CHEMWATCH

Bulletin Board

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ASIA PACIFIC

New and updated decision tools for categorisation

2020-11-30

We've published a new decision tool to help you work out your indicative risk to human health if your introduction in human health exposure band 3.

· Hazard characteristics for human health exposure band 3

We've also updated 2 decision tools with more detailed questions.

· Work out if your introduction is low risk for the environment (because it is internationally assessed for the environment)

Work out if your introduction is low risk for human health (because it is internationally assessed for human health)

Australian Industrial Chemicals Introduction Scheme, 30 November 2020

https://www.industrialchemicals.gov.au/

We've published a new decision tool to help you work out your indicative risk to human health if your introduction in human health exposure band 3.

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Guide to categorising internationally assessed introductions

2020-11-30

There is a streamlined way to categorise introductions of chemicals that have been assessed overseas.

Who should use this guide?

Use this guide if you are using an international assessment report that we accept. This is extra information to help you follow Step 4.2: Introductions that can be low risk for human health **and** Step 5.2: Introductions that can be low risk for the environment**. in our Categorisation Guide.**

If you plan to use your chemical in a similar way to how it's used overseas, your consideration of the criteria in this guide will most likely be straightforward and quick.

Using international assessments for categorisation

If a trusted overseas body has assessed your introduction and it meets the criteria described in this guide, you are eligible to use the internationally

assessed pathway as a low-risk introduction for human health or the environment (or both).

For the full list of trusted overseas bodies that we accept, see Step 1 of Internationally assessed for human health only and Step 1 of Internationally assessed for the environment only.

The information in this guide will help you to work out whether your introduction could be one of the following:

- internationally assessed for human health
- internationally assessed for the environment
- internationally assessed for both human health and the environment

What is 'internationally assessed for human health only'

If a trusted overseas body has assessed your introduction for human health and you meet all other criteria in this guide related to human health, your indicative risk to human health is low.

You can also use our decision tool to work out if your introduction is low risk for human health.

If there is no assessment for the environment from a trusted overseas body, or there is one but it doesn't meet all our criteria related to the environment, then you must go back to our categorisation guide and determine the risk to the environment.

If you work out that the indicative environment risk of your introduction is low or very low, you can categorise it as a reported introduction. You need to submit a pre-introduction report in AICIS Business Services and select 'internationally assessed for human health but not for the environment'.

Full Article

Australian Industrial Chemicals Introduction Scheme, 30 November 2020

https://www.industrialchemicals.gov.au/

Inventory notices

2020-11-30

Chemicals added to the Inventory 5 years after issue of assessment certificate

CAS 169118-66-5 and 144093-88-9 (published 11 November)

Chemicals added to the Inventory 5 years after issue of assessment certificate

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Chemicals added to the Inventory following issue of assessment certificate

CAS 119275-52-4, 1384165-05-2 and 1471316-72-9 (published 13 November)

Variation of Inventory listing following revocation of CBI approval

CAS 35483-86-4, 1195979-93-1, 1203451-13-1, 77699-82-2, 2000198-09-2, 518045-13-1 (published 25 November)

Australian Industrial Chemicals Introduction Scheme, 30 November 2020

https://www.industrialchemicals.gov.au/

Application to further extend methyl bromide recapture deadline granted

2020-11-12

The timber industry group Stakeholders In Methyl Bromide Reduction (STIMBR) has been granted an additional four months on the recapture deadline for the fumigant methyl bromide.

The gas is mainly used to disinfect logs and timber products destined for export. It is a toxic and ozone-depleting substance.

Recapture was required by October 2020. STIMBR applied for and was granted a waiver, and the decision-making committee (DMC) directed that the new date for compliance was April 2021, on the grounds that a modified reassessment is underway to consider the definition and timing of recapture rules.

STIMBR then applied for a further extension, citing the need for certainty about log exports to India while a decision on the modified reassessment is pending. Parties involved in the modified reassessment were given an opportunity to provide feedback on this application.

The DMC has now set the recapture deadline for 28 August 2021. This date will be superceded when a decision on the modified reassessment of methyl bromide is delivered in early 2021.

The modified reassessment was initiated by STIMBR. Its scope is limited to the controls of use for methyl bromide, including recapture. The approval to import or manufacture the gas cannot be revoked as part of this modified reassessment.

It is a toxic and ozone-depleting substance.

We are committed to being completely transparent in the reassessment process. All of the material before the decision-making committee is available on our website.

Full Article

New Zealand EPA, 12 November 2020

https://www.epa.govt.nz/news-and-alerts/latest-news/application-to-further-extend-methyl-bromide-recapture-deadline-granted/

AMERICA

Cuomo approves van on PFAS in food packaging

2020-12-03

A ban on the usage of PFAS chemicals in food packaging was approved this week by Gov. Andrew Cuomo.

PFAS chemicals have been found in food packaging as well as in food containers used for takeout orders at restaurants.

"When we buy food from the grocery store or takeout from a restaurant, we assume that product is safe for our families," said Assemblywoman Pat Fahy, a Democrat from the Albany area who backed the bill. "PFAS — a dangerous and cancer-causing class of chemicals commonly used in everyday food packaging — however, is anything but safe for New Yorkers. The short-chain PFAS most commonly used in food packaging has been shown to have similar toxicity to long-banned long-chain PFAS."

The measure bans perfluoroalkyl and polyfluoroalkyl, considered potential carcinogens, making New York the latest and the largest state in the country have enacted a ban behind Maine and Washington state.

"I'm thrilled to see these dangerous chemicals banned in food packaging and the public health — especially that of our children — protected as a result," said Sen. Brad Hoylman, a Democrat from Manhattan who sponsored the bill in his chamber.

Restaurants and food distributors will have time to adjust to the new ban. The measure will take effect at the end of 2022.

PFAS chemicals have been found in food packaging as well as in food containers used for takeout orders at restaurants.

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Full Article

Spectrum News, 3 December 2020

https://spectrumlocalnews.com/nys/central-ny/ny-state-of-politics/2020/12/03/cuomo-approves-ban-on-pfas-in-food-packaging-

Toxic 'forever chemicals' found in pesticide used on millions of Mass. acres when spraying for mosquitoes

2020-12-01

For two decades, state environmental officials have used a controversial pesticide to kill mosquitoes in Massachusetts, spraying millions of acres from the air and ground to reduce the spread of Eastern equine encephalitis.

Now, after years of criticism from environmental advocates who have long raised health concerns about the expensive treatment known as Anvil 10+10, the pesticide has been found to also contain an array of toxic compounds known as PFAS. The so-called "forever chemicals," which are found in a range of commercial products and never fully degrade, have been linked to cancer, low infant birth weights, and a range of diseases.

Full Article

Boston Globe, 1 December 2020

https://www.bostonglobe.com/2020/12/01/metro/toxic-forever-chemicals-found-pesticide-used-millions-mass-acres-when-spraying-mosquitos

CEPA 1999 SNAc notice published

2020-12-01

On 28 November 2020, a Significant New Activity (SNAc) Notice under the Canadian Environmental Protection Act (CEPA) 1999 was published for the following substance:

1. Graphene

Full Article

Yordas Hive, 1 December 2020

https://www.yordashive.com/news/article/1121

The so-called "forever chemicals," which are found in a range of commercial products and never fully degrade, have been linked to cancer, low infant birth weights, and a range of diseases.

EUROPE

Declaration of nanomaterials: "Clearly, companies are not doing their job correctly", denounces ANSES

2020-12-01

The National Agency for Food, Environmental and Occupational Health Safety published on Tuesday, December 1 a review of the declarations of nanomaterials that manufacturers have been obliged to make every year since 2013, and warns that, on the 52,000 declarations analyzed, *"90% of the nanomaterial characterization data such as size, specific surface area, surface charge cannot be used and only 10% correctly indicate their use"*.

"Clearly, companies are not doing their job well", comments on franceinfo Olivier Merkal, head of the risk assessment unit at ANSES, who points to the difficulty of knowing, then, whether these nanomaterials are dangerous for our health or not.

Nanomaterials are present in many everyday products, such as sunscreens, textiles, food, paints, etc., and are therefore used in industrial sectors as diverse as construction, automotive, packaging , agro-food, cosmetic products or even health products.

"What you have to understand is that at some point you lose track of them, and you need this traceability to know the substances, to know where they are to obviously assess the risks", explains the head of unit.

In a press release published on Tuesday, ANSES underlines *"the importance of putting an end to the exemptions granted and of making the declaration more demanding in terms of information to be provided"*. Otherwise, *"A system for controlling the quality and relevance of recorded data would also be worth considering."*

The Health Assessment Agency also recommends broadening the criteria for declaring nanomaterials, first of all by forcing more players in the chain to do so, from the first marketer to the distributor and consumers, then by reducing the minimum declaration size, and finally by requiring additional information, such as *"the number of workers potentially exposed to nanomaterials and the quantities deployed by type of use."*

en24news, 1 December 2020

https://www.en24news.com/2020/12/clearly-companies-are-not-doing-their-job-properly-denounces-anses.html

"Clearly, companies are not doing their job well", comments on franceinfo Olivier Merkal, head of the risk assessment unit at ANSES, who points to the difficulty of knowing, then, whether these nanomaterials are dangerous for our health or not.

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Potential ethanol CMR classification in EU could spell disaster for hand disinfectants

2020-12-03

A potential reprotoxic hazard classification for ethanol in the EU could spell disaster for the availability of hand disinfectants in hospitals and beyond, the biocides industry has warned.

Greece intends to submit a proposal for harmonised classification and labelling of ethanol by 31 December. The proposal would classify it as flammable liquid 2, eye irritation 2, reprotoxicity 2, and specific target organ toxicity 2 and 3.

Full Article

Chemical Watch, 3 December 2020

https://chemicalwatch.com/187206/potential-ethanol-cmr-classification-in-eu-could-spell-disaster-for-hand-disinfectants

The proposal would classify it as flammable liquid 2, eye irritation 2, reprotoxicity 2, and specific target organ toxicity 2 and 3.

BPR union list updated with 5 approved active substances

2020-12-02

On 2 December 2020, the Biocidal Products Regulation (BPR) Union List was updated with the following approved active substances:

- Formaldehyde
- Product type 2 (disinfectants and algaecides not intended for direct application to humans or animals)
- Product type 3 (veterinary hygiene disinfectants)
- Reaction mass of peracetic acid and peroxyoctanoic acid
- Product type 2 (disinfectants and algaecides not intended for direct application to humans or animals)
- Product type 3 (veterinary hygiene disinfectants)
- Product type 4 (food and feed area disinfectants)
- This brought the number of approved active substances to 263.

Full Article

Yordas Hive, 2 December 2020

https://www.yordashive.com/news/article/1122

INTERNATIONAL

Hasbro participates in 'The chemical footprint project'

2020-11-24

Hasbro today issued a 2019-20 Corporate Social Responsibility Update. The update highlights Hasbro's ESG advancements in key areas in 2019. It also details Hasbro's 2019 acquisition of eOne and the opportunities it unlocks for corporate citizenship through storytelling, content responsibility and social engagement.

In 2019 and 2020, Hasbro took steps to strengthen its commitment to the environment. Key milestones include:

- Establishing a goal to eliminate all plastic in packaging of new products by the end of 2022
- Expanding the Hasbro Toy Recycling program to six countries
- Achieving its goal of virtually 100% renewable energy (99.4% through investment in renewable energy credits and carbon offsets).

Additionally, Hasbro became the first in its industry to pilot the Higg Index, originally developed by the Sustainable Apparel Coalition (SAC), to further assess the environmental impact of its toy and game suppliers.

Other highlights from this interim report include:

- As Hasbro continues to expand its global sourcing footprint, the company published an official Materials and Chemical Management Policy to guide the specification, sourcing and screening of materials and chemicals in product and packaging for all Hasbro products worldwide
- Managed the transition to third-party manufacturing facilities in India and Vietnam, from a China-based supply chain with mature quality systems
- Conducted over 50 quality assurance in-person training sessions with vendors, suppliers, labs, and Hasbro employees, totaling more than 1,000 hours of training
- Participated in The Chemical Footprint Project to develop and advance the concept and practice of chemical footprinting to reduce the use of chemicals of high concern

Additionally, Hasbro became the first in its industry to pilot the Higg Index, originally developed by the Sustainable Apparel Coalition (SAC), to further assess the environmental impact of its toy and game suppliers.

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Full Article

Environmental + Energy Leader, 24 November 2020

https://www.environmentalleader.com/2020/11/hasbro-participates-in-the-chemical-footprint-project/

European chemicals agency SCIP database is launched and ready for use

2020-12-03

At the end of October, the European Chemicals Agency (ECHA) launched the SCIP database. When populated, the database will ensure that information on articles in the EU that contain substances of very high concern (SVHCs) is widely available. The information will be of particular use to consumers and to waste industry operators.

This is a significant environmental regulatory development for EU manufacturers, importers into the EU and EU distributors operating in EU goods supply chains. Such companies now need to submit data on SVHCs in their articles to ECHA by 5 January 2021.

On 28 October 2020, the European Chemicals Agency (ECHA) launched the SCIP database as required under the EU's Waste Framework Directive – with ECHA's Executive Director noting:

We need to know more about the hazardous chemicals in products so that they can be safely recycled. This is key for a better circular economy and essential to make the EU Green Deal work. The increased knowledge protects workers, citizens and the environment, helps consumers make safer choices and encourages industry to replace hazardous chemicals with safer ones. We call on industry to start submitting the data to us now and we stand ready to support them.

The database needs to be populated. This is to be achieved following the extension of the existing "duty to communicate" REACH obligation (under Article 33 of the REACH Regulation) which requires suppliers of articles containing SVHCs on the Candidate List (in a concentration above 0.1% weight by weight (w/w)) to communicate certain information down the supply chain. The extended obligation now requires them to also submit the relevant information to ECHA for the purpose of populating the database.

This is a significant further environmental regulatory development which supplier companies (i.e. EU manufacturers, importers into the EU and EU distributors) should now be considering carefully – particularly given that the obligation to submit data starts to apply from 5 January 2021. ECHA has stated that consumers and waste operators will be able to access and use the data from February 2021 onwards.

The information will be of particular use to consumers and to waste industry operators.

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Full Article

JD Supra, 3 December 2020

https://www.jdsupra.com/legalnews/european-chemicals-agency-scip-database-48480/

Welcome to the REACH Metals Gateway

2020-12-03

This information system will guide the EU and International Metals Industry in the implementation process of the EU REACH and CLP Regulations. The REACH Metals Gateway allows quick and structured access to relevant information from authorities and from the metals industry. It is tailored to the specific needs of the metals industry sector. An overview is provided on responsibilities & contact points in metal commodity groups and national metal federations where more detailed information can be found.

Rock-metals.edu, 3 December 2020

https://www.reach-metals.eu/

The REACH Metals Gateway allows quick and structured access to relevant information from authorities and from the metals industry.

Janet's Corner

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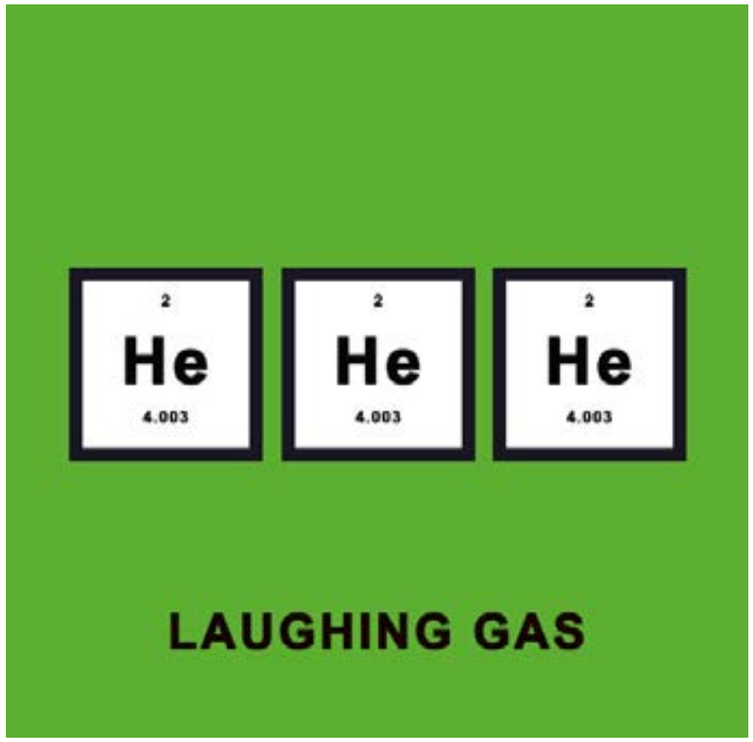
Laughing Gas

2020-12-11



https://www.chemistryjokes.com/jokes/laughing-gas/

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Hazard Alert

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Ethyl Acetate

2020-12-11

Ethyl acetate (commonly abbreviated EtOAc or EA) is the organic compound with the formula $CH_3COOCH_2CH_3$. [1] It is a clear, colourless, flammable liquid with a pleasant, fruity odour. [2] Ethyl acetate is an explosion hazard. It is slightly soluble in water, but soluble in most organic solvents. [3]

USES

Ethyl acetate is used as a solvent for varnishes, lacquers, dry cleaning, stains, fats and nitrocellulose. It is released during the production of artificial silk and leather, and during the preparation of photographic films and plates. It is released during the manufacture of linoleum, and 'plastic' wood, dyes, pharmaceuticals, drug intermediates, acetic acid, artificial fruit flavourings and essences, and perfumes and fragrances. Ethyl acetate is used as a solvent in nail polish, nail polish remover, base coats and other manicuring products. Ethyl acetate is present in wines. [3] Ethyl acetate is an effective poison for use in insect collecting; as its vapours are a respiratory tract irritant, which can kill the insect quickly without destroying it, leaving it intact for study. [4]

Ethyl acetate (commonly abbreviated EtOAc or EA) is the organic compound with the formula CH3COOCH2CH3.

SOURCES OF EMISSION & ROUTES OF EXPOSURE

Sources of Emission[3]

- Industry sources: The primary sources of ethyl acetate are the industries that manufacture it or use it in production. Some of the industries that manufacture it or use it in production are the chemical industry, pharmaceutical industry, manufacturers of paints, varnishes and lacquers. These emissions mainly are to the air.
- Diffuse sources: Other possible emitters of ethyl acetate are vapours and spilling of commercial and household, varnish and lacquer and their removal, preparation of films and film plates, manufacture of artificial leather and silk, and consumer products containing ethyl acetate. These emissions are to the air unless there is a spill.
- Natural sources: Natural sources of ethyl acetate are wines and naturally fermented products.
- Consumer products: Some of the consumer products containing ethyl acetate are automotive and machinery paints, inks, lubricating oils, moisturising creams, nail polish, enamels and removers, paint thinners,

premoistened towelettes, resin and rubber adhesives, and artificial flavourings. It is also found in wines.

Routes of Exposure [1]

Ethyl acetate will enter the body if we breathe in contaminated air, or eat or drink contaminated materials. It can also pass through the skin. The major routes of exposure are:

- inhalation,
- ingestion, and
- eye or skin contact

HEALTH EFFECTS [1,3,4]

Acute Effects

Ethyl acetate causes irritation, redness, and tearing of the eyes and irritation of the nose and throat. It is a defatting agent and may cause skin dryness after acute exposure. Sensitisation of the lining of the nose may occur with symptoms of inflammation (swelling, runny nose, redness of lining). Exposure to ethyl acetate may also cause headache, nausea, vomiting, sleepiness, and unconsciousness. Very high concentrations may cause a stupor, but it is relatively non-toxic.

Chronic Effects

Chronic exposure of the skin to ethyl acetate may cause dermatitis. In addition prolonged exposures may cause clouding of the eye, damage to the lungs and heart and kidney and liver problems. The carcinogenic properties of ethyl acetate are not known.

SAFETY [5]

First Aid Measures

- Eye Contact: Check for and remove any contact lenses. In case of contact, immediately flush eyes with plenty of water for at least 15 minutes. Cold water may be used. Get medical attention.
- Skin Contact: Wash with soap and water. Cover the irritated skin with an emollient. Get medical attention if irritation develops. Cold water may be used.

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- Inhalation: If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical attention if symptoms appear.
- Serious Inhalation: Evacuate the victim to a safe area as soon as possible. Loosen tight clothing such as a collar, tie, belt or waistband. If breathing is difficult, administer oxygen. If the victim is not breathing, perform mouth-to-mouth resuscitation. Seek medical attention.
- Ingestion: Do NOT induce vomiting unless directed to do so by medical personnel. Never give anything by mouth to an unconscious person. Loosen tight clothing such as a collar, tie, belt or waistband. Get medical attention if symptoms appear.

Exposure Controls & Personal Protection

Engineering Controls

Provide exhaust ventilation or other engineering controls to keep the airborne concentrations of vapours below their respective threshold limit value. Ensure that eyewash stations and safety showers are proximal to the workstation location.

Personal Protective Equipment

The following personal protective equipment is recommended when handling ethyl acetate:

- Safety glasses;
- Lab coat;
- Vapour respirator (be sure to use an approved/certified respirator or equivalent);
- Gloves

Personal Protection in Case of a Large Spill:

- Splash goggles
- Full suit
- Vapour respirator
- Boots
- Gloves
- A self-contained breathing apparatus should be used to avoid inhalation of the product.
- Suggested protective clothing might not be sufficient; consult a specialist BEFORE handling.

REGULATIONS [1,6]

Exposure Limits

United States

- OSHA: The current Occupational Safety and Health Administration permissible exposure limit (PEL) for ethyl acetate is 400 ppm (1400 milligrams per cubic metre (mg/m^3) as an 8-hour time-weighted average (TWA) concentration [29 CFR 1910.1000, Table Z-1].
- NIOSH: The National Institute for Occupational Safety and Health has established a recommended exposure limit (REL) for ethyl acetate of 400 ppm (1400 mg/m^3) as a TWA for up to a 10-hour workday and a 40-hour workweek [NIOSH 1992].
- ACGIH: The American Conference of Governmental Industrial Hygienists has assigned ethyl acetate a threshold limit value (TLV) of 400 ppm (1440 mg/m^3) as a TWA for a normal 8-hour workday and a 40-hour workweek [ACGIH 1994, p. 21].

Australia

Safe Work Australia has established an 8 hour TWA for ethyl acetate of 200ppm (720mg/m^3) and a 15 minute short term exposure limit (STEL) of 400ppm (1440 mg/m^3).

REFERENCES

1. http://en.wikipedia.org/wiki/Ethyl_acetate
2. http://www.osha.gov/SLTC/healthguidelines/ethylacetate/recognition.html
3. http://www.npi.gov.au/substances/ethyl-acetate/index.html
4. http://toxipedia.org/display/toxipedia/Ethyl+Acetate
5. http://www.sciencelab.com/msds.php?msdsId=9927165
6. http://www.safeworkaustralia.gov.au/sites/swa/search/results?k=ethyl+acetate

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Already had the coronavirus? You could get it again

2020-12-01

PEOPLE CAN CATCH COVID-19 twice. That's the emerging consensus among health experts who are learning more about the possibility that those who've recovered from the coronavirus can get it again. So far, the phenomenon doesn't appear to be widespread—with a few hundred reinfection cases reported worldwide—yet those numbers are likely to expand as the pandemic continues.

Identifying reinfections is tricky: Not only does it take a while for subsequent bouts to show up, health departments must make sure that alleged cases really are reinfections because coronavirus residue can linger for weeks. For example, University of Alabama football coach Nick Saban made headlines just before Thanksgiving when he tested positive for a second time. But it is unclear if he was truly reinfected because of a blindspot in how officials screened for cases during his first episode back in October.

Because COVID-19 reinfections are still relatively rare, they can't be blamed for the ongoing surges. Still, these incidents could be unwelcome news for coronavirus veterans who have been hoping their experience might have given them a so-called immunity passport. Such accounts show that recovering from the SARS-CoV2 coronavirus isn't an excuse to shed masks and flout social-distancing rules while the pandemic is in full swing. In October, an 89-year-old Dutch woman was the first documented death of someone who had contracted the coronavirus a second time.

In October, an 89-year-old Dutch woman was the first documented death of someone who had contracted the coronavirus a second time.

Immunity may wane over time—just like it does with other kinds of coronaviruses—and getting sick may even prime some people to suffer worse symptoms if they catch the virus a second time.

Take this case study, published in October in The Lancet: In early April, a 25-year-old Nevada man showed up to a community testing center complaining of a sore throat, cough, headache, and nausea. Sure enough, he tested positive for COVID-19, and he went home to isolate. In the weeks that followed, two more tests confirmed he had fully recovered. Yet by the end of May, the coronavirus had struck again. This time, he came down with an even worse case that was marked by shortness of breath and required him to go to the emergency room for oxygen.

Other countries have also reported reinfection rates that suggest the true global toll is unknown but potentially dangerous. Last month, Sweden launched an investigation into 150 cases. In Brazil, scientists are tracking

95 cases. And Mexico claimed to have 258 reinfection cases as of mid-October—nearly 15 percent of which were severe, and 4 percent were fatal. The nation's datasets show that people who suffered from serious first cases were more likely to be hospitalized with subsequent infections.

"The takeaway is that reinfection is certainly possible," says Richard Tillett, a biostatistician at the Nevada Institute of Personalized Medicine at the University of Nevada, Las Vegas, and lead author of the case study. "It seems uncommon and maybe even rare. But it's real and can happen."

Why spotting reinfection is harder

Reinfections are hard to document because researchers can't simply rely on patients' accounts of return symptoms or on routine COVID-19 tests involving polymerase chain reaction (PCR). They need stronger genetic proof, which calls for different technologies.

A new mutation appears in SARS-CoV-2 every 15 days, on average. So far, those natural changes are not so extensive that they alter the nature or potency of the coronavirus, aka it isn't a new strain. But they can provide evidence that the patient's second bout wasn't the same as the original infection.

"It's not that patients get re-infected from a new strain," says Nathan Grubaugh, assistant professor of epidemiology at Yale School of Public Health in New Haven, Connecticut. Such sequencing data, he says, simply offers a "genetic signature" to show if the recurrence of the disease stems from a new infection.

That's how the Nevada team was convinced that their patient didn't simply suffer from a persistent, clandestine infection that suddenly had grown worse. "Our argument is that he caught it from a second source because we observed six different mutations," says Tillett.

Using the combination of patient histories and genetic sequencing is the bona fide way to track reinfections; they can't be gleaned by surges measured with standard testing. To do this going forward, health labs will need to unify their practices and store specimens for the long term. A recent survey in Qatar identified 243 potential reinfections based on case history, but only four had enough genetic material to be confirmed.

This need prompted the U.S. Centers for Disease Control and Prevention in late October to establish new "gold standard" guidelines. (Saban's first case happened before this guidance arrived.)

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Local health officials who learn of alleged repeat cases are now encouraged to send specimens to a testing lab that is equipped with genetic sequencing capacity, as well as to carefully document symptoms and the interval between initial infection and a suspected reinfection.

That time interval is particularly critical because it could help answer the question: How long will our immunity last against SARS-CoV-2?

A kinder COVID-19 the second time around?

Much of society's return to normalcy hinges on the duration and strength of our COVID-19 immunity. Along with determining how people recover from the disease, it will dictate how often a vaccine needs to be taken to control the pandemic, and even whether social distancing will endure.

But it takes time to prove if immunity to any disease is durable. For early clues to how COVID-19 might behave, health experts tried to divine the risk of reinfection by looking at other human coronaviruses. For example, one study of four seasonal coronaviruses published in September in Nature Medicine found that reinfections could occur as soon as six or nine months later, but were more likely to be observed at 12 months. But a body's response to SARS-CoV-2 is unlike that of seasonal viruses because humans and those latter germs have had time to adapt to each other.

Grubaugh generally attributes the phenomenon of waning immunity to patients' lack of antibodies for a particular virus. These proteins are produced in the immune system in response to an infection. They help stifle the germ as it invades and are widely believed to ward off future attacks.

Evidence suggests that 95 percent of people produce antibodies two weeks after the COVID-19's onset. Grubaugh says it's possible SARS-CoV-2 antibodies could fade over time and you could become susceptible again, but he doesn't expect that to happen for years or decades. More likely is that some people don't develop a foolproof antibody response in the first place, he says.

The latter appears to be what happened to a 33-year-old Hong Kong man who was first sick in March and then developed an asymptomatic case in August. Even though he didn't exhibit the classic cough, fever, or headache the second time, he still became a potential spreader. Grubaugh suspects most reinfections at the moment are due to a person's immune system being compromised.

What makes the reinfection story even more mystifying is that such accounts come at a time when emerging research suggests immunity to COVID-19 might actually be robust. Some preliminary studies do show that antibody levels drop within a couple months after SARS-CoV-2 infections, but others argue that these waning numbers don't mean a loss of protection.

The immunity symphony

In fact, fading antibodies may be a sign of a normal and healthy immune response. In November, a British study published as a preprint (meaning that it was not peer reviewed) reported that an initial flood of antibodies soon after infection corresponded with protection for six months—even if the antibody levels faded over time. The study documented only three asymptomatic reinfections among 1,246 health-care workers who had detectable antibodies early on.

That's because antibody levels don't reveal the full story of a person's ability to fight off future infections, says S. Vincent Rajkumar, an oncologist and professor of medicine at the Mayo Clinic in Rochester, Minnesota, who studies immunity.

Think of the human immune system as an orchestra, and among its versatile players are B cells and T cells. When SARS-CoV-2 invades, the body's opening movement is frantic. Some B cells rev up swiftly, producing that first burst of antibodies within a week or two. Simultaneously, a group of T cells—known as killers—hunts down any other cell infected by the coronavirus and gets it to self-destruct. A separate type of T cell—known as helpers—guides both of these crisis responses. If any part loses the harmony, it can throw off the entire production and actually cause more damage rather than less.

While all of this is happening, the immune system is also learning. A fraction of these B cells and T cells get stored away as so-called memory cells. After recovery, the memory cells continue to work behind the scenes to prevent reinfections.

"The cells that made those antibodies will still be around. It will be difficult for a new infection to cause the same amount of harm as the first one. The body already knows how to respond," Rajkumar says.

This is why scientists were excited in July when a research paper showed that memory T cells were still detectable years after people recovered from the 2002-2003 SARS coronavirus, a close cousin of this year's plague.

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Now, the latest evidence suggests that both B cells and T cells generated from COVID-19 infections are also likely to stick around for the long run. One preprint, published November 16, began to sketch out the lifespans for these critical components of the immune system among 185 coronavirus patients. It showed that memory B cells remained widely abundant after six months, while memory T cells had been reduced, but only by half. Another study from November found that a hundred health-care workers who contracted the coronavirus in the spring and showed mild or few symptoms—and didn't produce many antibodies to begin with—still had robust T cells six months later.

What's unknown is how these B cells and T cells will act if the body is re-exposed to the coronavirus. Will they produce an inflammatory response that somehow leads to a worse case later with more severe symptoms? Or will they blunt the outcome and yield the mild reinfections witnessed in some early reports?

If the trajectories of cold-causing coronaviruses are any reassurance, getting COVID-19 again won't be nearly as miserable the second time for most people, says Rajkumar. That means the Hong Kong case would be the norm, while the Nevada man who developed a more severe case after being re-infected might not be typical.

For now, there isn't enough long-term research to know if B cells and T cells activated by the cutting-edge mRNA vaccines on the verge of approval will offer lasting protection, though a recent, two-month study in mice suggests that the answer could be "yes."

In the meantime, even if recovered COVID-19 patients are counting on a less painful second episode, they shouldn't toss aside their masks. They could still catch the virus and pass it to others, who might then become sick.

"You might get re-infected, and your symptoms might be so mild that you don't know about it," says Rajkumar, adding that mask-wearing should continue until the world has reached herd immunity. "It's wise to wear a mask even if you've had COVID-19 out of concern for others."

nationalgeographic.com, 1 December 2020

https://www.nationalgeographic.com

Extraterrestrial hexamethylenetetramine in meteorites—a precursor of prebiotic chemistry in the inner solar system

2020-12-07

Abstract

Despite extensive studies on the formation of organic molecules in various extraterrestrial environments, it still remains under debate when, where, and how such molecules were abiotically formed. A key molecule to solve the problem, hexamethylenetetramine (HMT) has not been confirmed in extraterrestrial materials despite extensive laboratory experimental evidence that it can be produced in interstellar or cometary environments. Here we report the first detection of HMT and functionalized HMT species in the carbonaceous chondrites Murchison, Murray, and Tagish Lake. While the part-per-billion level concentration of HMT in Murchison and Tagish Lake is comparable to other related soluble organic molecules like amino acids, these compounds may have eluded detection in previous studies due to the loss of HMT during the extraction processes. HMT, which can yield important molecules for prebiotic chemistry such as formaldehyde and ammonia upon degradation, is a likely precursor of meteoritic organic compounds of astrochemical and astrophysical interest.

nature.com, 7 December 2020

https://www.nature.com

Popular natural sweetener stevia may cause unfortunate gut health changes

2020-12-07

A natural sweetener called stevia has proven to be a popular alternative to sucralose and other sweeteners, but it may come with its own potential issues. A new study from the Ben-Gurion University of the Negev found that stevia may cause gut health problems by upsetting the balance of beneficial bacteria. The scientists are encouraging more research into the potential consequences of stevia use.

Stevia is a sweetener processed from leaves; it is a low-calorie alternative to sugar and, due to its 'natural' designation, many view it as a safer and healthier option compared to artificial sweeteners. The FDA only considers high-quality steviol glycosides — sweet compounds in the plant — as 'generally recognized as safe' (GRAS).

Here we report the first detection of HMT and functionalized HMT species in the carbonaceous chondrites Murchison, Murray, and Tagish Lake.

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Crude stevia extracts and stevia leaves do not have a GRAS designation and the FDA hasn't approved them for use in food products. Consumers can purchase a variety of processed stevia products, including ones formulated to resemble ordinary sugar, for use in everything from beverages to baked goods.

Though many people report consuming stevia without any obvious health changes, a percentage of people have reported experiencing unwanted side effects from the sweetener, including heart palpitations and digestion troubles. The new study focuses on the second matter, noting that stevia triggers changes in bacteria that may cause various gut health problems.

Though stevia wasn't found to kill the gut bacteria, the study did note that this sweetener may interfere with the communication between different bacteria in one's gut microbiome. This disruption may explain anecdotal reports from some consumers who report having experience stomach pain, gas, constipation, and more while using stevia, though more research is needed.

Dr. Karina Golberg, the study's lead author, explained, "This is an initial study that indicates that more research is warranted before the food industry replaces sugar and artificial sweeteners with stevia and its extracts."

slashgear.com, 7 December 2020

https://www.slashgear.com

Printable, flexible battery offers 10 times the density of lithium-ion

2020-12-07

Scientists investigating an experimental battery chemistry have wound up with a flexible device they say offers up to 10 times the energy density of current lithium-ion solutions, making it an ideal fit for a number of applications. The technique also allows for easier manufacturing of flexible batteries, with the researchers claiming the resulting device can be tailored to fit with electronics devices, rather than the other way around.

The work was carried out by scientists at the University of California (UC) San Diego, and focuses on a type of battery chemistry known as silver-oxide zinc. This has long been fancied as a promising alternative to lithium-ion designs, due to its greater energy density and safety, but a few

The work was carried out by scientists at the University of California (UC) San Diego, and focuses on a type of battery chemistry known as silver-oxide zinc.

roadblocks stand in the way of widespread adoption, namely an instability that leads to a limited cycle life.

The UC San Diego team addressed this by incorporating a new cathode material from Californian company ZPower, a long-time purveyor of batteries incorporating silver and zinc. This cathode uses a lead oxide coating to improve the battery's electrochemical stability and conductivity, along with reducing its impedance, which is the battery's resistance to an alternative current.

Armed with this new cathode, the researchers set out to do something that hadn't been done before, which is screen print a silver oxide-zinc battery. While this chemistry is favored for most commercial flexible batteries, they need to be pieced together under sterile conditions in a vacuum to counter chemical instability and high oxidation.

Through experimentation, the team came up with an ink formulation they say now makes printing these batteries possible. Layer-by-layer, the battery's current collectors, zinc anode, new cathode and separators are screen-printed onto a chemically stable polymer film, which has a high melting point of around 200 °C (392 °F).

The result of this is a flexible, stretchable battery with an areal capacity of 50 milliamps per square centimeter, which the team says is 10 to 20 times greater than that of a typical lithium-ion battery. All up, the team says the device can provide five to 10 times more power than a typical lithium-ion battery of the same size.

"This kind of areal capacity has never been obtained before," says Lu Yin, one of the paper's co-first authors. "And our manufacturing method is affordable and scalable."

The team demonstrated the battery's potential by using it to power a flexible display system, where it outperformed lithium coin cell batteries and was able to be recharged 80 times without any major evidence of capacity loss. The researchers imagine it finding use in soft robotics, wearables and other wireless devices, with the flexible nature opening up some interesting possibilities.

"Our batteries can be designed around electronics, instead of electronics needed to be designed around batteries," says Lu Yin.

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The research was published in the journal Joule, while the video below provides an overview of the breakthrough.

newatlas.com, 7 December 2020

https://www.newatlas.com

In surprising sign of resilience, some corals can survive long heat waves

2020-12-08

Just a few degrees of heat can "bleach" corals, putting them on a path to starvation and death. Driven by climate change, marine heat waves are becoming one of the greatest threats to the existence of tropical reefs. But in some rare good news, researchers have discovered some corals can recover from bleaching even before a heat wave ends, suggesting they have the potential to survive long heat waves.

"That gives us a pathway to coral recovery that we wouldn't necessarily have imagined before," says Steve Palumbi, a marine ecologist at Stanford University who was not involved in the research. In addition, the research suggests reducing water pollution and other stresses can make reefs more resilient to the shocks of climate change, says Nancy Knowlton, a coral reef biologist with the Smithsonian Institution's National Museum of Natural History, who was also not involved.

"That gives us a pathway to coral recovery that we wouldn't necessarily have imagined before," says Steve Palumbi, a marine ecologist at Stanford University who was not involved in the research.

Corals are colonies of millimeter-size, filter-feeding invertebrates. Each of these so-called polyps contributes to the skeleton and houses photosynthetic algae. In return, the microorganisms provide most of the polyp's food. In times of stress, particularly when the water gets too warm, the polyp ejects the algae, and the coral turns white, which is why the stressed state is called coral bleaching. Once the water temperature returns to normal, any polyps that haven't starved to death will host another alga. Most corals were thought to survive only if a heat wave lasted just a few weeks.

But no one had studied this process during a much longer heat wave. Then in 2015 and 2016, Julia Baum, a marine ecologist at the University of Victoria, had a front row seat to a very severe and prolonged bleaching event. One year earlier, she and her students had begun a survey of reefs around Kiritimati in the central Pacific Ocean. To track the fate of individual corals, they attached metal tags to two common species, called brain and star coral. For these 141 corals, they identified the symbiotic algae by DNA

sequencing. They checked the condition of the corals and resampled their algae symbionts six more times as the heat wave struck and then waned.

Starting in May 2015, the temperature rose about 1°C within 2 months. As expected, corals that housed heat-sensitive algae bleached sooner than those that housed the heat-tolerant genus of algae. And as the water continued to warm, even heat-tolerant algae were ejected. Also, no surprise.

The "jaw dropper" on Kiritimati, Baum says, was that many brain and star corals recovered from bleaching while the water was still unusually warm. Up until now, marine biologists had only seen bleached corals recover once water had cooled to its normal temperature. The unexpected recovery on Kiritimati provides new hope, Baum says, "because it means that even under prolonged heat waves, there's a path forward for some of them."

An unusual feature of the recovery is that brain coral that started out with heat-sensitive algae had a higher survival rate (82%) than coral that began with heat-tolerant algae (25%), the team reports today in Nature Communications.

That finding is surprising and "superinteresting," says Madeleine Van Oppen, a coral geneticist at the University of Melbourne, who was not involved with the work. The expectation was that heat-tolerant algae would be better suited for helping coral survive a heat wave, Baum says. But during a longer heat wave, it might be more advantageous to start with a heat-sensitive alga, says lead author Danielle Claar, now a postdoc at the University of Washington, Seattle. That's because these algae supply the coral host with more food than do heat-tolerant algae, thereby providing them with greater reserves to survive bleaching.

Water quality could influence the choice of algal partner. Because heat-tolerant algae also tend to be generally more stress resistant, they may help coral survive in polluted water. The corals on Kiritimati with heat-tolerant algae tend to be closer to large villages, where the water contains excess sediments, sewage, and other types of pollution. The more distant parts of the reef have cleaner water, and corals there are more likely to be living with heat-sensitive algae. In addition to more energy stores, it's possible that coral living in cleaner water have more robust immune systems or other factors, the team notes.

There's been some debate about whether local conditions, such as pollution and overfishing, impact the ability of a reef to survive heat

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waves, Baum says. Some researchers have concluded that local conditions don't matter. "This paper clearly shows that argument is false, at least for these corals in this location," Knowlton says. "Healthy local conditions were in fact very important for coral survival."

sciencemag.org, 8 December 2020

https://www.sciencemag.org

'The game has changed.' AI triumphs at solving protein structures

2020-11-30

Artificial intelligence (AI) has solved one of biology's grand challenges: predicting how proteins curl up from a linear chain of amino acids into 3D shapes that allow them to carry out life's tasks. Today, leading structural biologists and organizers of a biennial protein-folding competition announced the achievement by researchers at DeepMind, a U.K.-based AI company. They say the DeepMind method will have far-reaching effects, among them dramatically speeding the creation of new medications.

"What the DeepMind team has managed to achieve is fantastic and will change the future of structural biology and protein research," says Janet Thornton, director emeritus of the European Bioinformatics Institute. "This is a 50-year-old problem," adds John Moult, a structural biologist at the University of Maryland, Shady Grove, and co-founder of the competition, Critical Assessment of Protein Structure Prediction (CASP). "I never thought I'd see this in my lifetime."

"I never thought I'd see this in my lifetime."

The human body uses tens of thousands of different proteins, each a string of dozens to many hundreds of amino acids. The order of those amino acids dictates how the myriad pushes and pulls between them give rise to proteins' complex 3D shapes, which, in turn, determine how they function. Knowing those shapes helps researchers devise drugs that can lodge in proteins' pockets and crevices. And being able to synthesize proteins with a desired structure could speed the development of enzymes that make biofuels and degrade waste plastic.

For decades, researchers deciphered proteins' 3D structures using experimental techniques such as x-ray crystallography or cryo–electron microscopy (cryo-EM). But such methods can take months or years and don't always work. Structures have been solved for only about 170,000 of the more than 200 million proteins discovered across life forms.

In the 1960s, researchers realized if they could work out all individual interactions within a protein's sequence, they could predict its 3D shape. With hundreds of amino acids per protein and numerous ways each pair of amino acids can interact, however, the number of possible structures per sequence was astronomical. Computational scientists jumped on the problem, but progress was slow.

In 1994, Moult and colleagues launched CASP, which takes place every 2 years. Entrants get amino acid sequences for about 100 proteins whose structures are not known. Some groups compute a structure for each sequence, while other groups determine it experimentally. The organizers then compare the computational predictions with the lab results and give the predictions a global distance test (GDT) score. Scores above 90 on the zero to 100 scale are considered on par with experimental methods, Moult says.

Even in 1994, predicted structures for small, simple proteins could match experimental results. But for larger, challenging proteins, computations' GDT scores were about 20, "a complete catastrophe," says Andrei Lupas, a CASP judge and evolutionary biologist at the Max Planck Institute for Developmental Biology. By 2016, competing groups had reached scores of about 40 for the hardest proteins, mostly by drawing insights from known structures of proteins that were closely related to the CASP targets.

When DeepMind first competed in 2018, its algorithm, called AlphaFold, relied on this comparative strategy. But AlphaFold also incorporated a computational approach called deep learning, in which the software is trained on vast data troves—in this case, the sequences and structures of known proteins—and learns to spot patterns. DeepMind won handily, beating the competition by an average of 15% on each structure, and winning GDT scores of up to about 60 for the hardest targets.

But the predictions were still too coarse to be useful, says John Jumper, who heads AlphaFold's development at DeepMind. "We knew how far we were from biological relevance." To do better, Jumper and his colleagues combined deep learning with an "attention algorithm" that mimics the way a person might assemble a jigsaw puzzle: first connecting pieces in small clumps—in this case clusters of amino acids—and then searching for ways to join the clumps in a larger whole. Working with a computer network built around 128 machine learning processors, they trained the algorithm on all 170,000 or so known protein structures.

And it worked. Across target proteins in this year's CASP, AlphaFold achieved a median GDT score of 92.4. For the most challenging proteins,

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AlphaFold scored a median of 87, 25 points above the next best predictions. It even excelled at solving structures of proteins that sit wedged in cell membranes, which are central to many human diseases but notoriously difficult to solve with x-ray crystallography. Venki Ramakrishnan, a structural biologist at the Medical Research Council Laboratory of Molecular Biology, calls the result "a stunning advance on the protein folding problem."

All of the groups in this year's competition improved, Moult says. But with AlphaFold, Lupas says, "The game has changed." The organizers even worried DeepMind may have been cheating somehow. So Lupas set a special challenge: a membrane protein from a species of archaea, an ancient group of microbes. For 10 years, his research team tried every trick in the book to get an x-ray crystal structure of the protein. "We couldn't solve it."

But AlphaFold had no trouble. It returned a detailed image of a three-part protein with two long helical arms in the middle. The model enabled Lupas and his colleagues to make sense of their x-ray data; within half an hour, they had fit their experimental results to AlphaFold's predicted structure. "It's almost perfect," Lupas says. "They could not possibly have cheated on this. I don't know how they do it."

As a condition of entering CASP, DeepMind—like all groups—agreed to reveal sufficient details about its method for other groups to re-create it. That will be a boon for experimentalists, who will be able to use accurate structure predictions to make sense of opaque x-ray and cryo-EM data. It could also enable drug designers to quickly work out the structure of every protein in new and dangerous pathogens like SARS-CoV-2, a key step in the hunt for molecules to block them, Moult says.

Still, AlphaFold doesn't do everything well yet. In the contest, it faltered noticeably on one protein, an amalgam of 52 small repeating segments, which distort each others' positions as they assemble. Jumper says the team now wants to train AlphaFold to solve such structures, as well as those of complexes of proteins that work together to carry out key functions in the cell.

Even though one grand challenge has fallen, others will undoubtedly emerge. "This isn't the end of something," Thornton says. "It's the beginning of many new things."

sciencemag.org, 30 November 2020

https://www.sciencemag.org

New method quickly converts natural gas into solid form for storage

2020-12-07

Engineers at the National University of Singapore (NUS) have developed a new way to convert natural gas into a solid form, allowing it to be stored and transported more safely and easily. The process can be done in just 15 minutes using a low-toxicity mixture.

It may be a fossil fuel, but natural gas remains a key energy source for now, and some argue it might help us bridge the gap towards more renewable energy. It still has its problems though – the stuff can be hazardous to store or transport, and it is often converted into liquid form to make it easier to work with. However, that requires extremely cold temperatures of around -162 °C (-260 °F).

An emerging method is to instead convert the gas into a solid for easier transport and storage. In fact, nature already does this under certain conditions, as molecules of natural gas can become trapped in "cages" of water molecules, forming what are known as gas hydrates or combustible ice. It's far from a quick process though, taking upwards of millions of years.

Researchers have been trying to speed that up, and now the NUS team claims the fastest conversion time on record. The key ingredient in the new mixture is L-tryptophan, an amino acid that speeds up the reaction rate and traps more of the gas into solid hydrates faster. Taking just 15 minutes, the team says the new method is more than twice as fast as the current standard.

"Our breakthrough can really be put into perspective when you consider that it takes millions and millions of years for gas hydrates to form in nature, yet with our correct addition of secret ingredients to the system in small quantities, the same process can be effected in the laboratory in a matter of minutes," says Gaurav Bhattacharjee, an author of the study.

The process can be done in just 15 minutes using a low-toxicity mixture.

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The end product is much more convenient and safer to store and transport. As a block of ice it's shrunk in volume by 90 times, and is non-explosive and stable enough to be stored in a regular freezer at -5 °C (23 °F). The new method also apparently requires less toxic additives than usual.

While it's so far only been tested in the lab, the researchers next plan to try a pilot scale experiment, with the aim of converting around 100 kg (220 lb) of gas per day. Eventually, they hope to scale it up for industrial use.

newatlas.com, 7 December 2020

https://www.newatlas.com

Weaker penis bones in river otters linked to oilsands contaminants in new study

2020-11-29

A new study has found that hydrocarbon contaminants typically associated with oilsands operations are contributing to decreased penis bone strength among river otters.

That might sound like a quirky bit of science clickbait — but the study's primary author warns that his findings could have broader consequences for wildlife and human health in the oilsands region in northern Alberta.

"We've demonstrated how the bone health measure, the penis bone, is tied to exposure to certain trace elements and to hydrocarbons," said Philippe Thomas, a wildlife toxicologist with Environment and Climate Change Canada.

The male river otter has a penis bone, or baculum, that is typically long, curvy and slender. The study says river otters are considered a "sentinel species" — one which can register the effects of environmental contaminants before other species.

Brittle penis bones could impair the species' ability to reproduce, affecting other species up and down the food chain.

With the help of local trappers, researchers analyzed river otter livers and their penis bones. The specimens came from a range of locations both close to and far away from oilsands sites in Alberta.

Brittle penis bones could impair the species' ability to reproduce, affecting other species up and down the food chain.

"We do find, for the most part, that [the] river otter baculum is stronger, stiffer and denser at the low impact of those control sites — so in areas with usually lower levels of some of these hydrocarbons," Thomas said.

While the discovery of weaker otter penises may stand out, the study also found that the presence of some contaminants — strontium, iron and the hydrocarbon retene — was associated with stronger penis bones among some otters. The former two elements are naturally occurring and retene is a byproduct of forest fires.

The study, Co-exposures to trace elements and polycyclic aromatic compounds impacts North American river otter baculum, appeared in the peer-reviewed scientific journal Chemosphere this month.

'There were a few jokes'

Much of the research was conducted at a McMaster University lab that typically studies human bone injuries, not animal penises.

"It was a new area of research for my lab group, certainly," said Cheryl Quenneville, an associate professor in mechanical and biomedical engineering at McMaster. "I have to admit there were a few jokes flying around."

Along with measuring and scanning the bones, Quenneville and her team also conducted destructive and non-destructive mechanical tests.

Quenneville acknowledged that one of the tests her lab conducted might make some cringe — they tested how much force it would take to break the penis bones.

"I should be more sensitive to the way I speak about this," she said, apologizing. "Certainly, we like to say we are trying to help the otters one at a time, trying to ensure their reproductive success."

Thomas said past studies of mice and polar bears have shown that mammals with weaker penis bones tend to produce fewer offspring, or none at all. He said he only thought to study otters after he heard concerns from Dene and Cree hunters and trappers living in northern Alberta.

"We were given information by those land users saying that they were seeing reduced litter sizes, fewer pups ... at some of these traplines," he said. "So they were concerned that there might have been a reproductive failure.

"So we did a bit more digging around."

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In Fort Chipewyan, Alta., one of the communities closest to the oilsands, the head of a community-based environmental monitoring program for two First Nations said the new research validates what Indigenous elders have been observing for years — the collapse of wildlife numbers as oilsands production increased.

"[Thomas] applied science to a puzzle put to him by the elders," said Bruce Maclean, a coordinator of community monitoring for the Athabasca Chipewyan and the Mikisew Cree First Nations.

Thomas's study forms part of the joint oilsands monitoring program that's been spearheaded by the region's Indigenous communities and the governments of Alberta and Canada for almost a decade.

Thomas said he recognizes that studies like these often become highly politicized and weaponized on news and social media feeds by people for and against the oilsands. He added that the industry listens to reputable science and has responded in proactive ways in the past when their practices have been shown to be harmful.

These new findings and further research could help oilsands operators find new ways to phase out or limit exposure to by-products of their operations, he said.

cbc.ca, 29 November 2020

https://www.cbc.ca

The 'last mile' for COVID-19 vaccines could be the biggest challenge yet

2020-12-03

A race to develop a COVID-19 vaccine began almost the minute the coronavirus's genetic makeup was revealed in January.

Already, two companies have announced that their vaccines appear safe and about 95 percent effective (SN: 11/18/20, SN: 11/16/20). Government regulators in the United Kingdom granted permission December 2 for emergency use of a vaccine made by the pharmaceutical company Pfizer and its German biotech partner BioNTech. The first doses could be delivered within days of the announcement. Emergency use authorization and even full approval of the vaccines is probably not far off in the United States and other countries.

Ultimately, the vaccines won't truly be successful until enough people have gotten them to stop the spread of the virus and prevent severe disease and death.

But another race is just beginning. Ultimately, the vaccines won't truly be successful until enough people have gotten them to stop the spread of the virus and prevent severe disease and death. And that will pose a logistical challenge unlike any other.

In normal times, potential vaccines have only a 10 percent chance of making it from Phase II clinical trials — which test safety, dosing and sometimes give hints about effectiveness — to approval within 10 years, researchers reported November 24 in the Annals of Internal Medicine. On average, it takes successful vaccines over four years to go from Phase II trials to full regulatory approval.

Even if the COVID-19 vaccines made by Pfizer or by the biotechnology company Moderna are distributed in late December under emergency use provisions — less than a year after clinical trials began — they may not gain full approval from the U.S. Food and Drug Administration for months, or even years. Even so, such lickety-split action to get out a vaccine against a previously unknown illness is unparalleled.

But though the race to make a COVID-19 vaccine is moving at a world-record pace, it is far from over, says Robin Townley in Washington, D.C., who heads special-projects logistics for A.P. Moller-Maersk, a company that handles supply chain logistics and transportation services for companies around the world.

"The vaccine race now is not a race out of the lab. It's a race to the patient," he says. And the most successful vaccines, Townley says, will be those made by the companies that pay the most attention to the last mile of the race.

That last mile — the vaccine's journey from, say, centralized distribution centers to clinics and finally to patients — isn't a measure of distance. It's a pothole-strewn maze of regulations and supply chains that companies must navigate to get their vaccine distributed, eventually to almost every person on the planet.

The magnitude and intensity of the task ahead is unprecedented, Townley says. "It is the largest product launch in the history of humankind."

Managing the last mile

The sheer scale of vaccinating the world is daunting. With most COVID-19 vaccines in development requiring two doses for full effect, there will be a need for roughly 15 billion doses globally.

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Management of the vaccine rollout is a key variable — at least as important as vaccine efficacy — in the equation determining how well a vaccine will quell the pandemic, researchers reported November 19 in Health Affairs. Researchers considered different scenarios, figuring in vaccine effectiveness, the pace at which people could be vaccinated (depending both on delivery systems and public willingness) and how quickly the virus spreads.

Even a vaccine that is only 50 percent effective in preventing disease could quell the pandemic if it were distributed quickly enough, says study coauthor Jason Schwartz, a vaccination policy researcher at the Yale School of Public Health. "Implementation matters."

Creating the vaccines is a remarkable scientific achievement, Schwartz says, but the technical and logistical challenges of getting the vaccines where they need to go is going to be every bit as challenging as the scientific issues.

For example, while many of the vaccines in the works will require refrigeration, Pfizer's vaccine — the first fully tested vaccine to get permission for emergency use — must be kept especially cold, frozen at –70° Celsius. That vaccine requires ultracold freezers or dry ice for refilling specialized delivery containers (SN: 11/20/20). Moderna's vaccine also needs to be frozen, but is stable at regular freezer temperatures.

To get a sense of the task ahead, imagine "putting two iPhones in the hands of every single human on the planet, and make sure those iPhones are cold when they get there," Townley says.

Refrigerated and freezer trucks, planes and trains that can transport such chilly goods aren't in huge supply. Cold transportation is also necessary to move bacon, avocados and many other foods and medicines, such as insulin, Townley says. "Normal systems are not built to take on this large of a challenge in this short of a time frame," he adds.

As a result, trade-offs will need to be made. Either distributors won't be able to ship some other temperature-controlled cargoes, or they will need to add more cold-shipping capacity, which is expensive.

Much of the need for cold shipping is seasonal, such as avocado season in South Africa and Mexico. "If the vaccine season hits South Africa at the same time as avocado season [and] there's not a whole lot of capacity for carrying avocados," Townley says, "what does that do to South Africa's economy?"

It will be hard enough for many places within the United States to manage Pfizer's super-cold vaccine, says Mei Mei Hu, cofounder and cochief executive of Covaxx, a company based in Hauppauge, N.Y., that is working on its own COVID-19 vaccine. And "if it's difficult in the U.S., it's going to be virtually impossible in most emerging markets," such as Central and South America and many places in Africa, she says.

Even regular freezers, such as those needed to store Moderna's vaccine, may be a challenge in some areas. "There's lots of places where you can't get a cold Coke," Hu says.

Keeping it cold

Pfizer has devised special shipping containers, nicknamed pizza boxes for the food delivery containers that they resemble, that can be recharged with dry ice to keep the company's vaccine cold in transit and for short-term storage. The U.S. government has told states that it will send one dry ice recharge with each shipment of the vaccine, says Kurt Seetoo, the immunization program manager for the Maryland Department of Health in Baltimore.

But that recharge won't last long, so providers will need to find local sources of dry ice, which may be difficult in rural areas. Maryland is working with local contractors to ensure there will be a ready supply of dry ice when it is needed, Seetoo says.

Pfizer has assured health officials in the United States that its vaccine can be held for up to 15 days in its pizza boxes with dry ice recharges every five days and then spend another five days in the refrigerator before going bad, Seetoo says. That gives officials about 20 days to distribute the vaccine once they receive it.

Still, dry ice sublimates, or turns directly into carbon dioxide gas. The fumes can build up and suffocate people if there's not enough ventilation, which could make transporting and storing vaccines cooled with dry ice a problem.

One solution is to use devices developed for transporting cells between laboratories or for moving temperature-sensitive medicines, such as those used in cancer or gene therapies, to clinics, says Dusty Tenney, chief executive of Stirling Ultracold, a company that makes portable freezers that go as low as –80° C.

Stirling's portable freezers — which look like high-tech versions of beach coolers — are being deployed to get COVID-19 vaccines from "freezer

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farms," where the vaccines are stored after they come off production lines, to clinics and other distribution sites.

Such freezers are just one link in a "cold chain" needed to keep the vaccines fresh and effective. But the chain is fragile. The World Health Organization estimates that about 2.8 million doses of vaccines were lost in five countries in 2011 because the cold chain was broken. That includes losses in countries such as Nigeria, where 41 percent of refrigerators were nonfunctional, and Ethiopia, which had about 30 percent of its cold-chain equipment go kaput. Losing millions of doses of COVID-19 vaccines could be disastrous for getting a handle on the pandemic.

Dosing dilemma

In the United States, another hurdle is that each state isn't sure how much vaccine it will get from the federal government, Seetoo says. That makes it hard to determine how many doses the state will get for health care workers and people in long-term care homes who will be first in line to get the vaccine (SN:12/1/20).

And the two-dose requirement for most COVID-19 vaccines adds to the supply problems, says Christine Turley, a pediatrician and Vice Chair of Research for Atrium Health Levine Children's Hospital in Charlotte, N.C. Unless doctors, pharmacies and other providers are sure they'll have a steady supply of vaccine, they will need to save half of a shipment to give people booster shots three weeks to a month after the first shot.

"If I vaccinate people and can't provide a second dose, that's not meeting a moral and ethical obligation," Turley says.

Keeping track of who got vaccinated, which vaccine they got — both doses need to come from the same company — and when people are due for a second dose is another potentially daunting logistical challenge. Databases used to manage patient data or to order and ship medical supplies aren't well integrated among vaccine providers and local, state and federal government agencies, which could lead to confusion, says Pouria Sanae, chief executive of ixlayer, a company that provides logistics services for COVID-19 testing and vaccination centers. Existing databases may need to be beefed up and given new ways of managing information, he says.

And it's not just digital infrastructure that will be important. Physical spaces will be needed to administer the vaccines and their multiple doses to many, many people as quickly and efficiently as possible.

For comparison, Sanae points out that the demand for widespread COVID-19 testing initially took many people by surprise. "If we went back to January and I told you we'd be collecting testing samples in a parking lot, you'd probably laugh at me," he says. But that's what it may take to get vaccines distributed as widely as tests are. He envisions every school, government and community testing center converted to vaccination clinics, along with doctors' offices, pharmacies, hospitals and other clinics.

Logistical nightmare

Finally, it's not just the vaccines themselves that need to be rolled out smoothly. Suppliers of the glass vials that hold the vaccines have to make sure they have enough surgical-grade sand to make the vials. Nurses giving vaccine shots need alcohol wipes, syringes, needles, masks and gloves, some of which are in short supply in places. Managing all of those logistics is a sticky proposition, especially on the scale needed to immunize the world against COVID-19.

"The logistics just keep going," Turley says. From Borneo to Paris to Charlotte, N.C., how best to distribute vaccines is a problem people are facing everywhere, she says. "The only consolation is that everybody is grappling with this, and that's really no consolation to any of us."

Even if everything goes smoothly and distribution happens as swiftly as the vaccines' initial development, all could be for naught if people don't take other measures, such as universal mask wearing and social distancing, that can help slow the spread of the virus.

Schwartz, the vaccination policy researcher at the Yale, and his colleagues took virus spread into account when making their calculations. If things keep going as they have in the past few weeks, with more than 150,000 new coronavirus cases and about 1,500 deaths — about one every minute — reported daily in the United States, vaccine distribution would need to move lightning fast to prevent millions more deaths. "If we're at that [high level of transmission], even a highly effective vaccine will struggle to make a dent in the trajectory of the pandemic," Schwartz says.

sciencemag.org, 3 December 2020

https://www.sciencenews.org

But not all the batteries are cut out for a life on the road.

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The race to crack battery recycling—before it's too late

2020-11-30

EVERY DAY, MILLIONS of lithium-ion batteries roll off the line at Tesla's Gigafactory in Sparks, Nevada. These cells, produced on site by Panasonic, are destined to be bundled together by the thousands in the battery packs of new Teslas. But not all the batteries are cut out for a life on the road. Panasonic ships truckloads of cells that don't pass their qualification tests to a facility in Carson City, about a half hour's drive south. This is the home of Redwood Materials, a small company founded in 2017 with an ambition to become the anti-Gigafactory, a place where batteries are cooked down into raw materials that will serve as the grist for new cells.

Redwood is part of a wave of new startups racing to solve a problem that doesn't really exist yet: How to recycle the mountains of batteries from electric vehicles that are past their prime. Over the past decade, the world's lithium-ion production capacity has increased tenfold to meet the growing demand for EVs. Now vehicles from that first production wave are just beginning to reach the end of their lifespan. This marks the beginning of a tsunami of spent batteries, which will only get worse as more electric cars hit the road. The International Energy Agency predicts an 800 percent increase in the number of EVs over the next decade, each car packed with thousands of cells. The dirty secret of the EV revolution is that it created an e-waste timebomb—and cracking lithium-ion recycling is the only way to defuse it.

Redwood's CEO and founder J. B. Straubel understands the problem better than most. After all, he played a significant role in creating it. Straubel is cofounder and, until last year, was the CTO at Tesla, a company he joined when it was possible to count all of its employees on one hand. During his time there, the company grew from a scrappy startup peddling sports cars to the most valuable auto manufacturer on the planet. Along the way, Tesla also became one of the world's largest battery producers. But the way Straubel sees it, those batteries aren't really a problem. "The major opportunity is to think of this material for reuse and recovery," he says. "With all these batteries in circulation, it just seems super obvious that eventually we're going to build a remanufacturing ecosystem."

There are two main ways to deactivate lithium-ion batteries. The most common technique, called pyrometallurgy, involves burning them to remove unwanted organic materials and plastics. This method leaves the recycler with just a fraction of the original material—typically just the copper from current collectors and nickel or cobalt from the cathode. A

common pyro method, called smelting, uses a furnace powered with fossil fuels, which isn't great for the environment, and it loses a lot of aluminum and lithium in the process. But it is simple, and smelting factories that currently exist to process ore from the mining industry are already able to handle batteries. Of the small fraction of lithium-ion batteries that are recycled in the US—just 5 percent of all spent cells—most of them end up in a smelting furnace.

The other approach is called hydrometallurgy. A common form of this technique, called leaching, involves soaking lithium-ion cells in strong acids to dissolve the metals into a solution. More materials, including lithium, can be recovered this way. But leaching comes with its own challenges. Recyclers must preprocess the cells to remove unwanted plastic casings and drain the charge on the battery, which increases cost and complexity. It's part of the reason why spent lithium-ion batteries have been treated as waste ever since the first commercial cells hit the market in the early 1990s. It was often several times cheaper to mine new material, especially lithium, than recover it with leaching.

Redwood uses a combination of pyrometallurgy and hydrometallurgy to recover these valuable materials. First, technicians wearing reflective silver heat suits cook the batteries in converters to separate the metals. Rather than using fossil fuels to burn the material, like in a conventional smelting process, Redwood's pyro technique uses residual energy in the batteries, such as the organics in the electrolyte, to drive the conversion process. The stuff that's left over is a metal alloy that is filtered through a hydrometallurgical process to recover individual compounds.

Straubel declined to go into the specifics of the company's recovery techniques, but he claims that it can recover between 95 and 98 percent of a battery's nickel, cobalt, copper, aluminum, and graphite, and more than 80 percent of its lithium. By the time a battery has made it through Redwood's recycling facility, it has been broken down into its basic ingredients—lithium carbonate, cobalt sulfate, and nickel sulfate—that are ready to be reintegrated into the battery manufacturing process. "We're going to build a remanufacturing ecosystem for all those batteries," says Straubel. "Material can get reused almost infinitely. There's no inherent degradation to the metal atoms."

Many of the challenges that come with lithium-ion recycling stem from the fact that the facilities that process them weren't designed specifically for cooking down batteries. But people at the vanguard of battery recycling expect that creating dedicated facilities will improve the industry's

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economics. "We're focused on a bespoke process that is specifically designed for lithium ion batteries because we're starting to see increased volumes," says Tim Johnston, the cofounder of Li-Cycle, a Canadian battery recycler. "Historically, batteries were viewed as waste, and we seek to turn that on its head by focusing on them as a resource."

Li-Cycle bills itself as the largest lithium-ion recycler in North America, and takes a different approach to recovery than Redwood. The company's process skips smelting entirely and refines the battery with leaching alone. First, they drop the batteries into a vat that simultaneously discharges and shreds them. Next, the cells travel through a staged chemical bath to unlock the metals trapped inside them. The process converts almost everything back into a usable raw material—the plastic from the battery's separator is turned into flakes, the current collectors are turned into copper and aluminum foils, the graphite from the anode is turned into a carbon concentrate, and the cathode materials like nickel, cobalt, and lithium are individually recovered for new batteries.

"We don't produce any meaningful amounts of waste," says Johnston. "We don't produce any meaningful amount of air emissions, we don't produce any waste water, and everything is done at a low temperature. The footprint is very small."

Arguably, the most significant innovation at Li-Cycle is not the chemical processes but the design of the recycling facilities themselves. Li-Cycle uses a "hub and spoke" approach, in which batteries are preprocessed at different sites in the US and Canada, each a modular factory that turns the cells into black mass. The spokes feed this inert material back to a central hub, where it is refined into usable battery-grade chemicals. Today, Li-Cycle operates spokes in Ontario and Rochester, and just received state permission to open its first commercial hub in New York in 2022.

The processing equipment at each spoke is packaged in shipping containers that can be sited close to battery production facilities or municipal collection sites to minimize the distance a battery has to travel once it's depleted. This system sidesteps one of the most significant hurdles for lithium-ion recycling, which is simply getting the waste where it needs to go. These batteries are federally designated as a Class 9 hazardous material, which means they're subjected to rigorous—and expensive—shipping restrictions to reduce the risk of fire or explosions during the journey.

Smelting and bleaching are the quickest ways to address the rapidly growing challenges with lithium-ion waste, but they may not be the best

ones. Their end products are battery-grade materials, but these still require a lot of processing before they're ready to go back into a cell. A battery's cathode, for example, is nanoengineered to boost performance. So some battery experts are working on a process called direct recovery, which salvages cathode material without destroying its crystalline nanostructure. This would dramatically reduce the cost of reusing the material.

In 2019, the Department of Energy tapped Argonne National Laboratory to lead its ReCell Center, which is focused on improving lithium-ion recycling techniques. A key part of that goal is direct recycling. It's still early days for ReCell, but scientists at the center have hit on a few direct recycling processes that they hope will demonstrate the potential of this approach. They've already successfully recovered battery material with many of these techniques in the lab, but a benchtop demo is only a first step toward a method that will be economical at scale.

"The goal of the center is to come up with something that will convince industry to take this on," says Linda Gaines, the ReCell Center chief scientist and a transportation systems analyst at Argonne National Laboratory. "We need to answer all the questions about what this is going to look like when it's scaled up."

The challenge with direct recycling is that cells are not designed with material recovery in mind. Instead, they're manufactured to produce energy for a long time, and as cheaply as possible. Generally speaking, recycling isn't even an afterthought. And this makes them hard to unpack. Individual cells are complex systems that have several chemically-distinct components mixed—sometimes welded—together in a small volume. These become challenging to extract without the help of strong acids or extreme temperatures.

For now, Gaines and her colleagues are focused on figuring out how to salvage the structure of batteries that already exist. In the future, however, it's possible that batteries may be made to be recycled—but only if that's cost effective and doesn't affect performance. "Designing for recycling is a very important area, but you can't sacrifice performance at all, or nobody's going to want to do it," says Gaines. "The best way to attack that isn't obvious, and to be honest, there hasn't been a lot of really good work in that area."

Still, there are plenty of other changes that can be made to the way battery systems are manufactured to improve recycling efforts, says Carlton Cummins, the CTO of Aceleron. He cofounded the company in 2015 after he started looking into the afterlife of EVs and "realized that you

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can reuse most of the car except the battery," he says. "It wasn't designed for repair, reuse, or upgrade. The key focus at the time was to build it cheaply and quickly." As a result, the cells used in EV and stationary storage battery packs tend to have multiple welds per battery that connect dozens of batteries so they can be controlled as one unit. Cummins says this is a technique of convenience borrowed from the consumer electronics industry, but it makes automotive battery packs remarkably more difficult to disassemble for upgrades or recycling.

Aceleron's solution to the problem is deceptively simple. Cummins and his team designed a battery container that can be used for a variety of different cell types to link them without a welded connection. The company's battery platform, Circa, compresses the batteries in a hard shell case and uses a removable circuit to connect them. This means that if an individual cell fails, or the pack's owner wants to upgrade to a better battery, the cells can be swapped out by loosening some nuts and bolts. "The way batteries are designed today, everything is welded and glued together, and the assumption is that at the end of usage it is disposed of," says Cummins. "We had to reinvent how you assemble batteries with something that is designed for reuse as well as recycling."

There are still a number of technical, political, and economic challenges that lithium-ion recyclers will have to meet, and success is not guaranteed. Cobalt, for example, is the most expensive material in most EV batteries, but battery manufacturers are chasing new cobalt-free chemistries. It's uncertain whether recyclers will still find material recovery worthwhile if this valuable mineral isn't in the mix to sell back to manufacturers. Still, the new generation of battery recyclers are betting that they can find a way to close the loop on the lithium-ion supply chain and make a buck while they do it. If they're right, they may turn black mass into a green revolution.

wired.com, 30 November 2020

https://www.wired.com

I tried the world's first no-kill lab-grown chicken burger

2020-12-04

A PhD in genetics might seem like an unusual requirement for the role of head chef. It makes more sense when the man running the kitchen is not just in charge of frying your chicken burger – he created the meat himself.

"This burger takes something between two to three days to grow," says Tomer Halevy as he chops red onions, iceberg lettuce and avocado. He proceeds to batter what appears to be a strip of raw chicken before dipping it in breadcrumbs.

Halevy uses the word "grow" because chickens do not need to be slaughtered en masse to produce this type of meat. Cells taken from "source" chickens are cultured in a laboratory, creating potentially endless supplies of muscle and fat tissue. Some cells were removed from eggs, meaning the meat is from birds that were never even born.

The result is the signature dish of a new venture in Israel, the Chicken, the world's first cultured meat restaurant experience. Still closed to the public owing to coronavirus restrictions, the eatery near Tel Aviv opened its doors to the Guardian for the first private visit by a journalist.

Advocates for the technology argue that if cultured meat can become affordable it will be revolutionary, and not just in its potential to end, or at least significantly cut back, the meat trade. Cultured meat requires no antibiotics or drugs.

Critically, one study suggested it could potentially be produced with 96% lower greenhouse gas emissions and 99% less land – although some animal rights activists argue it perpetuates an unhealthy obsession with eating animals.

At the Chicken, bottles of red wine line the walls, black stools surround circular tables, and the warm glow of hanging bulbs lights the restaurant. The entire back wall is made of glass. Behind it is the production facility where lab-coated scientists wander around between large metal vats. It is petri-dish-to-table service.

"The meat was made on the other side of the glass. That's true local production of meat," jokes Ido Savir, CEO of the restaurant's parent company, SuperMeat.

The breaded patty is deep-fried in oil, before being placed on a sweet brioche bun, flavoured by wasabi and chilli mayonnaise, with a side of sweet potato chips. Similar to many chicken burgers, it breaks and flakes when pulled apart and is extremely tender. It tastes, at least to this reporter, like a chicken burger.

"This burger takes something between two to three days to grow," says Tomer Halevy as he chops red onions, iceberg lettuce and avocado.

Halevy, who also holds the role of head of product at SuperMeat, explains that muscle cells naturally contract when they are grown, making the fibres that result in the flakes of the burger that you would expect.

While Halevy says he could make a recreation of a chicken breast – with longer fibres and a dryer, denser bite – one was not offered, and others in the industry have said a fillet is much harder to create outside the bird.

For now, like others in the nascent industry, the start-up is focused on minced chicken. It is aiming to sell to meat companies that often reprocess chicken anyway, for example, into patties and nuggets.

Unlike reared poultry, this meat is made bespoke. It can be significantly altered in the process, depending on how it is encouraged to grow (in any shape) and what it is used in the "feed" – the water, sugar, amino acid, protein and vitamin bath the meat grows in.

This can lead to surprising possibilities. "We can have something that is between a breast and a thigh," says Halevy. Meat from animals that are endangered could be cultured without harming them, he adds.

Under the right conditions, every 12 hours the number of cells will double, Halevy says: "If you harvest half the meat on one day, you will get the same amount the next day."

Similar to other patties, such as the McChicken, the burger is not just meat but heavily supplemented with other ingredients to add texture and flavour. Roughly 50% is plant-based proteins, with added seasonings.

And like the chicken it serves, the restaurant is not fully fledged. There is still no regulation around cultured meat in Israel, meaning SuperMeat cannot charge customers. However, it intends to invite members of the public to try its dishes, to create a buzz. A waiver agreeing to "voluntarily assume any and all risks" must also be signed.

Savir says the aim is to take cultured meat from a scientific "dream" to reality, adding he believes it will be one or two years before he can sell it.

"This is our platform to have the first engagement," he says. As well as the public, potential clients from food companies wanting to expand into cultured meat will be invited.

The industry was given a significant boost this week when Singapore became the first state to approve the sale of cultured meat for a "chicken bites" product, which is made using similar techniques. The US-based company that makes the nuggets, Eat Just, said they would be selling to an unnamed restaurant in Singapore.

Savir says the production cost of his chicken burger is $35, which seems high but is dramatically less than it was a few years ago. In 2013, a Dutch pharmacologist, Mark Post, made history by eating the first lab-grown beef burger. It cost about £225,000.

SuperMeat anticipates cultivated meat will get cheaper as the industry grows, possibly reaching cost parity with farmed meat in six to seven years. Reducing the price of the "feed" is vital, Savir says, which accounts for about 70% of costs, similar to conventional meat.

Even if people were to reject it, cultured meat advocates say it could be used for other purposes. In the US, dogs and cats are estimated to eat around a quarter of all meat. Perhaps the biggest hurdle, however, is the "yuck" factor. For many, the idea of lab-grown flesh remains unenticing, or even blasphemous.

"We're not interfering. We're just doing it in a different way," says Savir. "Ice made in a freezer is not interfering with God – it's using technology to do it more efficiently."

theguardian.com, 4 December 2020

https://www.theguardian.com

The easy way for Joe Biden to save lives

2020-12-05

There's an on-the-shelf policy the Biden administration could enact unilaterally that would save millions of American lives, without costing the government a single cent on net.

That policy, one pushed for but never implemented by the Trump administration, is eliminating most nicotine from tobacco products. It would not render cigarettes illegal; they would still be available to adults, and the smoking experience would remain much the same. But the product would no longer be so addictive. Researchers have estimated that this policy change would enable 5 million adult smokers to quit within a year. The share of adults who smoke regularly would drop from roughly 15 percent to just 1 percent; 33 million fewer people would become smokers

It would save 8.5 million lives by 2100, at little public cost.

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by the end of the century. It would save 8.5 million lives by 2100, at little public cost.

"I am always a bit suspicious of silver bullets in public health," Michael Fiore, one of the country's leading experts on tobacco use and smoking cessation, told me. "Things are rarely silver bullets. But reducing the nicotine in cigarettes to near-zero is as close to a silver bullet as you get."

He's right, and there's nothing I know of in public policy remotely like it. Changing laws, medical advances, and social mores have saved millions of lives by suppressing tobacco use. With nothing more than a few pen strokes and a standard regulatory process, Biden could save millions more.

As smoking has disappeared from television screens, planes, bars and restaurants, and other public spaces, the smoking rate has dropped to a third of its peak of 45 percent in the mid-1950s. The share of high-school students who have smoked a cigarette in the past 30 days is down too, falling from 36 percent in the mid-'90s to just 6 percent today. That latter figure is considered crucial among public-health experts, as most adults who are dependent on cigarettes, and who ultimately die from the habit, start smoking as kids.

Still, smoking remains the leading cause of preventable death in the United States. Thirty-four million American adults smoke. Sixteen million live with a health condition related to the habit, such as lung cancer, emphysema, or heart disease. Half a million die a preventable death each and every year due to their cigarette use. Other effects include lower productivity at work, higher rates of social isolation, and cigarette-induced impoverishment.

Nobody knows this better than smokers themselves, the majority of whom want to quit, sometimes desperately so. Government data show that two in three smokers want to stop. In any given year, 55 percent try to stop. But just 7.5 percent manage to. Hyper-addictive nicotine is a major reason why.

Public-health experts have for decades suggested that the government require cigarette makers to produce products with nonaddictive levels of nicotine. (The American Medical Association started recommending the policy in the '90s.) The Obama administration took a major step toward that goal in 2009 by giving the FDA the power to regulate nicotine levels in tobacco products. The Trump administration—yes, the Trump administration—took another major step forward in 2018, when it started

the rule-making process to ban the sale of cigarettes with addictive levels of nicotine.

Scott Gottlieb, Trump's former FDA director and arguably the best appointment Trump made, described the effort as a moral imperative. This was one area where this administration—so willing to slash regulations, public-health consequences be damned—went full nanny-state. "No statistical model can truly capture the full impact of this effort—including the joy from years of quality life gained with a loved one, or how much pain and suffering would be avoided for millions of families across the country," Gottlieb said. "This unprecedented public health opportunity, contrasted against the cost of doing nothing, weighs heavily on me."

Now it is up to Biden to save millions of lives and billions of dollars, to the detriment of the tobacco industry and few others. He could also enact important complementary policies, mostly without the need for new legislation. Those include banning mint and menthol tobacco products (the Obama administration banned the sale of flavored cigarettes but not menthols, and the Trump administration banned the sale of flavored e-cigarette cartridges but not menthol-flavored ones). "It's hard to overstate how big a public-health difference [this ban] would make," Matthew Myers of the Campaign for Tobacco-Free Kids told me, given that most kids prefer flavored products. "You would transform the history of heart disease and cancer in the United States."

That policy action would have particularly significant health effects for Black Americans, who are less likely to smoke than white Americans but more likely to die from cigarette use. Menthols, which are more toxic and more addictive than unflavored cigarettes, have for decades been marketed aggressively to Black communities, and three in four Black smokers prefer them. The issue is contentious; some Black leaders argue that menthol bans are paternalistic. But many others argue that exempting them from flavor bans has a far worse racial impact.

Fiore pointed to a suite of other policies that could help as well. "Each of these options has a mountain of undisputed evidence saying that they achieve their outcome," he told me. They include tightening up regulations to ensure that tobacco products aren't sold to underage people; expanding anti-smoking advertising; enacting comprehensive bans on smoking in public places and on work sites; and making access to cessation tools and treatments universal, simple, and free. "We have to make it as easy to quit smoking as it is to buy a pack of cigarettes at the corner store," he told me.

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Another option is increasing tobacco taxes. Cigarettes remain far cheaper in the United States than in many of our peer countries, due to lower government levies: The average cost for a pack is $15 in the United Kingdom and $25 in Australia, versus $8 here. Higher prices would have a particularly strong effect in discouraging teen use. But one caveat: Low-income Americans are much more likely to smoke than high-income Americans, and low-income smokers often spend large shares of their disposable income on cigarettes. Increasing cigarette taxes is highly regressive, a policy that burdens fragile, impoverished households the most. That's why policy makers should pair increases in cigarette taxes with other changes—ones that make cigarettes nonaddictive, give support to people who want to quit, and ideally also help alleviate deep poverty too.

This is a public-health crisis of extensive proportions, hiding in plain sight. But Biden has a silver bullet to use.

theatlantic.com, 5 December 2020

https://www.theatlantic.com

Tyre chemical drives mystery salmon deaths

2020-12-04

After several years of chemical detective work, researchers have identified the culprit that kills up to 90% of salmon as they return to their spawning streams in the American Northwest each autumn – a compound in car tyres.1

Edward Kolodziej and Zhenyu Tian from the University of Washington Tacoma, US, and colleagues identified the long-suspected but undiscovered poisonous substance – 6PPD-quinone – as originating from worn tyre fragments. At amounts similar to those measured flowing into salmon streams during autumn rainstorms, 6PPD-quinone killed Coho salmon in experiments within five hours.

Every autumn in urban streams around Seattle, many Coho salmon that return to spawn die when it rains. While there had been clues of what causes this urban stream syndrome as early as 2005,2 the exact cause of their deaths remained mysterious. Storm water is a very complex mixture, stresses Tian. 'You will see thousands of chemical features in these mixtures, and most of them are still unknown,' he says. That motivated the team to query whether one of these substances was killing the salmon.

At amounts similar to those measured flowing into salmon streams during autumn rainstorms, 6PPD-quinone killed Coho salmon in experiments within five hours.

'We are producing and using hundreds of thousands of anthropogenic chemicals, so these are inevitable results,' Tian says.

Previously team member Jenifer McIntyre from Washington State University, US, had led a related study showing that solutions made from tyre particles were toxic to salmon. The team had also shown that waters linked to salmon deaths had very similar chemical profiles to runoff from roads. However, because these waters are complex mixtures they are 'difficult to work with', Kolodziej stresses. The classic chemistry approach of separating components using chromatography and identifying them using mass spectrometry initially detected over 2,000 molecules and fragments to trawl through.

Serious separation

Over the last three years, Tian therefore adopted better equipment to handle that. 'We are one of the first groups using high-resolution mass spectrometry for water quality analysis of roadway runoff, so we brought some new tools to a longstanding problem,' Kolodziej explains.

The troublesome water samples remained toxic after the researchers filtered them through materials that removed metals and strongly ionic substances. After four separation stages, they cut down the list of candidates by around 90%, and further eliminated all possible currently known options. The team then moved on to 'a serious separation to resolve a toxicant from this complex mixture', Kolodziej says, ultimately identifying a substance with the formula $C_{18}H_{22}N_2O_2$.

That formula had never been reported as toxic before, so the team presumed it had been transformed from something else in the environment. Looking at the likely reactions suggested a breakdown product of N-(1,3-dimethylbutyl)-N'-phenyl-p-phenylenediamine, or 6PPD. 6PPD can comprise up to 2% of vehicle tyres, being added to help stop the rubber degrading in reactions with ground-level ozone. 6PPD, whose formula is $C_{18}H_{24}N_2$, reacts with ozone to make a substance with a formula of $C_{18}H_{22}N_2O_2$, which the team calls 6PPD-quinone. The team then checked waters from Los Angeles and San Francisco, and found 6PPD-quinone in them too.

'This finding is certainly alarming,' comments Susanne Brander from Oregon State University, US. She calls 6PPD-quinone a 'newly discovered and clearly ubiquitous' pollutant that is likely 'causing toxicity across the entire food web'. 'The authors have provided a strong case for the need to remove 6PPD from tyres and thus aquatic ecosystems,' she concludes.

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McIntyre notes that we don't yet know how 6PPD kills salmon, and that the researchers therefore want to find out. 'We will also test whether the newly discovered chemical can explain differences in sensitivity to stormwater that we see among salmon species,' she says. Kolodziej adds that identifying 6PPD-quinone can help improve water treatment efforts and develop more sustainable products for use in tyres.

chemistryworld.com, 4 December 2020

https://www.chemistryworld.com

Do adaptogens actually work?

2020-12-08

Spend enough time desperately googling cures for "brain fog" and "pathological procrastination" and you're likely to come across all kinds of things — YouTube videos in which bodybuilders beg you to take vitamin C, shady websites selling generic Adderall, Reddit threads in which weirdos who think they're doctors speak with clinical precision about enzymes and what does or doesn't cause liver cancer. An increasingly popular addition to this discourse are adaptogens, a group of herbs (e.g., Siberian ginseng, Arctic root) alleged to help the body deal with stress. As with any hazily understood panacea, it is probably worth doing some research before you flood your system with them. So for this week's Giz Asks, we reached out to a number of experts to find out whether adaptogens actually work.

An increasingly popular addition to this discourse are adaptogens, a group of herbs (e.g., Siberian ginseng, Arctic root) alleged to help the body deal with stress.

Nita Farahany

Professor of Law and Philosophy at Duke University and Founding Director of Duke Science & Society whose work focuses on the ethical, legal, and social implications of emerging technologies

"Adaptogens" is a fancy term for a lot of different herbal supplements that have been used over a long period of time. There's scientific evidence in favour of some of them — there have been mixed results, for instance, suggesting turmeric may be effective for its anti-inflammatory properties, and that nettle leaf has some beneficial uses. But a lot of modern medicine is derived naturally from plants or plant sources, and those have been well-studied and have good evidence to support them; a lot of the so-called adaptogens haven't been as well-studied, even if there's evidence to suggest that they have some potentially beneficial anti-stress properties.

Also, a lot of herbal supplements, taken in high concentrations or just taken at all, can interact with other drugs you're on and make those medicines less effective. One of the dangers is that a lot of herbal

supplements aren't regulated in the US — the FDA treats them more like food products. The result is that that have a much more relaxed regulatory oversight, which calls into question how pure they are and whether they actually contain the ingredients (or dosages) they say they do. We also might not know if there are other kinds of additives in them, and whether those additives interact with other medications you're on, or with other underlying conditions you might have. And anything taken in high concentrations, especially high concentrations that aren't overseen or regulated, can be potentially dangerous to the body.

A lot of the independent research that's been done on various supplements shows that there's really significant variation between different manufacturers — 10 brands might claim to have 1,000 micrograms in their product, but in actuality there could be great variability in dosage between brands, or even between bottles from the same brand. So having a company you really trust is important. There's also a great organisation called consumerlab.org, a subscription-based service that does a lot of independent testing of supplements, including adaptogens, and provides recommendations as to which one of the purest or most reliable, which has good manufacturing processes behind it, etc. Personally, I'd want some of that reassurance — I'd really want to trust the company I'm buying from before I start ingesting high concentrations of any of these things.

James David Adams

Associate Professor at the USC School of Pharmacy and an expert in medicinal plants, human drug metabolism, and herbal remedies

Adaptogens definitely work. They've been tested in placebo-controlled randomised clinical trials — especially Ashwaganda — and been shown to be effective. Ginseng has been tested by people in China for thousands of years, and they know it works.

There are all kinds of theories about why they do — that they regulate the hypothalamic pituitary axis and the sympathetic adrenal axis (in other words, that they keep your adrenal gland working properly); that they keep your sympathetic neurons working properly.

They'll only work, though, if you're under a kind of stress that you're not used to — i.e., you used to work at a desk, but now you're digging ditches. It has to be something your body isn't used to, and it can be psychological as well as physical — your in-law moving into your house, for instance.

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It's important to note that they take weeks to work. In China, they'll tell you you need to take ginseng for 2-3 weeks minimum to get an effect. Ashwagandha takes 60 days. You have to be patient. Americans aren't patient, which is why most of the adaptogens sold in the US are just huge doses of caffeine — so that when you take them you can say, wow, that really works!

For athletes, it's only useful right as you're starting the season — if, for instance, you're 18 kg overweight and need to get in shape fast. The adaptogen will help you get there a little faster. But once you've been trained for several months, you don't need an adaptogen — your body is already adapted. You can use the adaptogen for the first month or so, but after that, you should stop taking it — because you don't need it, and because it's a mild health risk.

The FDA and the American medical profession in general are very much against adaptogens, and that's partly because of racism — these come from India and China. The clinical trials are there, the evidence is there, it's incontrovertible. You can't dispute it. It's craziness.

Pieter Cohen

Associate Professor, Medicine, Cambridge Health Alliance

Dietary supplements are often promoted as adaptogens (you can tell if it's being marketed as a supplement because there will be a "Supplement Facts" panel). The problem is that almost any supplement could conceivably be promoted as an adaptogen because the bar to advertise supplements as having the ability to resist stress is very low. There is no need for a single human study to be performed before manufacturers can place adaptogen-type claims on supplement bottles. This creates a marketplace where it's extremely difficult for consumers to obtain accurate information about what the actual effects of the supplement will be on the body. For this reason, I recommend that supplements promoted as adaptogens are avoided. If you want to try a particular botanical, a high-quality product that lists only one ingredient and is certified by a high-quality third-party should be used — and remember to tell your doctor you're giving it a try.

C. Michael White

Department Head and Distinguished Professor, Pharmacy Practice, University of Connecticut

The single cell and small animal studies are very promising. They suggest that adaptogens as a class can reduce cellular inflammation in stress responses that are related to poorer mental performance in humans.

The very preliminary clinical trials for some of the better studied adaptogens like Rhodiola rosea are generally small and of poor quality but seem to support the hypotheses generated from basic science. That does not mean they are ready for prime time but does mean they should continue to be studied in a more rigorous way.

I have demonstrated how different the cellular environment in a Petri dish is than the human one and how these cellular models cannot be a substitute for human data. A couple decades ago, everyone was certain that the antioxidant vitamins E, C, and beta-carotene would dramatically reduce heart disease and cancer. Sales were huge. Unfortunately, when the quality clinical trials like the Heart Protection Study came out they showed clearly that antioxidants were not effective and people wasted their money. So we can be hopeful but should not get caught up in the hype.

It could turn out that some of these adaptogens are effective, but they might cause significant side effects that can only be detected in larger clinical trials. Remember, the absence of known safety issues because of scant data is not the same thing as proof of safety but many people want to jump the gun.

Finally, if you want to jump the gun and start taking an adaptogen now, please only use products that are verified by independent laboratories to have the ingredient you are paying for (several products do not), and don't have heavy metals, pesticides, herbicides, hidden prescription drugs, mould, and bacteria in them. The proper products carry the USP, NSF, or ConsumerLabs seals of quality.

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https://www.gizmodo.com.au

Is anyone on Earth not an immigrant?

2020-12-07

Human beings tend to be fascinated with their beginnings. Origin stories are found across cultures, religions, ethnicities and nationalities — and they are all deeply important. These stories tell people where they come from, how they fit in and how everyone fits together.

So after thousands and thousands of years of nearly constant migration, are there any people out there who have never left the spot where it's thought Homo sapiens evolved?

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One of these stories, of course, is the story of human genes, and it's a story anyone with human DNA shares.

As scientists find more ancient human DNA, sample more modern DNA and develop more ways to analyze this genetic material, it's revealing a lot about how early humans moved — and moved and moved — around the world, coming to inhabit nearly every swath of land.

So after thousands and thousands of years of nearly constant migration, are there any people out there who have never left the spot where it's thought Homo sapiens evolved? Put another way, is there anybody on Earth who isn't an immigrant?

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"From a scientific point of view, maybe the only people that you could consider not to be immigrants would be some Khoe-San-speaking groups in southern Africa," said Austin Reynolds, an assistant professor of anthropology at Baylor University in Texas who specializes in human population genetics.

The designation Khoe-San (pronounced coy-sawn) refers to certain African communities in the areas of Botswana, Namibia, Angola and South Africa who speak similar languages with distinctive clicking consonants, Reynolds told Live Science.

Reynolds said there are two main factors indicating that Khoe-San groups may be non-migratory descendants of original humans: They live in the place where it's likely humans first appeared, and they have a high amount of genetic diversity. A good way to understand why high genetic diversity indicates original ancestry is by comparing genes to a bowl of M&Ms, Reynolds said. Handfuls taken out of the bowl — i.e. people who broke off from the original human population — might have only a couple M&Ms colors in them, but the original bowl will have all the colors.

Yet despite the Khoe-San groups' proximity to the proverbial "cradle of humankind" and their significant genetic diversity, identifying them as the last genetically aboriginal peoples is not cut and dry.

Firstly, researchers don't know for sure that southern Africa is the cradle of humankind. Some scientists think humans first evolved in East Africa, said Reynolds, and scientists haven't amassed enough archaeological evidence in either area to be completely certain just where Homo sapiens first came on the scene.

There's even a possibility people evolved in western Africa, Mark Stoneking, a molecular geneticist at the Max Planck Institute for Evolutionary Anthropology in Leipzig, Germany, told Live Science. Different environments do a worse or better job at preserving fossil remains, Stoneking said, so just because human remains were or were not found in specific places doesn't mean humans didn't live there long ago.

Stoneking doesn't think there are any folks left on Earth who aren't — scientifically, at least — immigrants.

"People have always been on the move," Stoneking said. His recent genetic research on populations across Asia has shown that there's a touch of just about everyone in everyone else. "All human populations have been in contact with others," including the Khoe-San, he said, denoted by evidence in their genes, their cultures and their languages.

Early humans moved extensively around Africa for more than 100,000 years before leaving, at which point they probably moved out of eastern Africa into the Middle East, Stoneking said. It's likely that not long afterward, people headed southeastward along the Indian coast, with many more waves of migrants following these original adventurers over a span of tens of thousands of years. Along the way, there would have been a great exchange of DNA, Stoneking said, and these two components — movement and intermixture — is what he sees as a defining characteristic of the human species.

"Humans — what they like to do is migrate, and they like to have sex," Stoneking said. And so it seems to have been since time immemorial.

livescience.com, 7 December 2020

https://www.livescience.com

Scientists finally think they know why these pandas like to roll in horse poop

2020-12-07

The panda bear may one of the world's cutest animals, but it also has one of the world's grossest habits: Giant pandas in central China's Foping National Nature Reserve like to rub horse manure on their necks and faces and roll around in it to cover their entire bodies. Now, researchers say they have an explanation for these dung baths. The horse poop contains compounds that might help the animals deal with colder temperatures.

The horse poop contains compounds that might help the animals deal with colder temperatures.

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Droppings are something like an identification card for animals. Creatures sniff the feces of their own kind to pick up clues to sex and mating status, and the scat of other species can tell them when a predator is nearby. But none of this explained why wild pandas (Ailuropoda melanoleuca) at the reserve were attracted to horse poop. Although horses sometimes pass through the reserve, towing supplies to local farmers, the solitary panda does not interact with these hoofed animals in the wild.

To get to the bottom of things, researchers analyzed 38 instances of dung rolling, captured on infrared cameras at the reserve from June 2016 to July 2017. The bears tended to roll in horse poop less than 10 days old. These feces contained natural compounds, called beta-caryophyllene (BCP) and beta-caryophyllene oxide (BCPO), that are scarce in older dung, say the scientists, led by researchers at the Chinese Academy of Sciences's Institute of Zoology.

The team then added this compound to the hay of pandas at the Beijing Zoo, and found the animals favored the hay treated with these compounds, sometimes rubbing it all over their bodies. What's more, the pandas tended to roll in horse poop in colder weather, at temperatures between –5°C to 15°C. Could BCP/BCPO help keep the giant pandas warm?

As giant pandas are a national treasure for China, there are strict limitations on conducting research on these protected animals, so the team turned to mice. Covering mice in a diluted BCP-BCPO solution boosted the animals' cold tolerance, the authors report today in the Proceedings of the National Academy of Sciences. Treated mice more readily walked on colder surfaces and did not huddle together in below freezing temperatures, unlike mice given a saline solution. In cells, the researchers discovered BCP-BCPO blocks receptors that sense cold in pandas.

Although it's not concrete proof, the authors "provided solid evidence from the molecular level to elegantly explain the unique behavior," Fan Yang, a biophysicist at the Zhejiang University School of Medicine, wrote in an email. The same thermo-regulating receptors are present in many animals, including elephants, penguins, and humans, he notes. So it is possible that using natural compounds to regulate body temperature "may actually be a general strategy widely adopted in other animals." For example, a compound in chili peppers, called capsaicin, activates a receptor that makes humans feel warmer, which is why we sometimes sweat while eating spicy food.

Staying warm in the winter can be challenging for pandas, notes Zejun Zhang, an ecologist at China West Normal University, because they don't hibernate and their low-calorie diet of bamboo makes it hard to store extra fat for insulation. It's possible, the authors say, that pandas have used horse poop in this way for thousands of years, as ancient trade routes crossed through this mountainous area.

But Malcolm Kennedy, a professor of natural history the University of Glasgow, is not convinced. Pandas will smear on their bodies "anything they find unusual or interesting," he says, and these bears could just be attracted to the strong smell of horse poop. And although blocking thermosensing receptors would theoretically help animals from feeling cold, their bodies would still need to use more energy to function at lower temperatures. If limiting the animal's cold sensitivity stopped them from seeking shelter, he says, that could be "potentially suicidal."

sciencemag.org, 7 December 2020

https://www.sciencemag.org

COVID-19: When are you most infectious?

2020-12-05

A close friend – let's call him John – recently called, asking for advice. He woke up with severe muscle aches and fatigue. Understandably worried that it could be COVID-19, he asked whether he should go to work, run to get a test or stay home. Because he didn't have other symptoms, such as a fever, cough or shortness of breath, he was unsure what to do. Of course, this could be any other respiratory infection, such as the flu or the common cold, but what if it is COVID-19? What is the risk of him transmitting the virus to others?

To understand when people with COVID-19 are most likely to be infectious, our team conducted a study which was recently published in The Lancet Microbe.

We investigated three things: viral load (how the amount of the virus in the body changes throughout infection), viral shedding (the length of time someone sheds viral genetic material, which does not necessarily mean a person is infectious), and isolation of the live virus (a better indicator of a person's infectiousness, as the live virus is isolated and tested to see if it can replicate in the laboratory).

We found that viral load reached its peak in the throat and nose (which is thought to be the main source of transmission) very early in the disease,

Of course, this could be any other respiratory infection, such as the flu or the common cold, but what if it is COVID-19?

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particularly from the first day of symptoms to day five of symptoms – even in people with mild symptoms.

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We also found that genetic material can still be detected in throat swab or stool samples for several weeks. But no live virus was found in any sample collected beyond nine days of symptoms. Although some people, especially those with severe illness or with a weakened immune system (say from chemotherapy), may have longer viral shedding, the results suggest that those infected with SARS-CoV-2 are most likely to be highly infectious a few days before symptoms start and the following five days.

In comparison, the viral load of Sars peaks at 10-14 days and for Mers at 7-10 days after symptoms start (Sars and Mers are both diseases caused by coronaviruses). This explains why the transmission of these viruses was effectively reduced by immediately finding and isolating people who had symptoms. It also explains why it has been so difficult to contain COVID-19 as it spreads very quickly early in the disease course.

Contact tracing and modelling studies also show that transmission is highest in the first five days of experiencing symptoms. According to a recent study, the period of highest infectiousness is within about five days of symptoms starting. A contact tracing study from Taiwan and the UK found that most contacts got infected if they were exposed to the infected person within five days of their symptom onset.

By the time most people get their test result, they may already be beyond their most infectious period. This early viral load peak suggests that to prevent onward transmission, a person with COVID-19 needs to self-isolate as soon as symptoms start without waiting for test results.

John self-isolated immediately and called everyone that he had been in contact with in the previous few days. The next day, he woke up with a mild fever. He couldn't get a test immediately, but was able to get an appointment at a later time. The results were available by day five of his symptoms. He tested positive for COVID.

Fortunately, John managed to self-isolate throughout his most infectious period and his contacts started quarantining immediately.

John was fortunate in that he was able to work from home and continue to get paid. But according to a UK survey, only one in five people are able to self-isolate. Barriers include having a dependent child at home, having

low income, experiencing greater financial hardship during the pandemic, and being a key worker, such as a nurse or teacher.

Governments could do more to help

How will a diagnosis help if your living situation doesn't allow for isolation, if you have a job that can't be done from home, and your work doesn't provide sick leave? And how will a diagnosis help if your family depends on your income to meet basic needs, or your access to care is linked to your employment?

This highlights why we must focus on supporting people with COVID-19 to self-isolate early in the disease course. Here are four ways to help people self-isolate:

Income relief to avoid undue pressure to work when sick (the proportion of salary covered by sick pay is 29% in the UK).

Housing for disadvantaged communities, especially those living in crowded houses and those living with vulnerable people, as has been successfully done in Vermont, in the US.

Services to support people who are self-isolating, as is done in New York and many south-east Asian countries.

Remove barriers to accessing healthcare and consider making isolation periods shorter – five to seven days after symptoms begin. This could cover the most infectious period and might improve people's ability to comply with isolation. In September, France dropped isolation period for cases to seven days, and Germany is considering shortening it to five days. The benefit of shortening isolation may more than offset any risk to the community.

With these measures in place, we should be in a much better position to beat the pandemic.

livescience.com, 5 December 2020

https://www.livescience.com

The best way to win a horse race? Mathematicians may have the answer

2020-12-02

Attention racehorse jockeys: Start fast, but save enough energy for a final kick. That's the ideal strategy to win short-distance horse races, according

Every racehorse has different capabilities. Like humans, some excel at sprinting, whereas others are marathoners.

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to the first mathematical model to calculate how horses use up energy in races. The researchers say the approach could be used to identify customized pacing plans that, in theory, would optimize individual horses' chances of winning.

Every racehorse has different capabilities. Like humans, some excel at sprinting, whereas others are marathoners. Figuring out which is which, and how to pace them, can be the difference between faltering in the final furlough and taking home the Kentucky Derby's $1.3 million winner's payout. Jockeys and trainers have traditionally relied on centuries of experience, data from previous races, and intuition to plan their races.

Amandine Aftalion, a mathematician at the School for Advanced Studies in the Social Sciences (EHESS) in Paris, thought she could add to that. Since 2013, she has been analyzing the performances of world champion runners like sprinter Usain Bolt. She's found that short-distance runners tend to win when they start strong and gradually slow down toward the finish line. But in medium-distance races, such as the 1600-meter, runners perform better when they start strong, settle down, and finish with a burst of speed.

Her model shows how those winning strategies maximize the energy output of muscles reliant on two different pathways: powerful aerobic ones that require oxygen, which can be in limited supply during a race, and anaerobic ones, which don't need oxygen but build up waste products that lead to fatigue.

Aftalion wondered which strategy would be best for horses. So she and Quentin Mercier, another EHESS mathematician, took advantage of a new GPS tracking tool embedded in French racing saddles. The trackers let fans watch digital images of the horses move across a screen, and they gave Aftalion and Mercier real-time speed and position data.

The duo studied patterns in dozens of races at the Chantilly racetracks north of Paris and developed a model that accounted for winning strategies for three different races: a short one (1300 meters), a medium one (1900 meters), and a slightly longer one (2100 meters), all with different starting points on the same curved track. The model takes into account not just different race distances, but also the size and bend of track curves, and any slopes or friction from the track surface.

The results, published today in PLOS ONE, might surprise jockeys who hold horses back early for bursts of energy in the last furlough. Instead, a strong start leads to a better finish, the team found. That doesn't mean those

jockeys are wrong, though. Too strong of a start can be devastating as well, leaving the horse "exhausted by the end," Aftalion says.

In theory, the model could allow trainers to plug in parameters for individual horses—like their unique aerobic capacities—to get custom racing strategies, from pacing recommendations to ideal racing distances. And if there's a market for it, developers might even create an app, Aftalion says.

That's a nice thought, but it's not likely to win over horse trainers and jockeys, says Peter Knight, a veterinarian at the University of Sydney with more than 30 years of experience working on horse racetracks. Various other scientific attempts to explain performance over the past 4 decades "haven't been particularly successful," he says—and not just because horses vary so much in body size and aerobic capacity: The models cannot account for the horse's own behaviors.

For example, a horse might give up when another horse passes it, because it doesn't understand that it's supposed to win. Until researchers can get inside the horse's head and account for psychological variables, Knight says, "we can't truly model performance."

"But perhaps the fundamental question is: Do we really want to?" he adds. "For people who love horse racing, the uncertainty provides the excitement, and the actual running of the horses provides the spectacle and the beauty."

sciencemag.org, 2 December 2020

https://www.sciencemag.org

Mysterious black spot in polar explorer's diary offers gruesome clue to his fate

2020-12-02

As a polar explorer lay frostbitten and starving in a frozen Greenland cave, he smeared a black spot onto the bottom of his last journal entry. More than a century later, that dark smudge has revealed grim new details of the dying man's final hours.

His name was Jørgen Brønlund; he was a Greenland-born Inuit and was part of a three-man team on the Denmark Expedition to Greenland's Northeast Coast, conducted from 1906 to 1908 and led by Danish ethnologist Ludvig Mylius-Erichsen. Brønlund died in November 1907 and was the last of the team to perish — and the only one whose body was ever recovered.

Brønlund died in November 1907 and was the last of the team to perish — and the only one whose body was ever recovered.

He recorded his final thoughts in a diary, and the last page included a heavy black smudge. Researchers recently conducted extensive analysis of the spot, finding that it contained burnt rubber, oils and feces. These traces hint at Brønlund's desperate and unsuccessful attempts to light a life-saving petroleum burner before he succumbed to cold and hunger, scientists wrote in a new study.PLAY SOUND

Brønlund died during the team's return to base camp from Greenland's northern coast, as they were traveling over inland ice. Mylius-Erichsen and Niels Peter Høeg Hagen, the expedition's cartographer, had already died of exposure and exhaustion by the time Brønlund made it to a sheltering cave near the depot, he wrote in his journal.

"I reached this place under a waning moon, and cannot go on, because of my frozen feet and the darkness. The bodies of the others are in the middle of the fjord," read the diary's bleak final entry, according to a report published in 1908 in Scottish Geographical Magazine. Another expedition had discovered Brønlund's body and journal in March 1908; they buried him at the site of his death, and the diary was added to the collection at the Royal Library in Copenhagen.

Under Brønlund's signature on that last diary page was "an adhered black spot," according to the new study. The mysterious mark was so intriguing that it prompted an unnamed researcher to surreptitiously remove it for analysis in 1993 without prior permission, said lead study author Kaare Lund Rasmussen, a professor in the Department of Physics, Chemistry and Pharmacy at the University of Southern Denmark.

"The spot was immediately brought to the National Museum [of Denmark] for examination. There was no commercial or otherwise gain for this person," Rasmussen told Live Science in an email. "Nowadays, we do not analyze samples without written authorization, but it was entirely different then."

At the time, experts with the National Museum's Natural Science Unit were unable to determine the chemical makeup of the strange spot. For the new study, scientists reexamined the spot using techniques that didn't exist in the 1990s — such as X-ray fluorescence (XRF) and inductively coupled plasma mass spectrometry (ICP-MS) — to analyze the mark at the atomic level and pinpoint its chemical elements.

Along with carbon in the charred fragment, the researchers discovered calcium, titanium and zinc. But that trio of signatures didn't match any known rock formations in northeastern Greenland, Rasmussen said. Further analysis of the spot solved the puzzle, identifying the minerals calcite, rutile and zincite, which contained those elements. These minerals were used as fillers in rubber production, suggesting that the diary spot included burnt rubber. That likely came from a charred gasket on a kerosene stove or burner that Brønlund was trying to light, according to the study.

The researchers also detected three groups of organic compounds: lipids — such as vegetable oil, animal fat, and fish or whale oil — petroleum and human fecal matter (in his severely weakened and desperate state, Brønlund may have tried burning his own excrement to get the stove to light).

"At this time, Brønlund had starved for weeks, was tired beyond his capacity, and he was freezing," the scientists wrote. "It is likely that his hands were shaking when he used the matches from the depot to pre-heat and turn on the stove in the small cave."

Such stoves metabolized alcohol for preheating before they could be lit, and there was none in the depot. Brønlund may have left the mark on his diary page after attempting — and probably failing — to preheat the stove with anything he could find, and the presence of feces in the mark speaks to the dire circumstances and poor conditions during his "last dismal days," the study authors reported.

livescience.com, 2 December 2020

https://www.livescience.com

How cats get their stripes

2020-12-02

When Rudyard Kipling told how the leopard got his spots, he missed the mark. Leopards have "rosettes"; spots are for cheetahs, says Gregory Barsh, a geneticist at the HudsonAlpha Institute for Biotechnology. But whatever you call the markings, how wild cats and their domestic counterparts acquire them has long been a mystery. Now, Barsh and his colleagues have found an answer. In so doing, they have shown that a 70-year-old theory explaining patterns in nature holds true for fur color in cats, and likely other mammals as well.

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"This is an important paper unveiling part of the genetic basis [of] coat color markings so prominent in many mammals," says Denis Headon, a developmental biologist at the Roslin Institute. It also offers a glimpse of how those genes operate during development, forming what he calls a "highly adaptable mechanism" that responds to genetic tweaks to produce diverse coat patterns, from stripes to spots.

Biologists have identified hair follicle cells as the source of the black, brown, yellow, and red pigments that color hair or fur. "But we didn't know when and where the process of the establishment of the color pattern took place," Barsh says.

In 1952, computing pioneer Alan Turing suggested molecules that inhibit and activate each other could create periodic patterns in nature if they diffused through tissue at different rates. Thirty years later, other scientists applied his theory to develop a hypothesis about how spots, stripes, and other color patterns form during development. In this scheme, activator molecules color a cell but also trigger the production of inhibitors, which diffuse faster than the activators and can shut off pigment production. Last year, that idea was proved correct in plants called monkeyflowers: Researchers showed that dark, activated speckles on the petals become ringed with unpigmented tissue as inhibitors spread. And researchers had shown molecules following the Turing pattern help trigger the development of hair follicles in mice. But how coat color develops in mammals remained largely mysterious because mice and other easy-to-study lab animals lack spots or stripes.

A decade ago, they tracked down a gene, Tabby, that, when mutated, gives tabby cats black blotches instead of their usual dark stripes.

So Barsh's team turned to domestic cats to track the identity of molecular activators and inhibitors of coat color. A decade ago, they tracked down a gene, Tabby, that, when mutated, gives tabby cats black blotches instead of their usual dark stripes. Hudson-Alpha geneticist Christopher Kaelin found that same mutation in king cheetahs whose spots were unusually big and blotchy, suggesting the same genes color both wild and domestic cats.

To see what other genes and their mutations operate during development, Kaelin and HudsonAlpha colleague Kelly McGowan spent several years collecting discarded tissue from clinics that spay feral cats, which are often pregnant. They first noticed temporary thickenings of the skin of 28- to 30-day-old embryos, where black stripes would later appear in the fur. "There's a change [in the skin] that precedes and mimics what you observe in adult [fur]," McGowan explains.

The researchers then isolated and sequenced the active genes in individual skin cells of early embryos. At about 20 days old, embryos showed a sharp increase in the activity of several genes involved in a key developmental pathway, known as Wnt signaling, in skin areas destined to briefly thicken before the area becomes permanently dark. One of the most active genes was Dkk4, as they reported on 16 November in a preprint on bioRxiv. The team also found that mutations that inactivated Dkk4 accounted for the loss of distinct markings in Abyssinian and Singapura breeds, making their spots too small to distinguish. Tabby and Dkk4 "are in the same pathway," and likely work in both domestic and wild cats, Barsh explains, though he doesn't yet know how they are connected.

Dkk4 is a known inhibitor of Wnt signaling, which helps determine cell fates and spurs cell growth during development in many animals. The team found that in domestic cats, Wnt and Dkk4, respectively, are the activator and inhibitor. In dark skin, they exist in about equal amounts. But in paler areas, the faster moving Dkk4 protein most likely turns off Wnt, shutting down pigment production and thereby generating stripes, just as Turing's theory had predicted. "It is remarkable, although not altogether surprising, that we see Wnt-Dkk4 signaling again playing a critical early role," says Larissa Patterson, a developmental biologist at Rhode Island College.

"This paper provides thought-provoking insights into potential mechanisms of pattern diversity in wild cats," Patterson adds. It "greatly adds to the evidence" that this process is at work in cats and, most likely, other mammals, agrees Roland Baddeley, a computational neuroscientist at the University of Bristol.

Researchers had already shown the Turing mechanism involving Wnt and Dkk4 sets up the formation of hair follicles—but not coat color—later in mouse development. Barsh's team, however, found that the color pattern in cats and possibly other mammals is established well before hair follicles appear, suggesting early color patterns may guide hair follicle pigmentation.

That simple interactions among well-known molecules can explain the variety of coat color patterns in mammals is an example of nature's thriftiness, Headon says. "It suggests that the same molecules and pathways are likely to be reused for patterning of very different structures

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and at very different scales to form the intricate elements of the vertebrate anatomy."

sciencemag.org, 2 December 2020

https://www.sciencemag.com

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CHEMICAL EFFECTS

Counteracting Environmental Chemicals with Coenzyme Q10: An Educational Primer for Use with "Antioxidant CoQ10 Restores Fertility by Rescuing Bisphenol A-Induced Oxidative DNA Damage in the Caenorhabditis elegans Germline"

Influence of chemical charge on the fate of organic chemicals in sediment particle size fractions

Overview of intentionally used food contact chemicals and their hazards

ENVIRONMENTAL RESEARCH

New approach to removal of hazardous Bypass Cement Dust (BCD) from the environment: 20Na2O-20BaCl 2-(60-x)B 2 O 3-(x)BCD glass system and Optical, mechanical, structural and nuclear radiation shielding competences

Indoor Exposure to Selected Air Pollutants in the Home Environment: A Systematic Review

Co-pyrolysis of food waste and wood bark to produce hydrogen with minimizing pollutant emissions

OCCUPATIONAL

Long-term exposure to low-level air pollution and incidence of chronic obstructive pulmonary disease: The ELAPSE project

Metabolic, immunologic, and histopathologic responses on premetamorphic American bullfrog (Lithobates catesbeianus) following exposure to lithium and selenium

Serum dioxin concentrations in military workers at three dioxin-contaminated airbases in Vietnam

PHARAMACEUTICAL/TOXICOLOGY

Long-term exposure to fine particle elemental components and lung cancer incidence in the ELAPSE pooled cohort