leverage the same system for mesothelioma?’”

Mesothelioma refers to any cancer that occurs in the tissue linings that surround and protect internal organs. About 80% of mesothelioma cases are linked to prolonged exposure to asbestos.

Immunotherapy with drugs called checkpoint inhibitors has met with some success in treating mesothelioma. Checkpoint inhibitors don’t kill cancer directly but rather by training the immune system to recognize and destroy cancer cells.

In the mesothelioma study, the Rice-Baylor team tested Veisheh’s drug factory implants both by themselves and in combination with a checkpoint inhibitor that targeted the PD-1 protein. They found the drug factory implants eliminated tumors in more than 50% of the treated

Bulletin Board

Gossip

SEP. 02, 2022

animals when used by themselves. Tumors were destroyed completely in all seven mice that were treated with both the drug factory implants and PD-1 checkpoint inhibitor.

"It's very hard to treat mesothelioma tumors in mice, like it is in human beings," said Burt, who also is a member of the Dan L. Duncan Comprehensive Cancer Center at Baylor. "And what our data show is that delivery of these immunotherapy particles, regionally, to these mice who have mesothelioma, has very provocative and very effective treatment responses. In fact, I've not seen these mesothelioma tumors in mice be eradicated, with such efficacy, as we have in this mouse model."

Veiseh said the results also suggested that the combination of IL-2-producing implants and anti-PD-1 checkpoint inhibitors could be effective at training "memory T cells" that can reactivate the immune system to fight mesothelioma if it recurs.

"We have a spinout company, Avenge Bio, that recently received clearance from the FDA to treat ovarian cancer patients, and in the next couple of months they expect to begin treating patients with these IL-2 cytokine factories," Veiseh said.

"The preclinical data reported in our latest manuscript helped justify initiating a second clinical trial for patients suffering from mesothelioma and other lung cancers with pleural metastasis," Veiseh said. "We have held meetings with the FDA and expect to initiate a second trial for this patient population in the latter half of 2023."

In addition to the cancer research, Veiseh and Ghanta have received a grant from the American Heart Association to study the cytokine implants' potential for healing heart injuries caused by heart attacks.

The Brighter Side of News, 24 August 2022

<https://www.thebrighterside.news>

Astronauts going to Mars will receive many lifetimes worth of radiation

2022-08-25

In a recent study to be published in Space Physics, an international team of researchers discuss an in-depth study examining the long-term physiological effects of solar radiation on astronauts with emphasis on future astronauts traveling to Mars to include steps we can take to help mitigate the risk of such solar radiation exposure. The researchers hailed

Bulletin Board

Gossip

SEP. 02, 2022

from the United Arab Emirates, New Zealand, India, United States, Italy, Greece, and Germany, and their study helps us better understand the in-depth, long-term health impacts of astronauts during long-term space missions, specifically to Mars and beyond.

"Exposure to ionizing radiation is one of the main health risks to astronauts in crewed missions to Mars," said Dr. Dimitra Atri, a Research Scientist at New York University Abu Dhabi, and lead author of the study. "Going to Mars is going to be humanity's ultimate adventure in the 21st century—it would be unfortunate if the mission is successful, but astronauts suffer major health issues or even die because of radiation exposure. So, we need to estimate radiation exposure in a very careful way and study its overall impact on human health. It will also help us develop mitigation strategies to keep our astronauts safe."

To conduct their study, the researchers utilized a computer simulation known as Geant4 with a model human phantom to calculate how each organ of the human body is affected by radiation doses from exposure to energetic charged particles for prolonged periods. These include impacts on an astronaut's health such as acute radiation syndrome, nervous system damage, and a higher risk of cancer. The CDC defines acute radiation syndrome, also known as radiation sickness or radiation toxicity, as "an acute illness caused by irradiation of the entire human body (or most of the body) by a high dose of penetrating radiation in a very short period of time (usually a matter of minutes)."

Combining their data from the model human phantom with dozens of past medical studies, the researchers discuss the underlying impacts of ionizing radiation on physiological systems, to include the nervous, immune, and skeletal systems, and behavioral effects, along with impacts on genetic material and risk of cancer. They considered a crewed mission to Mars comprising of 600 days in cruise phase to and from the Red Planet and spending 400 days on the Martian surface. While they noted a knowledge gap regarding past medical studies and their own study, they stated radiation limits set by the European Space Agency, Roscosmos, Japanese Aerospace Exploration Agency, and NASA would be surpassed during a crewed mission to Mars.

"It is a comprehensive study modeling the impact of charged particles—protons, alpha particles, heavier species on a human phantom by using CERN's charged particle interaction code," said Dr. Atri. "We were able to calculate radiation dose deposited in various organs of the human body. We then compared our calculations with medical literature to assess the

"Exposure to ionizing radiation is one of the main health risks to astronauts in crewed missions to Mars."

Bulletin Board

Gossip

SEP. 02, 2022

health risks to astronauts. We also discussed various mitigation strategies which will enable us to reduce this risk.”

The mitigation strategies include medicine and dietary strategies, along with active and passive shielding and potential types of Martian habitats to help further mitigate solar radiation exposure. Such habitats include using the Martian regolith as shielding material, along with the potential for habitats inside lava tubes and caves that currently exist on Mars. One previous study discussed a candidate lava tube southwest of Hadriacus Mons on Mars that could constitute an ~82% decrease in a crew’s radiation exposure.

Dr. Atri considers the best strategy to maintain cumulative low doses of radiation on the crew would be to send astronauts to Mars who have received the least amount of radiation exposure throughout their careers to reduce the chances of long-term health effects.

Phys Org, 25 August 2022

<https://phys.org>

Bulletin Board

Curiosities

SEP. 02, 2022

Your taste for weird food may be down to your genes

2022-08-18

How many times have you been presented with a type of food you dislike only to be told it’s an acquired taste, and eventually, if you try it enough times, you’ll come to enjoy it? A new study has found genetics may play a larger role than previously thought in determining the foods you do and don’t like.

Food preferences are complex, shaped by a variety of factors, not the least being the culture and environment one is raised in. But researchers are increasingly discovering a person’s genetics can also play a significant role in determining the food they like to eat.

Prior studies have homed in on particular genetic variants that can determine how a person responds to certain types of food. Perhaps the most infamous is the discovery that around 10 percent of people carry a gene variant that heightens their ability to sense a pungent, almost soapy, smell in the herb cilantro. Other more specific discoveries linking genetics to food preferences include a 2020 study that revealed why some people almost enjoy the smell of rotten fish.

In general, these prior studies have often been small and targeted at specific taste sensations. But a new study, published in Nature Communications, is offering the most sweeping investigation of genetics and taste ever conducted.

The new research performed a genome-wide association study tracking taste preferences for 139 foods in more than 150,000 people. More than 400 specific taste-influencing gene variants were identified.

“This is a great example of applying complex statistical methods to large genetic datasets in order to reveal new biology, in this case the underlying basis of what we like to eat and how that is structured hierarchically, from individual items up to large groups of foodstuffs,” explained co-author Jim Wilson.

The study grouped its novel genetic findings into three distinct food categories: Highly palatable (high-calories foods such as meat, cakes, dairy and carbohydrates), Low-calorie (whole foods, fruits and vegetables), and Acquired (pungent or strong flavors such as coffee, olives, cheeses and alcohol).

Interestingly, the researchers found distinct correlations between health traits and food preferences. Some of those correlations were unsurprising,

Around 10 percent of people carry a gene variant that heightens their ability to sense a pungent, almost soapy, smell in the herb cilantro.

Bulletin Board

Curiosities

SEP. 02, 2022

such as genetic links between obesity, cardiovascular disease and highly palatable, high-calorie foods.

Other links were unusual. For example, those people with the greatest genetic propensity for liking foods in the Acquired taste category were also associated with lower indices of obesity and better blood lipid profiles, but had a higher likelihood for addictive behaviors such as smoking and drinking.

Perhaps the most valuable takeaway from the large study was the finding that many of these genetically-driven taste preferences can be linked to genes that play different roles in the brain. Co-author Nicola Piratsu said this points to much more complex biological processes determining food preferences beyond simple physiological differences in a person's taste receptors.

"[An] important observation is that the main division of preferences is not between savory and sweet foods, as might have been expected, but between highly pleasurable and high calorie foods and those for which taste needs to be learned," explained Piratsu. "This difference is reflected in the regions of the brain involved in their liking and it strongly points to an underlying biological mechanism."

At this point these new findings are relatively academic, offering novel insights into what factors drive our food choices. But who knows what kind of science-fiction future these genetic discoveries could ultimately lead to? Maybe with a little CRISPR gene edit you could finally enjoy eating those healthy green vegetables and stop craving meat?

The new study was published in the journal Nature Communications.

New Atlas, 18 August 2022

<https://newatlas.com>

Are indoor vertical farms really 'future-proofing agriculture'?

2022-08-18

At a hyper-controlled indoor farm in industrial South San Francisco, four robots named John, Paul, George and Ringo carefully transfer seedlings from barcoded trays into 15-plus foot towers that are then hung vertically inside a 4,800 sq ft grow room.

Bulletin Board

Curiosities

SEP. 02, 2022

Inside the hygienic space, which is operated by the indoor farming company Plenty, there's no soil, sunlight or tractors, but rows of hanging crops illuminated by colorful LED lights and carefully monitored by cameras, sensors and artificial intelligence. Once a tower is ready to be harvested, a balletic automated process reminiscent of a dry cleaner's conveyor belt begins.

A robot named Garfunkel (a nearby counterpart is called Simon) gently grabs and turns the tower on its side before setting it down to be trimmed by a machine. Workers in navy branded jumpsuits inspect the greens for any defects, but there are almost none. Then the pesticide-free product is packaged and put on a truck to be delivered to a local market where the customer becomes the first person to touch it.

Welcome to the world of indoor vertical farming, which, depending on who you ask, will revolutionize the future of agriculture in a warming world, or is a problematic climate solution due to its high energy costs.

"We're moving into an age where climate change is changing what we grow and how we grow it," said Nate Storey, Plenty's co-founder and chief science officer. "Ultimately, I think we're future-proofing agriculture for our species."

With the world's population expected to reach nearly 10 billion by 2050, most of whom will be living in cities, experts say it will require a 70% increase from current levels of global food production. But with agricultural land in short supply thanks to climate crisis and urbanization, it's clear today's food systems are not ready.

It's estimated there are more than 2,000 vertical farms in the US growing produce such as lettuce, herbs and berries. Market leaders such as Plenty, Bowery, Kalera and AeroFarms – which can operate 365 days a year regardless of weather conditions – and sprawling greenhouses from companies like AppHarvest and Gotham Greens, see themselves as part of the solution. And investors clearly agree.

Indoor farming raised over \$1bn in 2021, exceeding the combined funding generated in 2018 and 2019, and the industry is expected to grow to \$9.7bn worldwide by 2026.

Earlier this year, Walmart announced an investment in Plenty as part of its \$400m Series E funding round. The retail giant will source leafy greens for all of its California stores from Plenty's new 95,000 sq ft flagship farm in Compton, California, which will open early next year.

Bulletin Board

Curiosities

SEP. 02, 2022

Plenty will also be growing Driscoll's strawberries indoors at their Laramie, Wyoming, research and development farm as part of a new agreement.

But critics say the massive energy costs needed to run vertical farms and greenhouses make the practice far less eco-friendly than their branding suggests and question how they can truly feed a world that relies on calories from grains such as soy, corn and wheat.

Designed to produce yields hundreds of times larger than traditional outdoor farming, vertical farms occupy spaces such as buildings or shipping containers while using 70 to 95% less water since they can recapture and recycle water rather than waste it due to poor irrigation or evaporation. Products are fully traceable from seed to shelf, stay fresher longer and there's little risk of bacteria like E coli, which led to large recalls of romaine lettuce in 2019 and 2020, since there's no contamination from runoff water, infected animal feces or having to travel long distances in trucks and cargo planes.

Large-scale vertical farms are typically built near cities where greens can be bred for flavor rather than storage. With futuristic farming there's no need for lettuce to sit inside a truck for days losing its quality and nutritional value.

California's ongoing drought, the demand for locally grown food and the recent failures of the supply chain during the pandemic has made the practice, which is already popular in parts of Asia, Europe and the Middle East, especially attractive.

"What's clear to me is that we're living in an increasingly unreliable and uncertain world," said Irving Fain, CEO and founder of Manhattan-based Bowery Farming. "We need to find certainty and reliability – and we need to act now."

Bowery's smart farms in the north-east collect billions of real-time data points via sensors and cameras that feed into machine-learning algorithms to provide their produce to more than 1,100 grocery stores, including Whole Foods, Albertsons, Safeway and Amazon.

In the process of trying to find solutions to vulnerabilities in the food system, entrepreneurs like Fain say they're gathering the kind of knowledge about plant growth and agronomy that would take a traditional farmer outdoors hundreds of years to accumulate.

Bulletin Board

Curiosities

SEP. 02, 2022

"We're reimagining farming and reinventing the fresh food supply chain and rebuilding one that's a lot simpler, safer, has much more surety of supply and ultimately it's much more sustainable as well," said Fain.

But not everyone is as optimistic about indoor farming's prospects.

Washington Post columnist and co-host of the Climavores podcast Tamar Haspel calls vertical farming "lettuce for rich people". During a recent episode on vertical farms, Haspel and co-host Mike Grunwald highlighted the ways growing upwards indoors can bypass so many of the problems related to traditional farming, but say that the huge energy costs required to power vertical farms make them a "deal-breaker".

LeJeun "LJ" Holmes poses for a portrait at Planting Justice's nursery in Oakland, Calif., on Wednesday, July 27, 2022. Holmes, who was incarcerated before joining Planting Justice, says that working in a garden has changed his life.

While Plenty, Bowery and other vertical farms don't release data on how much energy they use, the 2021 Global CEA Census Report found that greenhouse growers used 15-20 times as much energy, on average, and vertical farms used a little over 100 times as much energy as outdoor lettuce growers in Arizona. The same report noted that smaller facilities had significantly higher energy use relative to larger counterparts.

Other experts aren't so sure. Gail Taylor, the department chair of plant sciences at the University of California, Davis, said that while vertical farming is energy intensive in its current form, so is traditional outdoor farming.

"Sometimes we forget all the consequential effects like how many times you drive a tractor over a field or how many trucks you use to bring lettuce from the west coast to the east coast and fly food all around the world," Taylor said.

Agriculture is already responsible for about 30% of total global emissions of carbon dioxide, methane and other planet-warming gasses. Researchers say cutting emissions from food is crucial in the fight to slow climate crisis.

Greenhouses have helped turn the Netherlands into the world's second-largest agricultural exporter by value, sending over \$10bn in tomatoes, cucumbers and bell peppers to neighboring countries such as Germany, Belgium and France in 2020.

Bulletin Board

Curiosities

SEP. 02, 2022

But some Dutch greenhouses recently had to go dark or scale back production due to soaring power prices. About 8.2% of the country's overall consumption of fuel is attributed to the glass structures, which require heating and artificial light to supplement sunlight.

While growing in controlled environments has been around since the 1970s, what made indoor vertical farming a reality in recent years was the significant drop in price of LED lights, which plummeted as much as 94% between 2008 and 2015.

The industry is counting on the grid continuing to get greener, which would drive power pricing down. "New energy sources will come online," said Storey, of Plenty. "We're going to see a massive and rapid evolution in the space that I think is going to shock people."

Farms like Plenty and Bowery are already powered entirely by renewables, but Kale Harbick, a research agricultural engineer at the USDA who works on the optimization of controlled-environment agriculture, said it was important to understand the scale of the problem.

He said if you put a vertical farm in a skyscraper like the World Trade Center to grow lettuce and wanted to power it with renewable energy like solar, you would have to bulldoze the rest of the island of Manhattan to make room for panels to generate enough power just for the lights of that building.

"There are certainly benefits for renewables, but I wouldn't call them a silver bullet," he said.

Industry watchers say indoor farms have made big strides in recent years, and that it's important to remember that we're only at the start of the vertical farming journey.

"I believe that over the next 10 years, we will see the industry expand as vertical farms adopt more sustainable business models and the costs of vertical farming decrease," said technology analyst Brandon Beh, co-author of a recent report by the technology company IDTechEx on vertical farming.

"Vertical farms do address a key consumer demand for fresh, organic produce," Beh said. "However, I wouldn't go so far as to say the industry will replace, or even overtake, conventional agriculture."

Bulletin Board

Curiosities

SEP. 02, 2022

While some ag-tech entrepreneurs believe they can grow almost anything indoors, others admit it's not feasible to produce grain crops such as wheat or corn due to basic economics.

"Field crops are always going to be the best way to do calorie grains," Harbick said.

Researchers are redesigning plants to grow in these new systems, so stone fruits, mushrooms, eggplants, peppers and cacao plants may be growing indoors in the near future.

About one-third of tomatoes are currently grown in greenhouses, but Harbick doesn't see them being the right fit for vertical farms since they require 60% more electricity to grow than lettuce.

He said a diverse food supply system where some foods are grown in the field, some in greenhouses and some in vertical farms would be more resilient and robust.

Taylor said people need to start reimagining indoor farms as part of the circular economy, noting that other forms of renewable energy, like anaerobic digestion – a process through which bacteria break down organic matter like food waste – can be used to help power indoor farms.

Another solution would be to build vertical farms and greenhouses near decarbonizing industrial hubs that are trying to reduce their greenhouse gas emissions, so farms could capture their heat and carbon dioxide to save electricity costs.

And while some farmers and scientists are critical about the influx of capital into the vertical and greenhouse farming space, saying indoor-grown food isn't necessarily better for people or the environment, Taylor said it doesn't need to be an either/or proposition.

"[Indoor farms] are never going to replace outdoor agriculture," she said, "they're only going to enhance it and make food supply systems better for the world."

The Guardian, 18 August 2022

<https://theguardian.com>

Bulletin Board

Curiosities

SEP. 02, 2022

Turning wind turbine blades into gummy bears

2022-08-23

Most of a wind turbine is pretty easy to recycle – but the fibreglass blades are a problem.

Currently the only ways to prevent them from heading to landfill involve downcycling the blades into lower-quality materials.

But one day our wind turbine blades might become...gummy bears.

A team of US researchers has developed a resin that works as a turbine blade and at the end of its life can be reformed into another blade or other materials like plastic, lights, nappies and sugary snacks.

“At the end of its cycle we can dissolve it and that releases it from whatever matrix it’s in, so it can be used over and over again in an infinite loop,” says Dr John Dorgan, a researcher at Michigan State University, US, who is presenting the work at the 2022 Meeting of the American Chemical Society.

“That’s the goal of the circular economy.”

The resin is made from a combination of glass fibres and two types of polymers. The resin is strong enough to be used as wind turbine blades or car windows.

When the resin is dissolved in a substance called methyl methacrylate, the researchers can remove the glass fibres and re-use all the materials again in more wind turbine blades.

Or they could react the polymers further into even higher-quality products. Mixing with minerals turns the resin into cultured stone, which can be used for household objects.

“We’ve recently made a bathroom sink with the cultured stone, so we know it works,” says Dorgan.

It can also be turned into acrylics suitable for car lights, or poly(methylacrylic acid) which is a super-absorbent substance used in disposable nappies.

Finally, the researchers turned the ex-resin into potassium lactate which is a common flavour enhancer in drinks and lollies.

“We recovered food-grade potassium lactate and used it to make gummy bear candies, which I ate,” says Dorgan.

The researchers turned the ex-resin into potassium lactate which is a common flavour enhancer in drinks and lollies.

Bulletin Board

Curiosities

SEP. 02, 2022

Could he taste the renewable energy? “A carbon atom derived from a plant, like corn or grass, is no different from a carbon atom that came from a fossil fuel,” says Dorgan.

“It’s all part of the global carbon cycle, and we’ve shown that we can go from biomass in the field to durable plastic materials and back to foodstuffs.”

The researchers are now looking to make blades they can test in the field – eventually hoping to scale up to commercial wind turbine blades, which are dozens of metres long.

“The current limitation is that there’s not enough of the bioplastic that we’re using to satisfy this market, so there needs to be considerable production volume brought online if we’re going to actually start making wind turbines out of these materials,” says Dorgan.

Cosmos, 23 August 2022

<https://cosmosmagazine.com>

An extrasolar world covered in water?

2022-08-24

An international team of researchers led by Charles Cadieux, a Ph.D. student at the Université de Montréal and member of the Institute for Research on Exoplanets (iREx), has announced the discovery of TOI-1452 b, an exoplanet orbiting one of two small stars in a binary system located in the Draco constellation about 100 light-years from Earth.

The exoplanet is slightly greater in size and mass than Earth and is located at a distance from its star where its temperature would be neither too hot nor too cold for liquid water to exist on its surface. The astronomers believe it could be an “ocean planet,” a planet completely covered by a thick layer of water, similar to some of Jupiter’s and Saturn’s moons.

In an article published today in *The Astronomical Journal*, Cadieux and his team describe the observations that elucidated the nature and characteristics of this unique exoplanet.

“I’m extremely proud of this discovery because it shows the high caliber of our researchers and instrumentation,” said René Doyon, Université de Montréal Professor and Director of iREx and of the Observatoire du Mont-Mégantic (OMM). “It is thanks to the OMM, a special instrument designed in our labs called SPIrou, and an innovative analytic method developed

“TOI-1452 b is one of the best candidates for an ocean planet that we have found to date.”

Bulletin Board

Curiosities

SEP. 02, 2022

by our research team that we were able to detect this one-of-a-kind exoplanet.”

It was NASA’s space telescope TESS, which surveys the entire sky in search of planetary systems close to our own, that put the researchers on the trail of this exoplanet. Based on the TESS signal, which showed a slight decrease in brightness every 11 days, astronomers predicted a planet about 70% larger than Earth.

Charles Cadieux belongs to a group of astronomers that does ground follow-up observations of candidates identified by TESS in order to confirm their planet type and characteristics. He uses PESTO, a camera installed on the OMM’s telescope that was developed by Université de Montréal Professor David Lafrenière and his Ph.D. student François-René Lachapelle.

“The OMM played a crucial role in confirming the nature of this signal and estimating the planet’s radius,” explained Cadieux. “This was no routine check. We had to make sure the signal detected by TESS was really caused by an exoplanet circling TOI-1452, the largest of the two stars in that binary system.”

The host star TOI-1452 is much smaller than our Sun and is one of two stars of similar size in the binary system. The two stars orbit each other and are separated by such a small distance—97 astronomical units, or about two and a half times the distance between the Sun and Pluto—that the TESS telescope sees them as a single point of light. But PESTO’s resolution is high enough to distinguish the two objects, and the images showed that the exoplanet does orbit TOI-1452, which was confirmed through subsequent observations by a Japanese team.

Ingenuity at work

To determine the planet’s mass, the researchers then observed the system with SPIRou, an instrument installed on the Canada-France-Hawaii Telescope in Hawai’i. Designed in large part in Canada, SPIRou is ideal for studying low-mass stars such as TOI-1452 because it operates in the infrared spectrum, where these stars are brightest. Even then, it took more than 50 hours of observation to estimate the planet’s mass, which is believed to be nearly five times that of Earth.

Researchers Étienne Artigau and Neil Cook, also with iREx at the Université de Montréal, played a key role in analyzing the data. They developed a powerful analytic method capable of detecting the planet in the data collected with SPIRou. “The LBL method [for line-by-line] allows us to

Bulletin Board

Curiosities

SEP. 02, 2022

clean the data obtained with SPIRou of many parasite signals and to reveal the weak signature of planets such as the one discovered by our team,” explained Artigau.

The team also includes Quebec researchers Farbod Jahandar and Thomas Vandal, two Ph.D. students at the Université de Montréal. Jahandar analyzed the host star’s composition, which is useful for constraining the planet’s internal structure, while Vandal was involved in analyzing the data collected with SPIRou.

A watery world

The exoplanet TOI-1452 b is probably rocky like Earth, but its radius, mass, and density suggest a world very different from our own. Earth is essentially a very dry planet; even though we sometimes call it the Blue Planet because about 70% of its surface is covered by ocean, water actually only makes up a negligible fraction of its mass—less than 1%.

Water may be much more abundant on some exoplanets. In recent years, astronomers have identified and determined the radius and mass of many exoplanets with a size between that of Earth and Neptune (about 3.8 times larger than Earth). Some of these planets have a density that can only be explained if a large fraction of their mass is made up of lighter materials than those that make up the internal structure of the Earth such as water. These hypothetical worlds have been dubbed “ocean planets.”

“TOI-1452 b is one of the best candidates for an ocean planet that we have found to date,” said Cadieux. “Its radius and mass suggest a much lower density than what one would expect for a planet that is basically made up of metal and rock, like Earth.”

The University of Toronto’s Mykhaylo Plotnykov and Diana Valencia are specialists in exoplanet interior modeling. Their analysis of TOI-1452 b shows that water may make up as much as 30% of its mass, a proportion similar to that of some natural satellites in our Solar System, such as Jupiter’s moons Ganymede and Callisto, and Saturn’s moons Titan and Enceladus.

To be continued...

An exoplanet such as TOI-1452 b is a perfect candidate for further observation with the James Webb Space Telescope, or Webb for short. It is one of the few known temperate planets that exhibit characteristics consistent with an ocean planet. It is close enough to Earth that researchers can hope to study its atmosphere and test this hypothesis.

Bulletin Board

Curiosities

SEP. 02, 2022

And, in a stroke of good fortune, it is located in a region of the sky that the telescope can observe year round.

“Our observations with the Webb Telescope will be essential to better understanding TOI-1452 b,” said Doyon who overviewed the conception of James Webb’s component NIRISS. “As soon as we can, we will book time on Webb to observe this strange and wonderful world.”

The article “TOI-1452 b: SPIRou and TESS reveal a super-Earth in a temperate orbit transiting an M4 dwarf” was published in August 12 2022 on The Astronomical Journal. In addition to Charles Cadieux, René Doyon, Étienne Artigau, Neil Cook, Farbod Jahandar and Thomas Vandal at the Université de Montréal’s iREx, the research team includes Nicolas B. Cowan (iREx, MSI, McGill, Canada); Björn Benneke, Stefan Pelletier and Antoine Darveau-Bernier (iREx, UdeM, Canada); Ryan Cloutier, former member of iREx (Harvard, U.S.); and co-authors from University of Toronto, France, Brazil, the United States, Japan, Spain, Switzerland, Portugal, Hungary, Germany, and Crimea.

Phys Org, 24 August 2022

<https://phys.org>

The chemical secrets behind vanilla’s allure

2022-08-24

From ice cream to lattes, vanilla is one of the most popular spices in the world. It’s also one of the most labor-intensive to produce, and shortcuts lead to a less tasty product. Today, scientists report a profile of 20 key chemicals found in vanilla bean extracts, including several previously unknown ones, that together create vanilla’s complex and enjoyable flavor. The work could help manufacturers and farmers develop better-tasting vanilla and improve quick-curing methods.

The researchers will present their results at the fall meeting of the American Chemical Society (ACS).

“Vanilla is the second-most expensive spice in the world,” says Diana Paola Forero-Arcila, Ph.D., who is presenting this work at the meeting. “One of the reasons it’s so expensive is because its flavor is developed during a curing process that takes up to nine months.”

Two shortcuts are currently used to get around this long, drawn-out curing process. One is to speed it up with quick-curing methods that attempt to recreate the luscious natural vanilla flavor in a fraction of the time. Another

Bulletin Board

Curiosities

SEP. 02, 2022

is to make artificial vanilla, familiar to consumers as a less pricey alternative to the real thing.

But these types of products fall flat in terms of flavor because they both focus on vanillin, Forero-Arcila explains. Quick curing attempts to maximize the amount of vanillin in the cured bean, whereas artificial vanilla contains only one flavoring agent—lab-made vanillin. Though vanillin is an important part of a vanilla bean’s flavor, the alternative products are missing many other flavor compounds that develop during the long, traditional curing process and that are essential to the distinctive vanilla taste. “It’s very important that we understand the complexity of vanilla’s flavor and try to identify the compounds that are behind that complexity,” says Forero-Arcila.

To capture that complexity, Forero-Arcila, who is a postdoc at The Ohio State University, used an approach called untargeted flavoromics to pinpoint which chemicals in vanilla bean extracts are the most important for the overall aroma and taste. The researchers first made extracts from 15 beans they sourced from various countries and that were cured differently. They then constructed a chemical profile of each type of bean and identified which compounds were present. To find out how people reacted to the extracts, the team asked more than 100 individuals to taste the samples and rate whether they liked or disliked the flavors.

By connecting the dots between the chemical profiles and the taste ratings, the researchers identified 20 compounds that are the main drivers behind whether a person likes the flavor of a vanilla extract. Of these compounds, some, like vanillin, were expected. “Some of the compounds we identified are well-known vanilla components; however, this is the first report of them impacting consumer acceptability,” says Forero-Arcila. And several compounds important for the flavor were completely unknown, says Devin Peterson, Ph.D., the project’s principal investigator. The researchers are still analyzing these novel vanilla compounds to determine the final structures, but they have observed that the compounds have phenolic and aglycone parts. They also identified some compounds present in the extracts that made people dislike the flavor. One example is anisaldehyde, which has a floral aroma. Forero-Arcila found that anisaldehyde is produced during the curing process from a previously unknown precursor.

With this new profile of compounds, the researchers plan to share what they’ve learned with others in the food and agricultural industries. They think that the profile could help producers and farmers identify high-

Bulletin Board

Curiosities

SEP. 02, 2022

quality, valuable extracts, and price those extracts to match their quality. "The more you understand about how to make the materials more valuable, the more that value should flow through the whole system," says Peterson. In the future, vanilla breeding programs and curing methods could focus on selectively producing the optimum compound profile for good flavor in vanilla plants.

Phys Org, 24 August 2022

<https://phys.org>

Your Brain Wakes Up Over 100 Times a Night – But Don't Worry, This Is a Good Thing

2022-08-24

You wake up. The alarm clock says 02:56.

"Oh no, it is not time to wake up yet," you think, fearing that you will need lots of coffee to stay awake the following day.

The majority of individuals feel that a good night's sleep must be uninterrupted. That is why waking up in the middle of the night when all you want to do is sleep can be incredibly irritating.

According to a new study from the University of Copenhagen, the stress transmitter noradrenaline leads you to wake up often throughout the night. But don't be concerned. It's all part of a regular, good night's sleep, and it may even indicate that you slept well.

"You may think that sleep is a constant state that you are in, and then you wake up. But there is a lot more to sleep than meets the eye. We have learned that noradrenaline causes you to wake up more than 100 times a night. And that is during perfectly normal sleep," says Assistant Professor Celia Kjærby from the Center for Translational Neuromedicine, who is one of the first authors of the study.

Despite the fact that noradrenaline technically causes the brain to wake up more than 100 times every night, we do not consider this to be waking up.

"Neurologically, you do wake up, because your brain activity during these very brief moments is the same as when you are awake. But the moment is so brief that the sleeper will not notice," explains Ph.D. Student Mie Andersen, the second first author of the study.

"You could say that the short awakenings reset the brain so that it is ready to store memory when you dive back into sleep."

Bulletin Board

Curiosities

SEP. 02, 2022

Despite the fact that the researchers analyzed mice, their results are most likely applicable to humans since they focused on fundamental biological mechanisms shared by all mammals.

What is Noradrenaline?

Noradrenaline is a stress hormone and transmitter substance, which i.a. is associated with the body's fight or flight response. It is related to adrenaline, and levels may increase during stress, but it also helps you stay focused.

The stress transmitter noradrenaline affects the sleep waves

Professor Maiken Nedergaard, who has led the study, sees the new finding as an important piece of the puzzle to understanding what happens in the brain when we sleep.

"We have found the essence for the part of sleep that makes us wake up rested and which enables us to remember what we learned the day before. We have found that the refreshing part of sleep is driven by waves of noradrenaline. The very short awakenings are created by waves of norepinephrine, which are also so important for memory," says Maiken Nedergaard and adds:

"You could say that the short awakenings reset the brain so that it is ready to store memory when you dive back into sleep."

We will return to the subject of memory shortly.

Previous research has suggested that noradrenaline, which is associated with stress, is inactive during sleep. Therefore, the researchers were surprised to see how active noradrenaline really is during sleep.

The new study shows that when we sleep the level of noradrenaline in the body is constantly increasing and decreasing in a wavelike pattern. High levels of noradrenaline mean that the brain is briefly awake, while low levels of noradrenaline mean that you are asleep. That is, your noradrenaline levels and degree of 'awakeness' are connected and constantly changing.

"Approximately 30 seconds pass from one 'top' to the next, which means that your noradrenaline levels are constantly changing. At the same time, we could tell that the deeper the 'valley', i.e. the better the sleep, the higher the subsequent top, and the higher degree of awakening," says Mie Andersen.

Bulletin Board

Curiosities

SEP. 02, 2022

“This shows that perhaps you do not need to worry if you wake up at night. Of course, it is not good to be sleepless for extended periods, but our study suggests that short-term awakenings are a natural part of sleep phases related to memory. It may even mean that you have slept really well,” Celia Kjærby adds.

What the researchers did

Microscopic optical fibers made of glass and genetically manipulated ‘light receptors’ were inserted into the brains of the test mice. The optical fibers were attached to cables, including an LED light source.

Subsequently, the researchers measured the here-and-now levels of noradrenaline while the animals slept and compared it to the electrical activity in their brains. This was where they spotted the high levels of noradrenaline.

The researchers then conducted memory tests by using the implanted equipment to increase the amplitude of the noradrenaline waves, improving the animals’ memory.

The mice developed “super memory”

It is a well-known fact that sleep is good for us – in a number of ways. It removes waste products, prevents Alzheimer’s, and improves our memory.

The latter was also a focus of this study, and the findings suggest that the mice with the highest number of deep noradrenaline valleys were also the ones with the best memory.

“The mice developed ‘super memory’. They had less trouble remembering things they had learned the previous day. Of course, this suggests that the noradrenaline dynamic strengthens the sleep processes which affect our memory,” says Celia Kjærby.

First, the mice were allowed to sniff at two identical objects. They were then put to sleep, and once awake they were returned to the objects. However, one of the two objects had now been replaced by a new one. The mice who had seen the highest number of noradrenaline valleys were more inclined to study the new object, which suggests that they remembered having seen a different object last time.

New perspectives on the use of noradrenaline in antidepressants

Besides increasing our knowledge of the engine room of sleep, the new study provides food for thought when it comes to antidepressants.

Bulletin Board

Curiosities

SEP. 02, 2022

“Some forms of antidepressants increase the level of noradrenaline in the body, which increases the risk that you will see fewer deep sleep valleys. Our study shows that this is likely to affect your memory,” Celia Kjærby says and adds:

“That is why we need to focus attention on how different types of medication regulating the level of noradrenaline in the body affect our sleep. In the future, we should seek to develop drugs that do not affect the noradrenaline waves during sleep.”

SciTechDaily, 24 August 2022

<https://scitechdaily.com>

Rechargeable aluminum: The cheap solution to seasonal energy storage?

2022-08-24

Aluminum has an energy density more than 50 times higher than lithium ion, if you treat it as an energy storage medium in a redox cycle battery. Swiss scientists are developing the technology as a renewable energy stash for the European winter.

The problem is simple enough: as countries worldwide plan their moves toward zero-emissions energy, they need to deal with the intermittent nature of cheap renewable energy. On a daily basis, solar harvests most of its energy in the middle of the day, and this necessitates some kind of short-term storage solution that can park that energy in some form of battery, then release it again in the evening when everyone gets home and starts running TVs and dishwashers. These kinds of big battery projects are already installed in many areas and proving their worth.

But intermittency is a much bigger issue on a seasonal level. The further you move from the equator, the less Sun you get in the winter months. Parts of Scandinavia famously get no Sun at all for months on end – resulting in some pretty epic springtime parties, I’m told – but a much broader area is going to find itself very short on solar, every year, right when everyone’s starting to crank up their heaters. The zero-carbon world needs a way to store absolutely massive amounts of excess renewable energy generated in the warmer months, then release it through the long winters. And it’ll need to be affordable, or else it’s not going to happen.

Researchers from Switzerland’s SPF Institute for Solar Technology have been studying aluminum redox cycles for many years now, and with

Aluminum, used in a redox cycle, has a massive energy density. Swiss researchers believe it could be the key to affordable seasonal storage of renewable energy, clearing a path for the decarbonization of the energy grid.

Bulletin Board

Curiosities

SEP. 02, 2022

funding from the EU's Horizon Europe program and the Swiss government, they've just kicked off a research project called Reveal, drawing in nine different partners from seven European countries, to develop what looks like a very promising idea.

As a 2020 report from the SPF team states, a single, one cubic meter (35.3 cu ft) block of aluminum can chemically store a remarkable amount of energy – some 23.5 megawatt-hours, more than 50 times what a good lithium-ion setup can do, or roughly enough to power the average US home for 2.2 years, on 2020 figures. That's by volume – going by weight, aluminum holds a specific energy of 8.7 kWh per kilogram, or about 33 times more than the batteries Tesla uses in its Model 3.

Big fat blocks like that aren't exactly practical to work with, though, so the Reveal team proposes using 1-mm (0.04 in)-diameter balls of aluminum instead. Naturally, you lose some volumetric density here, but you're still coming out over 15 MWh per cubic meter.

Getting that energy in and out is, of course, a lot more involved. During the "charging process," excess renewable energy would be used to convert aluminum oxide, or aluminum hydroxide, into pure, elemental aluminum. This is an industrial electrolysis process, requiring temperatures around 800 °C (1,472 °F), as well as novel inert electrodes, if you want to avoid the carbon dioxide emissions that accompany today's conventional aluminum smelting processes.

The team estimates it'll be possible to "charge" an aluminum redox system like this at an efficiency around 65%. All the raw materials here are relatively cheap and abundant, some of them indeed being scrap, with the added benefits of being very simple to store and transport. Yes, aluminum oxidizes on contact with ambient air, but it's only a surface layer, less than half a nanometer thick, representing a chemical energy loss of "far less than 1%" when those tiny 1-mm balls are stored in air.

To discharge the aluminum, you simply convert it back again. This can be done at low temperatures, using aluminum-water reactions at less than 100 °C (212 °F), generating aluminum hydroxide, along with pure hydrogen, which can be run straight into a PEM fuel cell stack for conversion to electricity. The process and the fuel cell also generate heat, which can be recovered at temperatures relevant for space heating or domestic hot water.

There's also a higher-temperature process, running at over 200 °C (392 °F), which reacts the aluminum with steam to generate aluminum oxide,

Bulletin Board

Curiosities

SEP. 02, 2022

hydrogen and much higher levels of heat, more relevant for industrial applications.

In the Reveal model, the charging process would be done at central smelting depots, and the "charged-up" aluminum would be trucked out in bulk to be "discharged" on-site at apartment buildings, industrial facilities, and even individual homes, since the equipment needed is relatively simple and low-maintenance – well, apart from the fact that the aluminum-to-hydrogen conversion system doesn't exactly exist yet at this point.

Once it's out of juice, the aluminum oxides and hydroxides would be sent back to the depot for "recharging." Ideally, the Reveal team says, this aluminum will be cycled back and forth in this process indefinitely, so there won't be any ongoing raw material costs for a given system.

In a February 2022 report, the SPF team claims a levelized cost of energy (LCOE) of just €0.09 (US\$0.09) per kWh is possible for such a storage system, in a detailed analysis of the entire life cycle of a project. That's pretty remarkable, given that the current LCOE of the average recently financed "big battery" project in 2020 was around US\$0.15, according to Energy Storage News – and those projects get to sell their energy much more frequently, with daily charge and discharge cycles as compared to the aluminum solution's seasonal cycles.

So it certainly seems like there's something here, capable of filling in the winter-sized hole in renewable energy grids. It's unlikely to come about soon; the Reveal team has given itself until summer 2026 to "work on solutions for this new storage concept."

There are many other metal redox energy storage and release concepts under development – notably, a Dutch brewery began burning recyclable iron in its fuel cycle at the end of 2020. But it's worth noting, anything that burns in air at high temperatures is going to produce harmful nitrous oxides – a problem these aluminum batteries won't have at all. So the Reveal project is definitely one to watch.

New Atlas, 24 August 2022

<https://newatlas.com>

Bulletin Board

Curiosities

SEP. 02, 2022

Created from food waste, these solar panels generate energy without sunlight

2022-08-24

Solar panels are a cornerstone of the clean energy revolution. And yet, they have one great flaw: when the clouds roll in their productivity dives.

Now, a new type of solar panel has been developed by an electrical engineering student at Mapua University that harvests the unseen ultraviolet light from the sun that makes it through even dense cloud coverage.

Carvey Ehren Mague, who in 2020 won the James Dyson Sustainability Award for his creation, hopes it will soon be used on the windows and walls of large buildings, turning them into constant sources of energy.

Solar panels that don't rely on visible sunlight

The concept, called AuREUS (which stands for Aurora Renewable Energy and UV Sequestration), uses luminescent particles from fruit and vegetable waste that absorb UV light and convert it into visible light. A solar film then converts that visible light into energy.

"It's similar to how we breathe in oxygen and we exhale carbon dioxide," Mague said. "It takes in ultraviolet light, and then after some time it would shed it as visible light."

Mague's prototype for AuREUS is a single 3-by-2-foot lime green-tinted panel that he installed in the window in his apartment. In his demonstration for the James Dyson Award, he showed that his test panel can generate enough electricity to charge two phones per day. Scaled up, Mague says these panels would enable buildings to run entirely on their own electricity.

Democratizing renewable energy

The creator also says the flexibility of the material — the resin can even be applied to fabric for clothing — allows designers to use the panels in a variety of different, innovative designs that could help more people to understand and adopt renewable energy solutions.

"If we can democratize renewable energy, we can bring it both physically closer to people as well as psychologically closer," Mague explained. "It would give them a sense of access to it, that they are closer to it, that they

Bulletin Board

Curiosities

SEP. 02, 2022

don't have to be large institutions that have the capability to harvest solar energy with their rooftops."

Mague's next step is to develop his first building installation of AuREUS at a small medical clinic on the island of Jomalig, off the Philippine mainland, that is frequently left without power during storms.

The Brighter Side of News, 24 August 2022

<https://www.thebrighterside.news>

The Netherlands Is Building an Ark for Its Bees

2022-08-25

Summer is here, and some public outdoor spaces in the Dutch city of Utrecht are a riot of colors: wildflowers in myriad hues of orange, red, yellow and purple pop in the sun. More than mere beautification projects, these wildflower patches are among an array of Dutch initiatives to help insect pollinators — part of an ambitious national strategy to support honey bees, wild bees, hoverflies, beetles, butterflies and other species.

The Netherlands is one of only a handful of countries that has a comprehensive strategy aimed directly at stemming the decline in pollinators. Launched in 2018, the National Pollinator Strategy encompasses a range of ongoing efforts and carries clear and measurable benchmarks for success. Already, it is providing a roadmap for other countries looking to conserve their pollinators.

Prioritizing pollination

The Netherlands' awareness of the importance of pollinators began growing over the past decade following dramatic declines in bee populations that began in the mid 1940s. As wilderness and countryside became farmland and towns, and pesticides grew in use, more than half of the country's nearly 360 bee species have become endangered. "There are too many pressures on the Dutch landscape," says Marten Schoonman of the Naturalis Biodiversity Center in Leiden.

Acknowledging the critical role played by pollinators in agriculture, the Netherlands — the world's second largest exporter of agricultural products — began conservation measures over a decade ago. In 2013, the government launched the Bee Health Action Program, an initiative focused on honey bees. In 2016, along with 13 other countries, the Netherlands became one of the founding members of Promote Pollinators,

Insect hotels. Rooftop gardens. "Honey highways." With its National Pollinator Strategy, one country is showing the world how to save pollinators.

Bulletin Board

Curiosities

SEP. 02, 2022

a coalition of countries (now numbering 30) sharing knowledge about protecting and conserving pollinators.

But it was the country's National Pollinator Strategy that set it apart from its peers. Launched in 2018 with some 70 initiatives, from creating more nesting sites to improving pollinators' access to food, the Strategy set out to make the Netherlands a haven for pollinating insects. "We have destroyed a lot [of biodiversity] in the past," says Nicky Kruizinga, the Strategy's project leader. "We have a lot of catching up to do."

The National Pollinator Strategy currently consists of 120 initiatives, underway both in urban centers and agricultural regions. These programs are created and executed at the stakeholder-level, be it a nonprofit, a collective, or a city or province. They follow the general guidelines necessary to create food and nesting opportunities for insect pollinators.

"There's a lot of energy going into the Strategy, which is a big change from 10 years ago," says David Kleijn, a professor of plant ecology and nature conservation at Wageningen University who was involved in formulating the Strategy's objectives. "It has drawn attention to pollinators, it has gotten people to think about their decline, and motivated them to do something about it. Today, there are over a hundred initiatives. In that sense, it's a big success."

The broad aim of the Strategy is "to arrive at a number of bee species showing a stable or positive population trend by 2023 and 2030." This objective has been further broken down into measurable targets for those years. The 2023 goal is to reduce the number of species showing a downward trend by 30 percent and increase the number of species with an upward trend by 30 percent, as compared to a 2012 baseline. In 2030, the broad goal remains the same as 2023, but the target increases to 50 percent as compared to the 2012 baseline.

According to Kleijn, who was involved in formulating the objectives of the Strategy, "One of the most frustrating things in policy evaluation is that you can't find clear objectives of what the policy aims to achieve. In this case, the objectives are measurable, so scientists can evaluate if the goals are reached."

The Strategy's nearly 90 signatories include seven of the Netherlands' 12 provinces, as well as municipalities that have adopted a variety of measures: wildflower patches, insect hotels and green roofs, along with bans on the use of pesticides in public green spaces.

Bulletin Board

Curiosities

SEP. 02, 2022

Other signatories are very local, like De Fruitmotor, a cooperative that makes cider from "ugly" apples that won't sell because of blemishes or deformities. The cooperative's earnings are invested in planting pollen- and nectar-producing plants to create a pollinator-friendly area around the Betuwe River. "These plants flower at different times of the year, from early spring to late autumn, thus ensuring a steady supply of food for bees and other insects," says De Fruitmotor co-founder Henri Holster.

The Strategy even includes efforts propelled by private individuals, such as the Honey Highway, an entrepreneurial venture by bee enthusiast Deborah Postma that partners with municipalities to plant wildflowers along highways, railways, and waterways, turning stretches devoid of biodiversity into pollinator-rich zones.

"All stakeholders are working towards the same goal: more food and shelter for insect pollinators," says Kruizinga, who monitors the Strategy. In 2018 and 2019, the Pollinator Strategy team organized a large meeting where stakeholders could meet and learn from each other. "What is really working well is that our partners have started to cooperate at different levels and there is a lot of knowledge sharing." (Due to the pandemic, their annual meeting was not held in 2020 and 2021.)

The Dutch Pollinator Strategy aims to enroll as many signatories and pollinator-friendly initiatives as possible. Naturalis, where Schoonman works, is a knowledge partner of the Strategy and is involved with its roll-out. "Making people aware of the diversity and richness of pollinator species plays a key role in their conservation. That's why the bee count is so important," Schoonman says, referring to the annual bee count organized by Naturalis with the help of the public.

This year was the fifth edition of the Netherlands' annual bee count. Nearly 4,000 volunteers from across the country spent 30 minutes in their gardens counting bees on a designated weekend in April. The honey bee topped the count once again. The horned mason bee continued to be one of the most common wild bees in gardens, a species that was quite rare across the Netherlands a decade ago. While the bee count is not an exhaustive activity, it helps keep a track on pollinator population trends.

The National Pollinator Strategy has its limitations. For instance, managing issues like pesticide use and industrial pollution are beyond its scope. "How are we going to get farmers to reduce or eliminate the use of pesticides so that pollinators are not affected?" Kruizinga asks. Changing mindsets and behavior takes time, especially when commercial interests are involved. "Farmers are used to doing things in a certain way that

Bulletin Board

Curiosities

SEP. 02, 2022

makes sense economically or time management-wise," says Kleijn, adding that providing subsidies can steer farmers towards difficult but essential measures. "But then a sizable budget needs to be arranged," he says.

Meanwhile, the EU is moving forward in tackling pesticides. In 2013, it banned the use of three neonicotinoid pesticides — known to be extremely harmful to insect pollinators — on flowering crops. In 2018, this ban was extended to all crops. And in June, the European Commission adopted proposals to reduce pesticide use EU-wide by 50 percent before 2030. But there is still a lot of work to be done to reach those targets.

Another inherent limitation of the Strategy is that it relies mainly on the stakeholders to create pollinator friendly landscapes. "One could question whether that is enough to really make a difference," says Kleijn.

Kruizinga, however, remains optimistic about the impact of the Pollinator Strategy. "There's definitely a shift towards pollinator-friendly landscapes and nature-inclusive farming," she says.

Reasons to be Cheerful, 25 August 2022

<https://reasonstobecheerful.world>

Antibody "master key" discovery could neutralize all COVID variants

2022-08-21

A new study published in Nature Communications has homed in on a part of the SARS-CoV-2 spike protein that seems to be shared across all known variants. The research also reveals an antibody fragment that can hypothetically block the virus from entering human cells, paving the way for future therapies to neutralize all COVID-19 variants.

The new research offers one of the most thorough investigations to date into the spike protein differences between a number of SARS-CoV-2 variants. Using cryo-electron microscopy the study zoomed in on spike proteins from Alpha, Beta, Gamma, Delta, Kappa, Epsilon, and Omicron (BA.1 and BA.2) variants.

The researchers discovered a certain part of the spike protein is conserved across all these variants. This spot, known as an epitope, is vulnerable to novel antibodies that could block the virus' ability to infect human cells.

"The epitope we describe in this paper is mostly removed from the hot spots for mutations, which is why its capabilities are preserved across

Bulletin Board

Curiosities

SEP. 02, 2022

variants," explained Sriram Subramaniam. "Now that we've described the structure of this site in detail, it unlocks a whole new realm of treatment possibilities."

Antibodies work to block infection by fitting into those epitopes on the viral spike protein and interrupting the way the virus would lock onto human cells. The new research describes the development of an antibody fragment, dubbed VH Ab6, which can attach to that epitope found in all current SARS-CoV-2 variants.

"Antibodies attach to a virus in a very specific manner, like a key going into a lock. But when the virus mutates, the key no longer fits," said Subramaniam. "We've been looking for master keys – antibodies that continue to neutralize the virus even after extensive mutations."

At this stage the research is still speculative. The antibody fragment demonstrated in the study is more there to demonstrate how broadly effective targeting this particular part of the spike protein could be in neutralizing all known variants.

So far there has been little mutational movement in the part of spike protein highlighted in this study. The researchers suggest future therapeutics for COVID-19 should target this specific epitope in the hopes of developing antibody treatments that can neutralize all variants of the virus.

Validating these new findings is another recent study demonstrating an antibody candidate that, so far, in animal studies, can neutralize all current SARS-CoV-2 variants. That study, published in Science Immunology, comes from a team of researchers at Harvard Medical School and Boston Children's Hospital.

After genetically modifying mice so they would produce human-like immune responses to SARS-CoV-2, the researchers exposed the animals to parts of the virus and chronicled nine different groupings of antibodies. One specific antibody, dubbed SP1-77, was found to be incredibly potent at blocking infection from all known SARS-CoV-2 variants. And no prizes for guessing what part of the spike protein this variant-proof antibody targets.

"We now have a very clear picture of this vulnerable spot on the virus," said Subramaniam. "We know every interaction the spike protein makes with the antibody at this site. We can work backwards from this, using intelligent design, to develop a slew of antibody treatments. Having

Bulletin Board

Curiosities

SEP. 02, 2022

broadly effective, variant-resistant treatments would be a game changer in the ongoing fight against COVID-19.”

The new study was published in Nature Communications.

New Atlas, 21 August 2022

<https://newatlas.com>

Bulletin Board

Technical Notes

SEP. 02, 2022

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

CHEMICAL EFFECTS

[Assessing the Cytotoxicity of TiO₂-x Nanoparticles with a Different Ti³⁺\(Ti²⁺\)/Ti⁴⁺ Ratio](#)

[Amphibian toxicity testing for identification of thyroid disrupting chemicals](#)

[Perfluorooctanoic acid-induced developmental cardiotoxicity in chicken embryo: Roles of miR-490-5p](#)

ENVIRONMENTAL RESEARCH

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OCCUPATIONAL

[Temporary and Permanent Auditory Effects Associated with Occupational Coexposure to Low Levels of Noise and Solvents](#)

[Epigenome-wide association studies of occupational exposure to benzene and formaldehyde](#)