CHEMWATCH

# Bulletin Board

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*** While Chemwatch has taken all efforts to ensure the accuracy of information in this publication, it is not intended to be comprehensive or to render advice. Websites rendered are subject to change.**

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# Regulatory Update



## ASIA PACIFIC

### Variation of Inventory listing following revocation of CBI approval – 23 July 2021

*YYYY-MM-DD*

The Executive Director varied the terms of the Inventory listing for the following chemicals because approval had been revoked for the proper name of the industrial chemical to be treated as confidential business information (CBI). The terms of the listings as varied are:

CAS Number 2653977-03-6

Chemical Name Propanoic acid, 3-hydroxy-2-(hydroxymethyl)-2-methyl-, polymer with alpha-[2,2-bis(hydroxymethyl)butyl]-omega-methoxypoly(oxy-1,2-ethanediyl), 1,4-cyclohexanedimethanol, 5-isocyanato-1-(isocyanatomethyl)-1,3,3-trimethylcyclohexane and 1,1′ -methylenebis[isocyanatobenzene], polyethylene glycol mono-Me ether-blocked

Molecular Formula Unspecified

Specific information requirements Obligations to provide information apply. You must tell us within 28 days if the circumstances of your importation or manufacture (introduction) are different to those in our assessment.

Listing date 22 July 2021

Read More

aicis, 23 July 2021

https://www.industrialchemicals.gov.au/news-and-notices/variation-inventory-listing-following-revocation-cbi-approval-23-july-2021

**The Executive Director varied the terms of the Inventory listing for the following chemicals because approval had been revoked for the proper name of the industrial chemical to be treated as confidential business information (CBI).**

### Chemical added to the Inventory following issue of assessment certificate (early listing)

*2021-07-26*

CAS Number 13107-10-3

Chemical Name 2-Propen-1-aminium, N,N,N-tri-2-propen-1-yl-, chloride (1:1)

Molecular Formula C12H20N.Cl

Specific information requirements Obligations to provide information apply. You must tell us within 28 days if the circumstances of your importation or manufacture (introduction) are different to those in our assessment.

Listing date 22 July 2021

Published date

26 July 2021

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~sAICIS, 26 July 2021

https://www.industrialchemicals.gov.au/news-and-notices/chemicals-added-inventory-following-issue-assessment-certificate-early-listing-26-july-2021

## The 'Pool Standard' and current FAISD Handbook statements

*2021-07-29*

We have received enquiries from stakeholders about some discrepancies between the current first aid instructions and safety directions in the FAISD Handbook and the label particulars specified in the Agricultural and Veterinary Chemicals Code (Listed Chemical Product – Home Swimming Pool and Spa Products) Standard 2014 ('Pool Standard'), in relation to registered products and new product applications.

For registered products, holders are reminded that a notifiable variation may be submitted to update an approved label to reflect the current FAISD Handbook.

For new product applications, current statements may be included on the proposed product label if a suitable reference product with up-to-date FAISD statements can be found. For example, a proposed product that is closely similar to a registered reference product with updated FAISD statements on its label may be considered under an Item 7 application.

However, Item 9 applications must still include the FAISD statements set out in the Pool Standard. An Item 9 application is only suitable for the registration of a listed chemical product and approval of a product label where the product and label comply with an established standard that has been approved in accordance with section 8U of the Agvet Code.

**For new product applications, current statements may be included on the proposed product label if a suitable reference product with up-to-date FAISD statements can be found.**



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After registration under an Item 9 application, applicants may then update the FAISD statements on the product label to the latest version of the FAISD Handbook, under a notifiable variation.

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APVMA, 29 July 2021

https://apvma.gov.au/news-and-publications

# AMERICA

## Plastic bags banned in Washington starting October 1

*2021-07-21*

Single-use plastic bags will be banned in Washington state starting October 1.

The state's Department of Ecology (DEC) announced the date Wednesday after a proclamation in Gov. Jay Inslee's COVID-19 state of emergency delaying the ban was rescinded.

The ban was initially supposed to take effect on Jan. 1. It officially prohibits the distribution of single-use plastic bags, the types most often used by grocery stores, retail businesses and restaurants.

"Single-use plastic bags are not easily recyclable, which makes managing them at the end of their lives almost impossible," said Laurie Davies, manager of Ecology's Solid Waste Management Program.

The bags, according to DEC, are a common form of pollution that threatens the health of wildlife, the environment and even humans.

When chemicals are released from the production, use, incineration and even slow decay of plastic bags, they pose a risk to organic life.

Read More

K5, 21 July 2021

https://www.king5.com/article/news/local/plastic-bag-ban-washington/281-9146f9c9-d4d7-4806-a585-703257c95e24

**The bags, according to DEC, are a common form of pollution that threatens the health of wildlife, the environment and even humans.**

## Maine phasing out PFAS in all products by 2030

*YYYY-MM-DD*

US State of Maine passes LD 1503, the most comprehensive PFAS regulation in the United States; manufacturers must report the uses of PFAS in the state; by 2030 all uses of PFAS will be prohibited unless designated "currently unavoidable"; Maine already prohibits PFAS in food packaging.

On July 15, 2021, the US State of Maine passed law LD 1503, the strictest regulation on per- and polyfluoroalkyl substances (PFAS) in the United States so far and one of the strictest globally. By 2030, all uses of PFAS, except those specifically designated by Maine's Department of Environmental Protection (DEP) as "currently unavoidable," will be prohibited. By January 1, 2023, any manufacturer of a PFAS-containing product that wishes to sell in Maine must submit a notification including a description of the product and the purpose, amount, and types of PFAS used.

At least six other US states ban PFAS in specific use cases, such as food packaging and firefighting foam (FPF reported), but Maine's bill is the first that requires creating an inventory of all PFAS use in the state. The DEP can use the inventory to phase out PFAS in other product categories before 2030. LD 1503 bans the use of PFAS in carpeting and textiles beginning 2023, and Maine already prohibited the sale of PFAS-containing food contact materials, which became effective in 2020 (FPF reported).

Read More

Food Packaging Forum, 19 July 2021

https://www.foodpackagingforum.org/news/maine-phasing-out-pfas-in-all-products-by-2030

## Canada proposes maximum reside limits for benzovindiflupyr and mandipropamid pesticides

*YYYY-MM-DD*

On July 13, 2021, the Health Canada's Pesticides Management Regulatory Agency proposed to establish maximum residue limits (MRLs) for mandipropamid (PMRL2021-23) and benzovindiflupyr (PMRL2021-24). The proposed MRLs for mandipropamid and Benzovindiflupyr in Canada are equal to the corresponding American tolerances as listed in the Electronic Code of Federal Regulations, 40 CFR Part 180, by pesticide.

**The draft consultation is open for public comments for 75 days.**



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The scope of the document is herein summarized:

′ MRL for Benzovindiflupyr is proposed at 0.08ppm for Sugar beetroots.

′ MRL for Mandipropamid is proposed at 15ppm Citrus oil and 0.5ppm Citrus fruits (crop group 10) (revised).

′ Residues pose no health risk associated with human health.

′ The established MRL will be legally in effect as of the date that it is entered into the Maximum Residue Limit Database.

The draft consultation is open for public comments for 75 days.

Read More

Selerant, 16 July 2021

https://resources.selerant.com/food-regulatory-news/canada-proposes-maximum-residue-limits-for-benzovindiflupyr-and-mandipropamid-pesticides

## USDA promotes transparency in food product labelling

*2021-07-05*

On July 01, 2021, the U.S. Department of Agriculture voted to strengthen the enforcement of the "Made in USA standard", in view of the Federal Trade Commission's (FTC).

Following key points were highlighted:

′ The scope is to enhance the ability to enforce the Made in USA standard for American consumers.

′ The document is applicable for labelling of products regulated by FSIS

′ American consumers depend upon accurate, transparent labels to obtain important information about the food they consume.

′ Focus on American farmers and ranchers depend upon the same labels to convey information about their products that consumers value and demand.

′ Various comments submitted to USDA and the FTC regarding meat labelling.

**The current "Product of USA" label on meat products may no longer effectively serve a purpose, to the detriment of consumers, producers, and fair and competitive markets.**

′ The current "Product of USA" label on meat products may no longer effectively serve a purpose, to the detriment of consumers, producers, and fair and competitive markets.

′ To ensure labelling initiative is implemented in a way that fulfils a commitment to working cooperatively with trade partners and meet international trade obligations.

Read More

Selerant, 5 July 2021

https://resources.selerant.com/food-regulatory-news/usda-promotes-transparency-in-food-product-labelling

## EUROPE

### FSAI alerts withdrawal of food additive locust bean gum (E410) in certain food products due to ethylene oxide contamination

*2021-07-20*

On July 16, 2021, the Food Safety Authority of Ireland released the "FSAI Advises on Withdrawal of Some Food Containing Locust Bean Gum (E 410) due to Ethylene Oxide Contamination", in line with members of other EU states alerts on the identification of higher residues above regulatory maximum limits in locust bean gums.

The scope of the scientific report is summarized below:

′ Locust bean gum is a vegetable gum extracted from the seeds of the Carob tree

′ It is approved as a food additive in the EU mainly as a thickening agent or stabiliser and in a range of foods including ice-cream, breakfast cereals, meat products, confectionery, follow on formulae, fine bakery wares, fermented milk products and cheese.

′ Consumption of foods containing ethylene oxide does not pose an acute risk to health but prolonged consumption of contaminated products may result in health complications

FSAI is working with its official agencies in relation to the identification of the contaminated additive (E410) that may have been supplied to businesses or food manufacturers in Ireland and will provide updates as

**Locust bean gum is a vegetable gum extracted from the seeds of the Carob tree**



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and when available, it will also list affected food products as identified on its website.

Read More

Selerant, 20 July 2021

https://resources.selerant.com/food-regulatory-news/fsai-alerts-withdrawal-of-food-additive-locust-bean-gum-e410-in-certain-food-products-due-to-ethylene-oxide-contamination

### EU amends food additives regulations Steviol glycosides (E960)

*2021-07-19*

On July 14, 2021, the European Commission published the "Regulation 2021/1156 of 13 July 2021 amending Annex II to Regulation (EC) No 1333/2008 of the European Parliament and of the Council and the Annex to Commission Regulation (EU) No 231/2012 as regards steviol glycosides (E 960) and rebaudioside M produced via enzyme modification of steviol glycosides from Stevia."

The key points of the scientific document are summarized herein:

′ The current specifications stipulate glycosides (E 960) to contain no less than 95 % of eleven named steviol glycosides on a dried basis, in any combination and ratio.

′ The manufacturing process of the food additive comprises two main phases: water extraction from the leaves of the Stevia rebaudiana Bertoni plant and preliminary purification of the extract; the second involving recrystallisation of the steviol glycosides.

′ An amendment of the specifications of stevia glycosides (E 960) to include a new method for the production of rebaudioside M was requested.

′ The new process involves the bioconversion of purified stevia leaf extract (≥95% steviol glycosides) through a multistep enzymatic process with enzymes.

′ EFSA concludes existing Acceptable Daily Intake (ADI) of 4 mg/kg BW per day can also be applied to rebaudioside M produced via enzyme modification of Steviol glycosides.

**The current specifications stipulate glycosides (E 960) to contain no less than 95 % of eleven named steviol glycosides on a dried basis, in any combination and ratio.**

′ Rebaudioside M produced by enzyme modification of steviol glycosides, using UDP-glucosyltransferase and sucrose synthase enzymes produced by the genetically modified yeasts would not be of safety concern for the proposed uses and at the same use levels as steviol glycosides (E 960).

The regulation shall enter into force on the twentieth day following its publication in the Official Journal of the European Union.

Read More

Selerant, 19 July 2021

https://resources.selerant.com/food-regulatory-news/eu-amends-food-additives-regulations-steviol-glycosides-e960-and-rebaudioside-m-produced-via-enzyme-modification-of-steviol-glycosides-from-stevia

## EU safety assessment of calcium fructoborate as a novel food

*2021-07-08*

On July 05, 2021, the European Food Safety Authority's scientific opinions of Nutrition, Novel Foods and Food Allergens (NDA) evaluated the "Safety of calcium fructoborate as a novel food (NF) pursuant to Regulation (EU) 2015/2283".

The scope of the scientific assessment is summarized as follows:

′ The Novel food (NF), produced by chemical synthesis, contains a maximum of 2.9% of boron and on average 4.7% calcium and 84.2% fructose.

′ It is intended to be marketed as a food supplement targeting the general adult population, excluding pregnant and lactating women, at a maximum level of 220 mg/day (maximum boron intake of 6.4 mg per day).

′ The combined intake of boron from the background diet and the NF is in the range of 9.6–9.9 mg/day.

′ Range of the acceptable daily intake (ADI) of 0.16 mg/kg bw per day.

′ Under the given conditions of the gastrointestinal (GI) environment, the NF is fully hydrolyzed and boron toxicity was considered relevant for the safety assessment.

**The Novel food (NF), produced by chemical synthesis, contains a maximum of 2.9% of boron and on average 4.7% calcium and 84.2% fructose.**



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′ No concerns related to genotoxicity and toxicological studies.

′ The conclusion was considered appropriate on the NF, calcium fructoborate, is safe under the proposed uses and use levels.

Read More

Selerant, 8 July 2021

https://resources.selerant.com/food-regulatory-news/eu-safety-assessment-of-calcium-fructoborate-as-a-novel-food

## France seeks more protective European definition of nanomaterials

*2021-07-21*

As reported in our May 7, 2021, blog item, the European Commission (EC) recently held a targeted stakeholder consultation to update, test, and verify the preliminary findings of its review of the 2011 Recommendation on the definition of a nanomaterial. According to a July 23, 2021, news item posted by the French Agency for Food, Environmental and Occupational Health and Safety (ANSES), in its response to the consultation, ANSES maintained that the changes proposed by the EC "tend to restrict the number and type of objects that will ultimately be considered as nanomaterials. For example, nanoplastics, as well as certain emulsions and lipid nanoparticles, might not be considered to fall under this definition." ANSES states that the EC's definition "needs to be as comprehensive as possible and define nanomaterials in a unique way based on physico-chemical criteria." Sectoral regulations, such as for cosmetics, biocides, and food, could then clarify which nanomaterials should be subject to specific measures, including product labeling, specific assessment, and authorization, before the nanomaterials are placed on the market. ANSES "also finds it unfortunate that the size thresholds (1-100 nm) used in the current definition were not open to discussion as part of this consultation, as they have no scientific basis." According to the news item, ANSES will publish an opinion by 2022, "with the support of a multidisciplinary group of experts," that provides more information and perspective on its response to the EC.

Read More

Nano and Other Emerging Chemical Technologies Blog, 29 July 2021

https://nanotech.lawbc.com/2021/07/france-seeks-more-protective-european-definition-of-nanomaterials

**."ANSES states that the EC's definition "needs to be as comprehensive as possible and define nanomaterials in a unique way based on physico-chemical criteria."**

# REACH Update

AUG. 06, 2021

## REACH proposals could hit HFC and HFO refrigerants

*2021-07-21*

EUROPE: While Europe continues with the HFC refrigerant phase down, new proposals to be put before the Commission could see further restrictions or even bans on HFCs and HFOs.

On July 15, five European member states – Germany, the Netherlands, Norway, Sweden and Denmark – published their intention to submit a joint restriction proposal under the European REACH regulations for per- and polyfluorinated alkyl substances (PFAS) to the European Chemicals Agency (ECHA) by July 2022.

This proposal includes any substance that has a CF2 group or a CF3 group – properties shared by HFC and HFO refrigerants.

The European REACH (Registration, Evaluation, Authorisation and Restriction of Chemicals) regulation governs which chemicals can be manufactured and used within the EU. Any changes to this regulation would, in practice, override the F-gas regulation.

As first revealed by the *Cooling Post* last year, the restriction is intended to apply to the manufacture, placing on the market and use of all PFAS.

PFAS – perfluoroalkyls and polyfluoroalky – are a group of more than 4,700 chemicals. They are typically used in stain- and water-resistant fabrics and carpeting, cleaning products, paints, non-stick coatings and fire-fighting foams. They are known to be highly persistent in the environment, contaminating groundwater, surface water and soil, and causing serious health effects.

There is a concern in the refrigeration and air conditioning industry that this is a "catch-all" proposal which includes non-hazardous refrigerants vital to an orderly F-gas phase down.

Read More

Cooling Post, 21 July 2021

https://www.coolingpost.com/world-news/reach-proposals-could-hit-hfc-and-hfo-refrigerants/

**This proposal includes any substance that has a CF2 group or a CF3 group – properties shared by HFC and HFO refrigerants.**



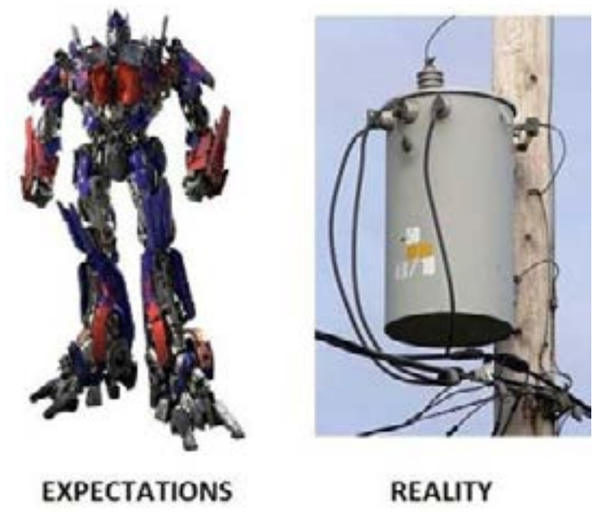


# Janet's Corner

AUG. 06, 2021

## Transformers

*2021-03-05*




http://www.dierk-raabe.com/science-cartoons/

## Cyclohexane

*2021-08-06*

Cyclohexane is a cycloalkane with the molecular formula $C_6H_{12.}$ [1] It is a colourless flammable liquid with a mild, sweet odour resembling that of chloroform or benzene that occurs naturally in crude oil, volcanic gases, and cigarette smoke but is also produced synthetically to be used as a solvent in numerous industries. [2,3]

### USES[4]

This compound is used as a solvent to dissolve cellulose ethers, lacquers, resins, fats, waxes, oils, bitumen and crude rubber. It is also used in perfume manufacturing, during surface coating operations (lacquers), in synthesis of adipic acid for production of nylon 66 and engineering plastics, during synthesis of caprolactam in nylon 6, paint and varnish remover, in the extraction of essential oils, in analytical chemistry for molecular weight determinations, in the manufacturing of adipic acid, benzene, cyclohexyl chloride, nitrocyclohexane, cyclohexanol and cyclohexanone, in the manufacturing of solid fuel for camp stoves, in fungicidal formulations (possesses slight fungicidal action) in the industrial recrystallising of steroids, organic synthesis, recrystallising medium glass substitutes, solid fuels, in analytical chemistry and in manufacturing of adhesives.

### SOURCES OF EMISSION & ROUTES OF EXPOSURE

#### Sources of Emission [4]

- Industry sources: The primary point sources are petroleum refining, automotive repair shops, and commercial printing and publishing.
- Diffuse sources: Sub-threshold facilities.
- Natural sources: Cyclohexane is a natural constituent of crude petroleum. It also occurs naturally as a plant volatile and can be released from volcanoes.
- Transport sources: Cyclohexane has been detected in motor vehicle exhaust.
- Consumer products: Cyclohexane is used as a solvent, oil extractant, paint and varnish remover, and in solid fuels.

**Cyclohexane is a cycloalkane with the molecular formula C6H12.**



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#### Routes of Exposure [2,5]

Exposure to cyclohexane can occur through inhalation, ingestion, and eye or skin contact. Cyclohexane enters the body when breathed in with contaminated air or when consumed with contaminated food or water. It can also be absorbed through skin contact. Cyclohexane is not likely to remain in the body due to its breakdown and removal in exhaled air and in urine.

### HEALTH EFFECTS [5]

The effects of cyclohexane on human health depend on how much of the chemical is present and the length and frequency of exposure. Effects also depend on the health of a person when exposure occurs. Breathing large amounts of cyclohexane for short periods of time adversely affects the human nervous system. Effects range from headaches to anaesthesia, tremors, and convulsions. Contact with cyclohexane liquid or vapour can damage the eyes. These effects are not likely to occur at levels of cyclohexane that are normally found in the environment. Human health effects associated with breathing or otherwise consuming smaller amounts of cyclohexane over long periods of time are not known. Information about cyclohexane's potential to cause cancer, developmental effects, or reproductive effects either does not exist or is not adequate. Studies show that repeat exposure to large amounts of cyclohexane in air causes nervous system effects, eye damage, and respiratory effects in animals. The cyclohexane industry is now studying how its chemical affects the reproductive system and the development of the foetus of animals.

### SAFETY [6]

#### First Aid Measure

- Eye Contact: Check for and remove any contact lenses. Immediately flush eyes with running water for at least 15 minutes, keeping eyelids open. Get medical attention.
- Skin Contact: In case of contact, immediately flush skin with plenty of water. Cover the irritated skin with an emollient. Remove contaminated clothing and shoes. Wash clothing before reuse. Thoroughly clean shoes before reuse. Get medical attention.

- Serious Skin Contact: Wash with a disinfectant soap and cover the contaminated skin with an anti-bacterial cream. Seek medical attention.
- Inhalation: If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical attention.
- Serious Inhalation: Evacuate the victim to a safe area as soon as possible. Loosen tight clothing such as a collar, tie, belt or waistband. If breathing is difficult, administer oxygen. If the victim is not breathing, perform mouth-to-mouth resuscitation. Seek medical attention.
- Ingestion: If swallowed, do NOT induce vomiting. Do NOT induce vomiting unless directed to do so by medical personnel. Never give anything by mouth to an unconscious person. Aspiration hazard if swallowed- can enter lungs and cause damage. Loosen tight clothing such as a collar, tie, belt or waistband. Get medical attention. Get medical attention if symptoms appear.

## Fire & Explosion Information

- Cyclohexane is highly flammable in presence of open flames and sparks, of heat. It is also slightly explosive in presence of open flames and sparks.
- Cyclohexane is insoluble in water. Dry chemical powder should be used to extinguish small fires. For large fires, use water spray or fog.
- Vapour may travel considerable distance to source of ignition and flash back.
- When mixed hot with liquid dinitrogen tetraoxide an explosion can result.

## Exposure Controls & Personal Protection

### Engineering Controls

When handling cyclohexane, exhaust ventilation or other engineering controls should be used to keep the airborne concentrations of vapours below their respective threshold limit value. Ensure that eyewash stations and safety showers are proximal to the work-station location.

### Personal Protective Equipment

The following personal protective equipment should be used when handling cyclohexane:

- Splash goggles
- Lab coat



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- 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 this product.

## REGULATION [2,7]

## Occupational Exposure Limits

United States

- OSHA: The current Occupational Safety and Health Administration (OSHA) permissible exposure limit (PEL) for cyclohexane is 300 ppm (1050 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 (NIOSH) has established a recommended exposure limit (REL) for cyclohexane of 300 ppm (1050 $mg/m^3$) 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 (ACGIH) has assigned cyclohexane a threshold limit value (TLV) of 300 ppm (1030 $mg/m^3$) as a TWA for a normal 8-hour workday and a 40-hour workweek [ACGIH 1994, p. 17].

Australia

- Safe Work Australia: Safe Work Australia has established an 8 hour time weighted average (TWA) for cyclohexane of 350 $mg/m^3$ and a short term exposure limit (STEL) of 1050 $mg/m^3$.

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## The overlooked superpower of mRNA vaccines

*2021-07-28*

Individuals facing the threat of COVID-19 may care most about a vaccine's ability to forestall grave disease that could lead to a hospital bed or worse. And a number of vaccines perform that vital task well, including those from Johnson & Johnson and AstraZeneca, which are based on genetically engineered cold viruses, as well as the not-yet-authorized protein vaccine from Novavax. But for public health experts trying to halt a global pandemic, shutting down even the mildest infections is also crucial, especially as the highly infectious Delta variant surges in scores of countries. By that measure, according to a brace of new studies, the messenger RNA (mRNA) vaccines from the Pfizer-BioNTech collaboration and Moderna stand out.

"All COVID-19 vaccines are not created equal," says Eric Topol, a physician-scientist at the Scripps Research Translational Institute. "It's clear that the two mRNA vaccines are highly effective at preventing infection—and that others wouldn't be expected to break the chain as well."

**"All COVID-19 vaccines are not created equal," says Eric Topol, a physician-scientist at the Scripps Research Translational Institute.**

The large clinical trials that persuaded governments around the world to authorize COVID-19 vaccines mostly looked at their ability to block symptomatic disease and illness severe enough to lead to hospitalization or death. Preventing all infections, including those with no symptoms at all, is "rather a neglected endpoint," says Adeel Butt, an epidemiologist and infectious disease specialist at the Veterans Affairs Pittsburgh Healthcare System. Yet, "It's very, very important … to break the transmission of infection," says Butt, who also works at Weill Cornell Medicine, Qatar.

Last week, Butt and his colleagues published some of the strongest evidence showing the mRNA vaccines can do just that. The researchers compared more than 54,000 veterans who sought SARS-CoV-2 testing and tested positive with an equal number who tested negative, matching each positive and negative case by age, sex, and comorbidities. Using the vaccination status of each participant, they calculated that the Pfizer and Moderna vaccines were, respectively, 96% and 98% effective in preventing SARS-CoV-2 infection, the researchers reported in the Annals of Internal Medicine.

Another study, from Qatar and published in Nature Medicine this month, used a similar approach to show that two Moderna shots were 92.5% effective in preventing asymptomatic infection with any variant circulating at the time. The jabs were also 100% effective against any infection with

the Alpha variant, and 96.4% effective against infection with the Beta variant.

A U.S. study used a different design, testing nearly 4000 front-line workers weekly, regardless of whether they had symptoms. Full vaccination with either Pfizer or Moderna vaccines was 90% effective against any infection, researchers reported in the Morbidity and Mortality Weekly Report. And in a study of more than 23,000 U.K. health care workers tested every 2 weeks, most of whom were vaccinated with the Pfizer jab, vaccination was 85% effective against infection.

These studies were conducted before the spread of the Delta variant, for which real-world data on asymptomatic infection are still lacking. But lab studies are promising, suggesting mRNA vaccines may inhibit asymptomatic Delta infection, too. Last week, separate groups at New York University and Yale University posted preprints analyzing blood serum from people vaccinated with the Pfizer and Moderna vaccines. Antibodies generated by those vaccines lost little of their potency against the Delta variant.

And Topol notes that a large real-world study from the United Kingdom, published last week in The New England Journal of Medicine, found that the Pfizer vaccine outperformed the Astra Zeneca vaccine at preventing symptomatic infection by the Delta variant that has taken over in that country by 21 points, 88% to 67%.

That substantial margin "likely translates to better suppression of transmission, unlike the similarities for the vaccines in reducing hospitalizations and deaths," Topol says.

Many scientists suspect the mRNA vaccines outperform others at preventing infection because of the high levels of virus-blocking antibodies, called neutralizing antibodies (nAbs), that they generate. A striking graph published in Nature Medicine in May showed a tight correlation between the levels of nAbs generated by each of seven major vaccines and their ability to protect against disease in clinical trials. The mRNA vaccines and the two-dose shot by Novavax topped the chart for both levels of nAbs and protectiveness. "Emerging evidence suggests that antibodies are particularly important for blocking infection and preventing onward transmission of the virus," says immunologist Eleanor Riley of the University of Edinburgh.

"The mRNA vaccines are arming the immune system in a way that seems to be better and at higher magnitude than some of the other approaches,"



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although no one is sure why, adds Larry Corey, a vaccinologist at the Fred Hutchinson Cancer Research Center.Some say the mRNA vaccines' performance suggests they should be distributed widely in poorer countries, which so far have mainly relied on AstraZeneca and Russian and Chinese vaccines. "There is something special here," with mRNA vaccines, Corey says. "Let's embrace that and think about turning it into public policy." He urges policymakers to get these "most potent vaccines … to low- and middle-income countries."

But Angela Rasmussen, a virologist at the Vaccine and Infectious Disease Organization at the University of Saskatchewan, doesn't think the poorer parts of the world can count on mRNA vaccines, noting that Pfizer and Moderna apparently prefer to sell to countries that can pay.

Other authorized vaccines are also highly effective against severe disease and death, Rasmussen stresses. "An adenovirus vaccine that works very well is still much better than an mRNA vaccine you will never get access to."

sciencemag.org, 28 July 2021

https://www.sciencemag.org

## Caffeine may help bumblebees pollinate more effectively, study shows

*2021-07-29*

The caffeine in the morning coffee that primes many humans for the day appears to inject bumblebees with a similar dose of purpose, helping them pollinate more effectively, a study has found.

The impact of the climate crisis, habitat loss and pesticide use has strained wild pollinator populations, including bees, moths, wasps, butterflies, beetles and birds. As a result, some fruit growers have resorted to relying on "managed pollinators" such as commercial bumblebee colonies to pollinate their crops.

But these handy helpers aren't quite as efficient as the farmers would like – some do not leave the nest, while others are easily distracted by other flora in the vicinity – which means the crop is not fully tended to.

The study was designed to evaluate whether the bees could be primed to target specific odours.

**The impact of the climate crisis, habitat loss and pesticide use has strained wild pollinator populations, including bees, moths, wasps, butterflies, beetles and birds.**

In order to do this, the researchers concocted a special blend of caffeine, sugar and the specific "target flower" smell (the scent of strawberry flowers) they wanted their bees to find, and wafted it through the nest.

The bees were then let loose in the lab where robotic flowers were either doused in the target odour or the soft, citrusy notes of linalool, a compound not present in strawberry flowers. "We were interested in seeing whether the bees would go for all of the flowers equally since they were all equally rewarded, or whether they go for the flowers that smell like the ones that they been kind of trained on in the nest," said the study author, Dr Sarah Arnold of the natural resources institute at the University of Greenwich.

The bees that had trained using the caffeine concoction were far more interested in the target flowers with the strawberry odour than the distractor flowers, the authors said, adding that the experiment did not appear to be toxic because there was no impact on the bees' lifespans.

The study was funded by the Biotechnology and Biological Sciences Research Council, Biobest (a supplier of bumblebees to fruit farms) and Berry Gardens (a fruit growers' production and marketing group).

Previous research designed to alter bee behaviour involved putting caffeine directly on to the flowers to attract them, which is impractical on a large scale.

This experiment, however, could be a good start to making it easier for farmers to ensure their crop is pollinated, Arnold said. "In a field situation … the bees would have to deal with different weather conditions, they would have further to fly and other challenges," she cautioned, noting that it would take a successful field-scale trial before this approach could be used in the real world.

If the results are replicated, then everyone stands to benefit, she added. "The growers get more value for money out of their commercial bumblebees, the wild bees potentially get a bit less competition for their natural food resources. And, as consumers, hopefully, we also get more fruit."

theguardian.com, 29 July 2021

https://www.theguardian.com



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## Iceland may be the tip of a sunken continent

*2021-07-30*

Iceland may be the last exposed remnant of a nearly Texas-size continent — called Icelandia — that sank beneath the North Atlantic Ocean about 10 million years ago, according to a new theory proposed by an international team of geophysicists and geologists.

The theory goes against long-standing ideas about the formation of Iceland and the North Atlantic, but the researchers say the theory explains both the geological features of the ocean floor and why Earth's crust beneath Iceland is so much thicker than it should be. Outside experts not affiliated with the research told Live Science they are skeptical that Icelandia exists based on the evidence collected so far.

Even so, if geological studies prove the theory, the radical new idea of a sunken continent could have implications for the ownership of any fuels found beneath the seafloor, which under international law belong to a country that can show their continental crust extends that far.PLAY SOUND

"The region that's got continental material underneath, it stretched from Greenland to Scandinavia," said Gillian Foulger, lead author of "Icelandia," a chapter in the new book "In the Footsteps of Warren B. Hamilton: New Ideas in Earth Science" (Geological Society of America, 2021) that describes the new theory. "Some of it in the west and east has now sunk below the surface of the water, but it's still standing higher than it should. … If the sea level dropped 600 meters [2,000 feet], then we would see a lot more land above the surface of the ocean," Foulger, an emeritus professor of geophysics at Durham University in the United Kingdom, told Live Science.

Lost continent

The North Atlantic region was once entirely dry land that made up the supercontinent of Pangaea from about 335 million to 175 million years ago, Foulger said. Geologists have long thought that the basin of the North Atlantic Ocean formed as Pangaea began to break up 200 million years ago and that Iceland formed about 60 million years ago above a volcanic plume near the center of the ocean.

But Foulger and her co-authors suggest a different theory: that oceans began to form roughly south and north — but not west and east — of Iceland as Pangaea broke up. Instead, the geologists wrote, the areas to

**Outside experts not affiliated with the research told Live Science they are skeptical that Icelandia exists based on the evidence collected so far.**

the west and east remained connected to what are now Greenland and Scandinavia.

"People have this highly simplistic idea that a tectonic plate is kind of like a dinner plate: It just splits in two and moves apart," Foulger said. "But it's more like a pizza, or a piece of artwork made from different materials — some fabric here and some ceramic there, so that different parts have different strengths."

According to the new theory, Pangaea didn't split apart cleanly, and the lost continent of Icelandia remained as an unbroken strip of dry land at least 200 miles (300 kilometers) wide that stayed above the waves until about 10 million years ago, Foulger said. Eventually, the eastern and western ends of Icelandia also sank, and only Iceland remained, she said.

The theory would explain why the crustal rocks underneath modern Iceland are about 25 miles (40 km) thick instead of about 5 miles (8 km) thick, which would be expected if Iceland had formed over a volcanic plume, the geologists said.

"When we considered the possibility that this thick crust is continental, our data suddenly all made sense," Foulger said in a statement. "This led us immediately to realize that the continental region was much bigger than Iceland itself — there is a hidden continent right there under the sea."

Continental shelf

Foulger and her colleagues estimated that Icelandia once stretched over more than 230,000 square miles (600,000 square kilometers) of dry land between Greenland and Scandinavia — an area a bit smaller than Texas. (Today, Iceland measures about 40,000 square miles, or 103,000 square km.)

They suggested that there was also a similarly sized adjoining region, making up "Greater Icelandia," to the west of what is now Britain and Ireland. But that region, too, has sunk beneath the waves, they said.

Fossil evidence showed that some plants that spread by dropping seeds are identical in both Greenland and Scandinavia. That finding reinforces the idea that a wide strip of dry land once connected the two regions, the authors said. However, the geologists are not aware of any fossil evidence of animals on the lost continent.

Geographer Philip Steinberg, director of Durham University's Centre for Borders Research, said the new theory of Icelandia could have implications



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for the ownership of fossil fuels beneath the seafloor; under international law, countries can claim those fossil fuels if the evidence proves the resources reside beneath that country's continental shelf — a relatively shallow region of the seafloor that can extend hundreds of miles beyond the coast.

Steinberg, who was not involved in the Icelandia research, noted that countries around the world are spending large amounts of money on geological research that could allow them to claim exclusive mineral rights beneath their continental shelves.

"Research like Professor Foulger's, which forces us to rethink the relationship between seabed and continental geology, can have far-reaching impact for countries trying to determine what area of the seabed are their exclusive preserve," Steinberg said in the statement.

The concept of Icelandia goes against prevailing theories for the formation of the North Atlantic region, and several prominent geologists and geophysicists are critical of the idea.

Ian Dalziel, a geologist at the University of Texas of Austin, who last month won the Penrose Medal for his work on ancient geography and past supercontinents, said he could see little to justify the proposal.

Unlike the sunken continent of Zealandia, for instance, which geologists have established was composed of continental crust that separated from Antarctica and then sank, there was not enough continental crust material in the North Atlantic region to have formed Icelandia, Dalziel told Live Science in an email.

Geophysicists Carmen Gaina, director of the Centre for Earth Evolution and Dynamics in Oslo, and Alexander Minakov of the University of Oslo told Live Science in an email that the proposal was a "bold claim" that had several problems, and that the existence of Icelandia was unlikely.

For instance, magnetic surveys of the seafloor in the region show "stripes" that indicate when successive layers of molten crust were laid down on the seafloor of the North Atlantic as the Earth's magnetic field changed polarity over millions of years — a clear sign of oceanic crust also seen in large oceanic plateaus in the Pacific Ocean, they said.

But "their conceptual view is a good starting point for discussions and more importantly, for more and relevant data collection,"Gaina and Minakov said — such as further geological drilling on the seafloor and

seismic surveys that can measure the crust from its seismic echoes of calibrated explosions carried out by research ships.

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livescience.com, 30 July 2021

https://www.livescience.com

## CRISPR creates first genetically modified marsupials

*2021-07-22*

After years of using the gene-editing technique CRISPR to genetically modify everything from vegetables to lab rodents to humans, researchers have used it to edit one of their hardest targets yet: marsupials, the MIT Technology Review reports. For the past 25 years, researchers have struggled to genetically modify these mammals—which are born prematurely and finish development in their mothers' pouches or bellies—because they have thick shells around their eggs and lack a functional placenta. But researchers at Japan's Riken Institute have finally cracked the code, successfully editing the genes for pigment production in gray short-tailed opossums. Their efforts resulted in a litter of albino opossums (above), researchers reported yesterday in Current Biology. The ability to modify marsupial genes may help biologists better understand the animals and use them to study immune responses, reproductive and developmental traits, and common diseases like melanoma.~ssciencemag.org, 22 July 2021

https://www.sciencemag.org

## Baby born with 'twin' fetus inside her stomach

*2021-07-30*

A baby in Israel was born with her own "twin" inside her stomach — a rare phenomenon known as "fetus in fetu," according to news reports.

Doctors first realized there might be a problem when they performed a late-pregnancy ultrasound on the baby's mother and saw that the baby's stomach was enlarged, according to The Times of Israel.

So when the baby was born, doctors performed a number of tests, including ultrasounds and X-rays, and spotted a partially developed fetus inside the baby's abdomen, The Times of Israel reported. Doctors performed an operation to remove the fetus. Video in 12 seconds

**But researchers at Japan's Riken Institute have finally cracked the code, successfully editing the genes for pigment production in gray short-tailed opossums.**



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The term "fetus in fetu," which literally means "fetus within fetus," is generally defined as a condition in which a developmentally abnormal fetus is found inside the body of its otherwise healthy twin, Live Science previously reported. The condition is extremely rare, occurring in about 1 in 500,000 births, according to a 2010 report on the phenomenon, published in the Journal of Surgical Technique and Case Report.

It is not exactly clear what causes fetus in fetu, but scientists think the fetus is a a rare type of "parasitic twin," according to Arizona State University. Such parasitic twins form when, during an identical-twin pregnancy, one of the fetuses is absorbed by the other early in pregnancy.

"It happens as part of the fetal development process when there are cavities that close during development and one of the embryos enters such a space," Dr. Omer Globus, director of neonatology at Assuta Medical Center in Ashdod, Israel, where the baby was born, told The Times of Israel. "The fetus inside partially develops but does not live and remains there."

Another theory is that fetus in fetu is a kind of teratoma, a type of tumor that can contain all three of the major cell types that are found in an early-stage human embryo, Live Science previously reported. Some researchers say that the presence of a spinal column distinguishes a diagnosis of fetus in fetu from a teratoma, with the latter lacking a spinal column, according to the 2010 paper.

The baby is recovering well from her operation and is now at home with her mother, The Times of Israel reported.

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livescience.com, 30 July 2021

https://www.livescience.com

## A super-short gamma-ray burst defies astronomers' expectations

*2021-08-02*

A surprisingly short gamma-ray burst has astronomers rethinking what triggers these celestial cataclysms.

The Fermi Gamma-ray Space Telescope detected a single-second-long blast of gamma rays, dubbed GRB 200826A, in August 2020. Such fleeting

**That process is typically thought to produce longer GRBs, lasting more than two seconds.**

gamma-ray bursts, or GRBs, are usually thought to originate from neutron star smashups (SN: 10/16/17). But a closer look at the burst revealed that it came from the implosion of a massive star's core.

In this scenario, the core of a star collapses into a compact object, such as a black hole, that powers high-speed particle jets. Those jets punch through the rest of the star and radiate powerful gamma rays before the outer layers of the star explode in a supernova (SN: 5/8/19). That process is typically thought to produce longer GRBs, lasting more than two seconds.

Discovering such a brief gamma-ray burst from a stellar explosion suggests that some bursts previously classified as stellar mergers may actually be from the deaths of massive stars, researchers report online July 26 in two studies in Nature Astronomy.

The first clues about GRB 200826A's origin came from the burst itself. The wavelengths of light and amount of energy released in the burst were more similar to collapse-related GRBs than collision-produced bursts, Bing Zhang, an astrophysicist at the University of Nevada, Las Vegas, and colleagues report. Plus, the burst hailed from the middle of a star-forming galaxy, where astronomers expect to find collapsing massive stars, but not neutron star mergers — which are generally found on the fringes of tranquil galaxies.

Another group, led by astronomer Tomás Ahumada-Mena of the University of Maryland in College Park, searched for the supernova that's expected to follow a GRB produced by a collapsing star. Using the Gemini North Telescope in Hawaii to observe GRB 200826A's host galaxy, the team was able to pick out the telltale infrared light of the supernova. The burst may have been so brief because its jets had just barely punched through the surface of the star before they petered out and the star blew up, Ahumada-Mena says.

sciencenews.org, 2 August 2021

https://www.sciencenews.org

## Male fertility is declining—studies show that environmental toxins could be a reason

*2021-07-30*

In the U.S., nearly 1 in 8 couples struggles with infertility. Unfortunately, physicians like me who specialize in reproductive medicine are unable to determine the cause of male infertility around 30% to 50% of the time.

**What my patients are really asking me is a big question in male reproductive health: Does environmental toxicity contribute to male infertility?**



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There is almost nothing more disheartening than telling a couple "I don't know" or "There's nothing I can do to help."

Upon getting this news, couple after couple asks me questions that all follow a similar line of thinking. "What about his work, his cellphone, our laptops, all these plastics? Do you think they could have contributed to this?"

What my patients are really asking me is a big question in male reproductive health: Does environmental toxicity contribute to male infertility?

Male fertility decline

Infertility is defined as a couple's inability to get pregnant for one year despite regular intercourse. When this is the case, doctors evaluate both partners to determine why.

For men, the cornerstone of the fertility evaluation is semen analysis, and there are a number of ways to assess sperm. Sperm count – the total number of sperm a man produces – and sperm concentration – number of sperm per milliliter of semen – are common measures, but they aren't the best predictors of fertility. A more accurate measure looks at the total motile sperm count, which evaluates the fraction of sperm that are able to swim and move.

A wide range of factors – from obesity to hormonal imbalances to genetic diseases – can affect fertility. For many men, there are treatments that can help. But starting in the 1990s, researchers noticed a concerning trend. Even when controlling for many of the known risk factors, male fertility appeared to have been declining for decades.

In 1992, a study found a global 50% decline in sperm counts in men over the previous 60 years. Multiple studies over subsequent years confirmed that initial finding, including a 2017 paper showing a 50% to 60% decline in sperm concentration between 1973 and 2011 in men from around the world.

These studies, though important, focused on sperm concentration or total sperm count. So in 2019, a team of researchers decided to focus on the more powerful total motile sperm count. They found that the proportion of men with a normal total motile sperm count had declined by approximately 10% over the previous 16 years.

The science is consistent: Men today produce fewer sperm than in the past, and the sperm are less healthy. The question, then, is what could be causing this decline in fertility.

Environmental toxicity and reproduction

Scientists have known for years that, at least in animal models, environmental toxic exposure can alter hormonal balance and throw off reproduction. Researchers can't intentionally expose human patients to harmful compounds and measure outcomes, but we can try to assess associations.

As the downward trend in male fertility emerged, I and other researchers began looking more toward chemicals in the environment for answers. This approach doesn't allow us to definitively establish which chemicals are causing the male fertility decline, but the weight of the evidence is growing.

A lot of this research focuses on endocrine disrupters, molecules that mimic the body's hormones and throw off the fragile hormonal balance of reproduction. These include substances like phthalates – better known as plasticizers – as well as pesticides, herbicides, heavy metals, toxic gases and other synthetic materials.

Plasticizers are found in most plastics – like water bottles and food containers – and exposure is associated with negative impacts on testosterone and semen health. Herbicides and pesticides abound in the food supply and some – specifically those with synthetic organic compounds that include phosphorus – are known to negatively affect fertility.

Air pollution surrounds cities, subjecting residents to particulate matter, sulfur dioxide, nitrogen oxide and other compounds that likely contribute to abnormal sperm quality. Radiation exposure from laptops, cellphones and modems has also been associated with declining sperm counts, impaired sperm motility and abnormal sperm shape. Heavy metals such as cadmium, lead and arsenic are also present in food, water and cosmetics and are also known to harm sperm health.

Endocrine-disrupting compounds and the infertility problems they cause are taking a significant toll on human physical and emotional health. And treating these harms is costly.

The effects of unregulated chemicals



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A lot of chemicals are in use today, and tracking them all is incredibly difficult. More than 80,000 chemicals are registered in the U.S. and nearly 2,000 new chemicals are introduced each year. Many scientists believe that the safety testing for health and environmental risks is not strong enough and that the rapid development and introduction of new chemicals challenges the ability of organizations to test long-term risks to human health.

Current U.S. regulations follow the principle of innocent until proved guilty and are less comprehensive and restrictive than similar regulations in Europe, for example. The World Health Organization recently identified 800 compounds capable of disrupting hormones, only a small fraction of which have been tested.

A trade group, the American Chemistry Council, says on its website that manufacturers "have the regulatory certainty they need to innovate, grow, create jobs and win in the global marketplace – at the same time that public health and the environment benefit from strong risk-based protections."

But the reality of the current regulatory system in the U.S. is that chemicals are introduced with minimal testing and taken off the market only when harm is proved. And that can take decades.

Dr. Niels Skakkebaek, the lead researcher on one of the first manuscripts on decreasing sperm counts, called the male fertility decline a "wake-up call to all of us." My patients have provided a wake–up call for me that increased public awareness and advocacy are important to protect global reproductive health now and in the future. I'm not a toxicologist and can't identify the cause of the infertility trends I'm seeing, but as physician, I am concerned that too much of the burden of proof is falling on the human body and people who become my patients.

This article was updated to more accurately represent the chemical regulatory system in the U.S.

theconversation.com, 30 July 2021

https://www.theconversation.com

**Stranger still, the out-of-place light bursts were smaller, arrived later and had different colors from the flares seen coming from the front of the black hole.**

## Light from behind a black hole spotted for 1st time, proving Einstein right

*2021-07-31*

Astronomers have detected light coming from behind a black hole for the first time, proving Albert Einstein right, yet again.

Researchers were studying the X-rays flaring from a supermassive black hole in the center of the spiral galaxy, Zwicky 1, 800 million light-years away when they discovered the unexpected phenomenon.

Alongside the expected X-ray flashes from the front of the black hole, the scientists also detected a number of "luminous echoes" from an origin they initially couldn't place.

Stranger still, the out-of-place light bursts were smaller, arrived later and had different colors from the flares seen coming from the front of the black hole.

The researchers soon realized that the echoes were arriving from behind the supermassive black hole, which, true to Einstein's theory of general relativity, was warping space-time — enabling the light to travel around the black hole.

"Any light that goes into that black hole doesn't come out, so we shouldn't be able to see anything that's behind the black hole," Dan Wilkins, a research scientist at the Kavli Institute for Particle Astrophysics and Cosmology at Stanford University, said in a statement. "The reason we can see that is because that black hole is warping space, bending light and twisting magnetic fields around itself."

Einstein's theory of general relativity describes how massive objects can warp the fabric of the universe, called space-time. Gravity, Einstein discovered, isn't produced by an unseen force, but is simply our experience of space-time curving and distorting in the presence of matter and energy.

This curved space, in turn, sets the rules for how energy and matter move. Even though light travels in a straight line, light travelling through a highly curved region of space-time, like the space around a black hole, will also travel in a curve — in this instance from its back to its front.

This isn't the first time that astronomers have spotted a black hole distorting light, called gravitational lensing, but it is the first time that they've seen light echoes from the area behind the black hole.



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The astronomers didn't originally intend to confirm Einstein's theory, formulated more than 100 years ago in 1915. Instead, they hoped to use the European Space Agency's XMM-Newton and NASA's NuSTAR space telescopes to peer at the light emitted from the cloud of super-hot particles that forms just outside of the black hole's point of no return, or event horizon.

The super-hot cloud, or corona, wraps around the black hole and gets heated up as it falls in. Temperatures in the corona can reach millions of degrees, according to the researchers, turning the cloud of particles into a magnetized plasma as electrons are ripped from atoms. The spinning of the black hole causes the combined magnetic field of the coronal plasma to arc high above the black hole and eventually snap, releasing X-rays from the corona as a result.

"This magnetic field getting tied up and then snapping close to the black hole heats everything around it and produces these high energy electrons that then go on to produce the X-rays," Wilkins said.

Now that the researchers have made this observation, their next steps will be to study in more detail how light bends around black holes and investigate the ways black hole coronas create such bright X-ray flashes.

The researchers published their findings July 28 in the journal Nature.

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https://www.livescience.com

## People who live to 100 have unique gut bacteria signatures

*2021-07-31*

People who live to age 100 and beyond may have special gut bacteria that help ward off infections, according to a new study from Japan.

The results suggest that these bacteria, and the specific compounds they produce — known as "secondary bile acids" — could contribute to a healthy gut and, in turn, healthy aging.

Still, much more research is needed to know whether these bacteria promote exceptionally long life spans. The current findings, published Thursday (July 29) in the journal Nature, only show an association between

**The community of bacteria and other microorganisms that live in the gut, known as the gut microbiome, is known to play a role in our health and changes as we age.**

these gut bacteria and living past 100; they don't prove that these bacteria caused people to live longer, said study senior author Dr. Kenya Honda, a professor in the Department of Microbiology and Immunology at the Keio University School of Medicine in Tokyo.

"Although it might suggest that these bile-acid-producing bacteria may contribute to longer life spans, we do not have any data showing the cause-and-effect relationship between them," Honda told Live Science.

Gut microbe "signature"

The community of bacteria and other microorganisms that live in the gut, known as the gut microbiome, is known to play a role in our health and changes as we age. For example, having less diversity in the types of gut bacteria has been linked with frailty in older adults. But researchers suspected that people who reach age 100 may have special gut bacteria that contribute to good health. Indeed, centenarians tend to be at lower risk of chronic diseases and infections compared with older adults who don't reach this milestone.

In the new study, the researchers examined the gut microbiota of 160 centenarians, who were, on average, 107 years old. They compared the centenarians' gut microbiota to those of 112 people ages 85 to 89, and 47 people ages 21 to 55.

They found that centenarians had a distinct "signature" of gut microbes not seen in the other two age groups. For example, certain species of bacteria were enriched or depleted in centenarians compared with the other two groups.

The researchers then analyzed gut metabolites (products of metabolism) in all three groups, and found that centenarians had significantly higher levels of so-called secondary bile acids compared with the other two groups.

Bile is the yellow-green fluid that's made by the liver and stored in the gallbladder, according to the National Institutes of Health. Bile acids are compounds in bile that aid in digestion, particularly of fats. After the liver produces bile acids, they are released into the intestine, where bacteria chemically modify them into  secondary bile acids, according to a 2009 paper published in the journal Diabetes Care.

The researchers found particularly high levels of a secondary bile acid called isoallolithocholic acid (isoalloLCA) in the centenarians. The authors didn't know what  metabolic process bacteria used to produce



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isoalloLCA, so they set out to identify the pathway. They screened gut bacterial strains from a 110-year-old who had particularly high levels of secondary bile acids and found that bacteria belonging to a family called Odoribacteraceae produced isoalloLCA.

What's more, isoalloLCA was found to have potent antimicrobial properties, meaning it could inhibit the growth of "bad" bacteria in the gut. In experiments in lab dishes and in mice, the authors found that isoalloLCA slowed the growth of Clostridium difficile, a bacterium that causes severe diarrhea and inflammation of the colon. IsoalloLCA also inhibited the growth of vancomycin-resistant enterococci, a type of antibiotic-resistant bacteria known to cause infections in hospital settings.

The findings suggest that isoalloLCA may contribute to a healthy gut by preventing the growth of bad bacteria.

They also suggest that these bacteria or their bile acids could treat or prevent C. difficile infection in people, Honda said, although more research would be needed to show this.

If these bile-acid-producing bacteria do contribute to a healthy gut, they might one day be used as a probiotic to improve human health, Honda said. He noted that these bacteria appear safe, as they don't produce toxins or harbor antibiotic-resistance genes.

It's unclear how centenarians come to acquire these beneficial bacteria, but both genetics and diet could play a role in shaping the composition of people's gut microbiota, Honda said.

The study did not collect information on participants' diet, exercise habits or medication use, all of which could affect gut microbiota and help to explain the link, the authors said.

Future studies that follow large groups of people over time could further probe the link between these bacteria and longevity.PLAY SOUND

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https://www.livescience.com

**The work could pave the way for a new generation of greener car engines, industrial furnaces, and other energy-generating devices.**

## Cheap material converts heat to electricity

*2021-08-02*

So-called thermoelectric generators turn waste heat into electricity without producing greenhouse gas emissions, providing what seems like a free lunch. But despite helping power the Mars rovers, the high cost of these devices has prevented their widespread use. Now, researchers have found a way to make cheap thermoelectrics that work just as well as the pricey kind. The work could pave the way for a new generation of greener car engines, industrial furnaces, and other energy-generating devices.

"This looks like a very smart way to realize high performance," says Li-Dong Zhao, a materials scientist at Beihang University who was not involved with the work. He notes there are still a few more steps to take before these materials can become high-performing thermoelectric generators. However, he says, "I think this will be used in the not too far future."

Thermoelectrics are semiconductor devices placed on a hot surface, like a gas-powered car engine. That gives them a hot side and a cool side, away from the hot surface. They work by using the heat to push electrical charges from one to the other. If a device allows the hot side to warm up the cool side, the electricity stops flowing. A device's success at preventing this, as well as its ability to conduct electrons, feeds into a score known as the figure of merit, or ZT.

Over the past 2 decades, researchers have produced thermoelectric materials with increasing ZTs. The record came in 2014 when Mercouri Kanatzidis, a materials scientist at Northwestern University, and his colleagues came up with a single crystal of tin selenide with a ZT of 3.1. Yet the material was difficult to make and too fragile to work with. "For practical applications, it's a non-starter," Kanatzidis says.

So, his team decided to make its thermoelectrics from readily available tin and selenium powders that, once processed, make grains of polycrystalline tin selenide instead of the single crystals. The polycrystalline grains are cheap and can be heated and compressed into ingots that are 3 to 5 centimeters long, which can be made into devices. The polycrystalline ingots are also more robust, and Kanatzidis expected the boundaries between the individual grains to slow the passage of heat. But when his team tested the polycrystalline materials, the thermal conductivity shot up, dropping their ZT scores as low as 1.2.

In 2016, the Northwestern team discovered the source of the problem: an ultrathin skin of tin oxide was forming around individual grains of



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polycrystalline tin selenide before they were pressed into ingots. And that skin acted as an express lane for the heat to travel from grain to grain through the material. So, in their current study, Kanatzidis and his colleagues came up with a way to use heat to drive any oxygen away from the powdery precursors, leaving pristine polycrystalline tin selenide.

The result, which they report today in Nature Materials, was not only a thermal conductivity below that of single-crystal tin selenide but also a ZT of 3.1. "This opens the door for new devices to be built from polycrystalline tin selenide pellets and their applications to be explored," Kanatzidis says.

Getting through that door will still take some time. The polycrystalline tin selenide the team makes is spiked with sodium atoms, creating what is known as a "p-type" material that conducts positive charges. To make working devices, researchers also need an "n-type" version to conduct negative charges.

Zhao's team recently reported making an n-type single-crystal tin selenide by spiking it with bromine atoms. And Kanatzidis says his team is now working on making an n-type polycrystalline version. Once n-type and p-type tin selenide devices are paired, researchers should have a clear path to making a new generation of ultra-efficient thermoelectric generators. Those could be installed everywhere from automobile exhaust pipes to water heaters and industrial furnaces to scavenge some of the 65% of fossil fuel energy that winds up as waste heat.

sciencemag.org, 2 August 2021

https://www.sciencemag.org

## DO these fossilized structures belong to Earth's first animals?

*2021-08-28*

Tiny, wormlike structures embedded within a fossilized Canadian reef may have been formed by the skeletons of ancient sea sponges some 890 million years ago, a controversial study argues. If the claim bears out, the structures would represent the oldest animal fossils yet found. The results would also suggest animals thrived even before a massive surge in Earth's oxygen levels that began about 800 million year ago—an event thought by many to have catalyzed the evolution of animal life. But other scientists say the paper doesn't do enough to single out sponges as the source of the fossils.

The findings are intriguing and plausible, says Gert Wörheide, a geobiologist at Ludwig Maximilian University of Munich whose own genetics work predicts that sponges could have arisen this early. Still, he's not convinced the fossils are truly sponges. "I'd prefer if there was a separate line of evidence."

Elizabeth Turner, the study's sole author and a geologist at Laurentian University, first discovered the fossils as a graduate student in the '90s, when working in a remote part of the rugged Mackenzie Mountains that separate the Yukon and the Northwest Territory. The ancient reef, which was formed by photosynthetic bacteria known as cyanobacteria, has been dated using a number of geological methods to be about 890 million years old. There are no roads near the site; to collect samples, Turner had to helicopter in and engage in a bit of "sketchy" mountaineering, she says.

Initially, her research focused on the reef itself. She ground down fist-size chunks of rock into sections 30 microns thin, then analyzed their contents under a microscope. Some samples contained tiny, branching structures that appeared to her to be too complex to have been made by microbes; they also resembled structures she'd seen in much younger reefs. But neither she nor her colleagues could figure out what they were. Turner finished her doctorate and moved onto other research projects, but she never forgot the mysterious branching pattern.

In the ensuing decades, other researchers pinned down the process by which "horny sponges"—still used today as bath scrubbers—leave behind a branching pattern of the chalky mineral calcite that gradually replaces the sponge's fibrous skeleton. The pattern looks identical to the structures

**But other scientists say the paper doesn't do enough to single out sponges as the source of the fossils.**



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Turner found in her ancient reef almost 20 years ago, she says. "This is a paean to slow science."

The cyanobacteria that built the reef don't make such complex patterns, Turner says. And the angles of the microscopic structures don't match anything known to be produced by algae or fungi. What's more, scientists like Wörheide have suggested sponges could have arisen perhaps 1 billion years ago. This is based on estimating how long it would take for modern sponge lineages to evolve—though these estimates are not universally accepted.

For these reasons, the samples may contain the fossilized remains of 890-million-old sponges, Turner argues today in Nature. That would make them about 350 million years older than the previous oldest known animal fossil—a flat, saucer-shaped creature known as Dickinsonia that lived on the sea floor almost 600 million years ago.

Turner is careful to call her fossils "putative sponges," as she is aware that such a bold claim will invite skepticism. The planet 890 million years ago only had a fraction of the oxygen it has today. Many scientists believe it wasn't until the so-called called Neoproterozoic oxygenation event between 800 million and 540 million years ago that animal life became possible.

Yet even before this event, reef-building cyanobacteria would have created an "oxygen oasis" for marine life forms, Turner argues. "Sponges could have evolved and trucked along for a few hundred million years doing nothing in particular evolutionarily," she says, until a boom in oxygen levels sparked an evolutionary explosion.

Jonathan Antcliffe, a geologist and paleobiologist at the University of Lausanne, doesn't buy it. "She's found some wiggles in a rock, performed a Rorschach inkblot test on them, and said, 'They sort of vaguely remind me of a sponge,'" he says. "Pretty much every major group of life can produce wiggly little structures."

Still, Allison Daley, a paleontologist at the University of Lausanne, says Turner's work merits further investigation. "It's important to understand these ancient ecosystems, including the structures described in this paper, whether or not they are sponges."

sciencemag.org, 28 July 2021

https://www.sciencemag.org

## How some lizards breathe underwater

*2021-08-27*

Some anole lizards have a newfound superpower: They can breathe underwater by trapping air in a bubble on their snouts. What's more, these reptiles can stay submerged for nearly 20 minutes by rebreathing exhaled air in the bubble, a new study shows.

"As anyone who has encountered one of these lizards can tell you, they dive underwater when they feel threatened," says evolutionary biologist Chris Boccia of Queen's University in Kingston, Canada. But how the lizards stay underwater for so long had been a mystery until now.

Boccia was inspired to investigate by a story one of his professors told him when he was a student at the University of Toronto. In 2009, evolutionary biologist Luke Mahler had been studying an endangered species of Anolis lizard in Haiti. After releasing a lizard back into a clear, shallow stream, Mahler noticed something odd. As the animal clung to the rocky bottom, it exhaled an air bubble on its snout and appeared to repeatedly suck the air in and out of the bubble. Mahler had to move on to his next research site so he couldn't explore more. But years later, he still remembered the bubble-headed lizard.

Boccia and colleagues traveled to Costa Rica in 2017 in search of bubble-headed anoles, capturing the creatures at night. "Doing this when they're sleeping makes things less stressful for them," Boccia says. It's also "easier for us to catch them."

Wearing head lamps to find the lizards in the dark, the researchers collected 300 anoles representing a range of species — 120 lizards were found near streams and 180 were found away from streams. Back at their camp, Boccia and colleagues gently dunked each lizard in containers of river water.

While underwater, all of the anoles carried a bubble of air around their snouts and appeared to breathe the bubble in and out. But river-based lizards rebreathed more often and stayed submerged longer than their land-based relatives, Boccia, Mahler and colleagues report in the July 12 Current Biology.

"One lizard was underwater for 18 minutes," Boccia says. "We were starting to get worried about him."

Anoles' water-repelling skin might play a role in forming the bubbles. As the reptile dives into the water, a thin layer of air may get trapped against

**But how the lizards stay underwater for so long had been a mystery until now.**



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that skin. When the lizard exhales, air exits through the nostrils and expands the trapped air layer. In that way, the lizard might use its lungs to control the bubble's size.

If a lizard rebreathed the air in those bubbles, then the bubbles' oxygen levels should drop over time. Inserting a small oxygen sensor into bubbles around submerged lizards' snouts confirmed that the oxygen levels slowly dropped as the lizards breathed.

To stay submerged for long periods, the anoles may slow down their metabolism, reducing the need for oxygen, Boccia suspects. And as oxygen levels in the bubble drop and CO2 levels rise, the bubble may rebalance the levels by shedding CO2 into the water and uptaking dissolved oxygen, he says.

The findings highlight how different animals have evolved to live in water, says evolutionary biologist Jonathan Losos of Washington University in St. Louis who wasn't involved in the research. "Species that experience the same challenge in nature often find different ways to overcome it," Losos says. "Fish use gills to extract oxygen from the water. Whales are able to hold their breath for a long time. And now we know that these lizards take oxygen underwater with them."

Both Boccia and Mahler hope to continue studying this newfound behavior. "There are so many different types of lizards, there is a good chance that others do it too," Boccia says. "We just haven't seen it."

sciencenews.org, 27 July 2021

https://www.sciencenews.org

## How do scientists calculate the age of a star?

*2021-07-23*

We know quite a lot about stars. After centuries of pointing telescopes at the night sky, astronomers and amateurs alike can figure out key attributes of any star, like its mass or its composition.

To calculate a star's mass, just look it its orbital period and do a bit of algebra. To determine what it's made of, look to the spectrum of light the star emits. But the one variable scientists haven't quite cracked yet is time.

"The sun is the only star we know the age of," says astronomer David Soderblom of the Space Telescope Science Institute in Baltimore. "Everything else is bootstrapped up from there."

**"The sun is the only star we know the age of," says astronomer David Soderblom of the Space Telescope Science Institute in Baltimore.**

Even well-studied stars surprise scientists every now and then. In 2019 when the red supergiant star Betelgeuse dimmed, astronomers weren't sure if it was just going through a phase or if a supernova explosion was imminent. (Turns out it was just a phase.) The sun also shook things up when scientists noticed that it wasn't behaving like other middle-aged stars. It's not as magnetically active compared with other stars of the same age and mass. That suggests that astronomers might not fully understand the timeline of middle age.

Calculations based on physics and indirect measurements of a star's age can give astronomers ballpark estimates. And some methods work better for different types of stars. Here are three ways astronomers calculate the age of a star.

Hertzsprung-Russell diagrams

Scientists do have a pretty good handle on how stars are born, how they live and how they die. For instance, stars burn through their hydrogen fuel, puff up and eventually expel their gases into space, whether with a bang or a whimper. But when exactly each stage of a star's life cycle happens is where things get complicated. Depending on their mass, certain stars hit those points after a different number of years. More massive stars die young, while less massive stars can burn for billions of years.

At the turn of the 20th century, two astronomers — Ejnar Hertzsprung and Henry Norris Russell — independently came up with the idea to plot stars' temperature against their brightness. The patterns on these Hertzsprung-Russell, or H-R, diagrams corresponded to where different stars were in that life cycle. Today, scientists use these patterns to determine the age of star clusters, whose stars are thought to have all formed at the same time.

The caveat is that, unless you do a lot of math and modeling, this method can be used only for stars in clusters, or by comparing a single star's color and brightness with theoretical H-R diagrams. "It's not very precise," says astronomer Travis Metcalfe of the Space Science Institute in Boulder, Colo. "Nevertheless, it's the best thing we've got."

Measuring a star's age isn't as easy as you'd think. Here's how scientists get their ballpark estimates.

Rotation rate

By the 1970s, astrophysicists had noticed a trend: Stars in younger clusters spin faster than stars in older clusters. In 1972, astronomer Andrew



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Skumanich used a star's rotation rate and surface activity to propose a simple equation to estimate a star's age: Rotation rate = (Age) -½.

This was the go-to method for individual stars for decades, but new data have poked holes in its utility. It turns out that some stars don't slow down when they hit a certain age. Instead they keep the same rotation speed for the rest of their lives.

"Rotation is the best thing to use for stars younger than the sun," Metcalfe says. For stars older than the sun, other methods are better.

Stellar seismology

The new data that confirmed rotation rate wasn't the best way to estimate an individual star's age came from an unlikely source: the exoplanet-hunting Kepler space telescope. Not just a boon for exoplanet research, Kepler pushed stellar seismology to the forefront by simply staring at the same stars for a really long time.

Watching a star flicker can give clues to its age. Scientists look at changes in a star's brightness as an indicator of what's happening beneath the surface and, through modeling, roughly calculate the star's age. To do this, one needs a really big dataset on the star's brightness — which the Kepler telescope could provide.

"Everybody thinks it was all about finding planets, which was true," Soderblom says. "But I like to say that the Kepler mission was a stealth stellar physics mission."

This approach helped reveal the sun's magnetic midlife crisis and recently provided some clues about the evolution of the Milky Way. Around 10 billion years ago, our galaxy collided with a dwarf galaxy. Scientists have found that stars left behind by that dwarf galaxy are younger or about the same age as stars original to the Milky Way. Thus, the Milky Way may have evolved more quickly than previously thought.

As space telescopes like NASA's TESS and the European Space Agency's CHEOPS survey new patches of sky, astrophysicists will be able to learn more about the stellar life cycle and come up with new estimates for more stars.

Aside from curiosity about the stars in our own backyard, star ages have implications beyond our solar system, from planet formation to galaxy evolution — and even the search for extraterrestrial life.

"One of these days — it'll probably be a while — somebody's going to claim they see signs of life on a planet around another star. The first question people will ask is, 'How old is that star?'" Soderblom says. "That's going to be a tough question to answer."

sciencenews.org, 23 July 2021

https://www.sciencenews.org

## How scientists turned daddy longlegs into 'daddy shortlegs'

*2021-08-03*

If there's one defining trait of daddy longlegs, it has to be their legs. Now, scientists have shortened the legs of one species—and turned them into food-handling limbs—by tweaking the arachnids' DNA expression.

To figure out which genes cause these spider relatives to develop long legs, researchers assembled the first draft genome of Phalangium opilio and looked at three genes that act as a blueprint for where various body parts should go. When they traced the activity of two of those genes, they found they were turned on in the legs of embryos under a microscope. Next, they used RNA interference—a technique that reduces gene expression—to knock them down in hundreds of developing P. opilio embryos. When they did so, they saw that in the surviving hatchlings, six of eight legs were about half their normal size, they report today in the Proceedings of the Royal Society B: Biological Sciences. What's more, they had transformed into short pedipalps, a type of limb for food handling.

**What's more, they had transformed into short pedipalps, a type of limb for food handling.**

When the researchers knocked down a third developmental gene, thought to help build embryonic legs, the limbs didn't turn into pedipalps, but they did get shorter. They also lost their tarsomeres, a set of about 100 knuckle-like joints that can wrap around sticks like a monkey's tail. Similar transformations have been seen in fruit flies, which may give scientists a clue to figuring out how P. opilio's legs may have evolved.

sciencemag.org, 3 August 2021

https://www.sciencemag.org



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## What's the true cost of shipping all your junk across the ocean?

*2021-07-27*

Take a look around your home and you'll likely find plenty of goods that traveled by cargo ship to your doorstep. A set of IKEA plates made in China. A dresser full of pandemic-era loungewear, ordered on Target and made in Guatemala, Sri Lanka, and Vietnam. Tracing the impact on the environment from shipping any of these goods is incredibly tricky to do. The data — if you can find it — involves many companies, countries, and cargo carriers.

Such obscurity makes it hard to count the full cost of our consumption. But a recent report helps unravel some of the mystery.

Two environmental groups, Pacific Environment and Stand.earth, worked with prominent maritime researchers to track goods imported by the 15 largest retail giants in the United States. They then quantified the greenhouse gas emissions and air pollutants associated with those imports, usually ferried across the oceans on cargo ships running on dirty bunker fuel. In 2019, importing some 3.8 million shipping containers' worth of cargo generated as much carbon dioxide emissions as three coal-fired power plants. These shipments also produced as much smog-forming nitrous oxide as 27.4 million cars and trucks do in a year, according to the report.

"Our report affirms that these retail giants' dirty ocean shipping is fueling the climate crisis," said Madeline Rose, climate campaign director for Pacific Environment and the study's lead author.

The study is the first to trace retailers' shipping-related emissions, and it used data from a separate, larger project to track the industry's emissions that's set to launch in October. The findings are likely just a snapshot of the true environmental toll: Researchers said they could only verify emissions for one-fifth of shipments by the 15 retailers, owing to a lack of data and the companies' use of shell companies and franchises.

The largest retail company in the United States, Walmart, was also the biggest polluter of the bunch. In 2019, Walmart imported enough goods to equal 893,000 shipping containers, resulting in some 3.7 million metric tons of carbon dioxide emissions.

Maritime shipping is a crucial part of the global economy. About 80 percent of everything bought and sold travels on oil-burning, seafaring

freighters at some point. All that shipping activity accounts for nearly 3 percent of the world's annual greenhouse gas emissions, as well as a significant share of air pollution in coastal communities. The International Maritime Organization, which regulates the industry, has recently adopted measures to curb cargo ship emissions and reduce fuel consumption. But experts say stronger regulations and bigger investments are needed to steer the industry away from fossil fuels and toward cleaner technologies, such as hydrogen fuel cells, batteries, and wind-harnessing devices.

Another way to spur companies to action is through accounting — figuring out how many emissions are produced by which activity, from which company, at which location. In the world of ocean freight, a shipment of cargo can pass through many hands and even owners between the time it leaves a factory and reaches a warehouse on the other side of the planet. The goal of the new research, Rose said, is "to bring baseline environmental and public health accounting oversight to this incredibly murky issue."

For the report, the environmental groups commissioned University Maritime Advisory Services, or UMAS, a well-regarded research consultancy in London. UMAS has developed a proprietary tool for estimating fuel consumption and emissions from individual ships and is also a partner in the SEA-CASE project at the Stockholm Environment Institute. That initiative has gathered billions of records on vessel movements, detailed shipment lists, import and export data, and other information from big economies like the United States, Brazil, and China.

"Once you combine all of that data, it's a very powerful thing," said Javier Godar, a senior research fellow at the Stockholm Environment Institute, who was not directly involved in writing the July report. "You can really start looking at responsibility for those emissions."

After Walmart, the next top polluter in the report was Ashley Furniture, which imported 270,000 containers and generated over 2.2 million metric tons of CO2. Next up was Target, with some 600,000 containers and over 2 million metric tons of CO2. Researchers could only track some 123,000 container imports for Amazon, a company whose 2019 revenues topped $280 billion. Those imports were responsible for more than 390,000 metric tons of emissions.

Representatives from Walmart and Amazon didn't comment directly on the study but provided information on their companies' efforts to curb emissions from their supply chains. In response to a request for comment, a Target spokesperson said the company is committed to "reducing our



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shipping carbon footprint," as it works toward becoming a "net zero enterprise" in its operations and supply chain by 2040.

A spokesperson from IKEA, which came in seventh place for CO2 output, said addressing emissions from cargo ships is "a significant topic" for the Swedish furniture giant. Ocean shipping accounts for about 40 percent of IKEA's total carbon emissions from transportation. The spokesperson said the company is working to reduce its carbon footprint from every shipment by 70 percent on average by 2030. To that end, IKEA participated in a 2019 pilot project to test biofuels in an ocean-going container ship.

Researchers who worked on the retail-focused report said it took them months to scour and analyze data. And it's taken years to develop the statistical models and build the database that underpin the recent findings.

Godar said his ship tracking efforts began in 2014 with the launch of Trase, an online database that follows the flow of agricultural commodities that are driving deforestation in tropical countries. A United Nations report might show the total amount of soy shipped from Brazil. With Trase, however, the idea is to discern whether that soy came from, say, illegal logging in the Amazon rainforest or a legal farm elsewhere, and then follow that to the final customer.

Researchers are increasingly able to access such valuable information as more companies keep records in digital form, Godar said, and as the ability to "scrape" data from the internet improves. Still, there are limits. Most data isn't publicly available, and it's expensive for researchers to buy. Godar hasn't been able to get a hold of shipping-related data from the European Union and other countries, which leaves an informational black hole.

A beta version of the SEA-CASE platform will launch this fall and be free for anyone to access. A preview over Zoom showed a flurry of yellow lines connecting continents, each one revealing a detailed breakdown of a particular voyage in 2019. A casual user could, for example, trace coffee imports by Starbucks into the United States, then see the carbon emissions associated with the shipments.

Ultimately, this kind of information could help consumers push retailers to cut carbon emissions from their suppliers, said Gary Cook, the global climate campaigns director for Stand.earth. Cook previously led Greenpeace campaigns challenging tech giants like Facebook and Apple to stop powering their data centers with coal-fired electricity and replace it with renewable energy.

"Companies can move very fast when motivated," he said. "It's to their advantage to show their loyal customers they care about the climate and are taking action."

grist.org, 27 July 2021

https://www.grist.org

## The best place to ride out a global societal collapse is New Zealand, study finds

*2021-07-29*

If the skies were to darken, seas swell and economies crumble, where would be the best place to ride out global civilizational collapse?

In the southwestern Pacific, in a country with some six times as many sheep as people, according to a recent study.

New Zealand could be one of the last places standing.

Released this month in the journal Sustainability by researchers at Britain's Anglia Ruskin University, the study aimed to build understanding of which destinations could survive independently in the face of a global disaster caused by the likes of climate change, a pandemic, a financial collapse or other cataclysmic disruptions.

Or, as the paper puts it, which destinations could survive as "nodes of persisting complexity" in the face of a period of rapid, uncontrolled and worldwide "de-complexification."

Islands in temperate regions and with low population densities generally came out on top. Destinations were ranked on a variety of factors, including land area per capita, distance from other population centers and potential for renewable energy and agriculture.

Other potential "nodes" include Iceland, Tasmania and Ireland, the study found, and the researchers said they were surprised by a relatively strong showing from Britain. However, New Zealand was found to have the most "potential."

Though New Zealand's economy is highly globalized and the country currently relies on imports, it has "abundant" energy resources and agricultural land, the study found.

The research adds a new layer of academic validation to a trend that is already in place. In its coverage of the findings, the NZ Herald reported

**New Zealand could be one of the last places standing.**



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that many locals found the result "no surprise, with billionaires reported to be buying land for bunkers in New Zealand in preparation for an apocalypse," although some have questioned the true extent of that trend.

New Zealand, an island nation of fewer than 5 million residents, has earned plaudits for its successful handling of the coronavirus pandemic.

Auckland, the largest city in the country, topped a global livability index released by the Economist Intelligence Unit in June. New Zealand was also ranked as the top country to ride out the pandemic in a 2020 ranking by Bloomberg News.

But even before the pandemic, New Zealand had a reputation as an escape route for foreigners — at least the wealthy ones.

A 2019 documentary called "Hunt for the Bunker People" saw Vice News' Baz Macdonald go searching for underground hideouts in the city of Queenstown that had reportedly been purchased by wealthy one percenters.

Two years before that, there was a political scandal after controversial Silicon Valley venture capitalist Peter Thiel was granted New Zealand citizenship after only four visits to the country. The Facebook investor bought a 193-hectare estate on the shores of Lake Wanaka in 2015, though local residents told CNBC last year that the land was neglected and forlorn.

Speaking to the Guardian, one of the authors of the "nodes" study said, "We need to start thinking about resilience much more in global planning."

"But obviously, the ideal thing is that a quick collapse doesn't happen," Aled Jones of Anglia Ruskin University also told the newspaper.

washingtonpost.com, 29 July 2021

https://www.washingtonpost.com

## Beat-up duck-billed dinosaur had cracked tailbones and 'cauliflower' tumor. But it just wouldn't die.

*2021-07-31*

A dinosaur that lived about 70 million years ago suffered from fractured tailbones and a "cauliflower-like" foot tumor, a new fossil analysis shows.

But despite these painful maladies, the dinosaur survived for some time after it was hurt.

**But despite these painful maladies, the dinosaur survived for some time after it was hurt.**

When late paleontologist Jaime Eduardo Powell discovered the skeleton in Argentina's Río Negro Province in the 1980s, he observed that one of the feet was injured, and he described the injury as a possible fracture. However, when researchers recently reexamined the fossil, they found that the foot deformity was instead caused by a large, possibly cancerous tumor.PLAY SOUND

Using computed X-ray tomography (CT) scans and microscopic analysis of bone samples, the researchers also identified fractures in two vertebrae in the middle of the dinosaur's tail, and there were erosions in the bone around the fractures that may have been caused by infections. As the fractures were partially healed, they likely weren't directly responsible for the dinosaur's death, scientists reported in a new study, published in the August 2021 issue of the journal Cretaceous Research.

"We cannot quantify how long it lived afterwards, which means that it could have lived for months or years," lead study author Penélope Cruzado-Caballero, a scientist in the Research Institute of Paleobiology and Geology for Argentina's National Scientific and Technical Research Council (CONICET), said in a statement.

Who was this beat-up dinosaur? Bonapartesaurus rionegrensis was a 30-foot-long (9-meters) hadrosaur — plant-eating dinosaurs known for their broad, ducklike mouths. Hadrosaurs were large and mostly bipedal ornithischians, or bird-hipped dinosaurs, that lived during the latter part of the Cretaceous period (about 145.5 million to 65.5 million years ago) in the Americas, Asia and Europe.

Some hadrosaur species sported ornate crests on their skulls, which may have been used for communication. Paleontologists don't know if Bonapartesaurus had a crest (the skeleton was missing its skull), but what attracted their attention was the dinosaur's left hind limb, where a large, bony overgrowth gave the foot "a cauliflower-like appearance," Cruzado-Caballero said in the statement.

The study authors found no fracture when they examined the bulging bone lump, but CT scans showed reduced bone density and ravaged bone tissue in surrounding areas, suggesting that the lump was a tumor. Dinosaurs in this group walked with most of their weight on their toes, and they had a high foot pad. This pad could have cushioned Bonapartesaurus' foot, and the injury — as dire as it appeared — might not have caused a limp, the researchers reported.



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Their scans also revealed a first hint of cracks in two tail bones and subsequent infections in the surrounding bone. Fractures such as these could have happened because the hadrosaur was trampled, struck by an object, attacked by a predator, "or simply due to running stress," the scientists wrote in the study. "These are all good hypotheses, but we cannot determine which one is more likely."

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livescience.com, 31 July 2021

https://www.livescience.com

## Real-life SpongeBob and Patrick found side by side on seafloor. But they likely don't get along.

*2021-08-02*

Real-life versions of cartoon best friends SpongeBob Squarepants and Patrick Star were sitting side by side at the bottom of the sea when marine researchers spotted them.

Controlling a remotely operated vehicle, the scientists discovered the square(ish) yellow sponge and five-pointed pink sea star at the Retriever Seamount off the coast of New England on July 27, at a depth of 6,184 feet (1,885 meters). The researchers, from the National Oceanic and Atmospheric Administration (NOAA), were exploring the seamount as part of the expedition Atlantic Stepping Stones onboard the ship Okeanos Explorer. NOAA shared images of the peculiar pair as part of a Facebook livestream.

**NOAA shared images of the peculiar pair as part of a Facebook livestream.**

When Christopher Mah, a marine biologist at Smithsonian's National Museum of Natural History and an expert on sea stars, saw the images, he immediately noticed the resemblance with Nickelodeon's cartoon characters. "I normally avoid these [references], but wow. Real-life SpongeBob and Patrick," Mah wrote on Twitter alongside a screengrab of the sponge and sea star.PLAY SOUND

The comparison to Bikini Bottom's dynamic duo was made "as soon as I saw them on video," Mah told Live Science.

The official SpongeBob Squarepants Instagram account also joined in on the fun and shared an image of the real-life creatures alongside their cartoon counterparts.

"The sponge is [in] the genus Hertwigia and the sea star is [in] the genus Chondraster," Mah said. The exact species is unclear, and they could even be brand new to science, he added.

The photo is particularly interesting to scientists because it is rare to find bright-yellow sponges at this depth. Most deep-sea sponges are white or other neutral colors, which helps them blend in with their surroundings, according to Smithsonian Magazine.

Unfortunately, the comparisons with the cartoon characters end with appearances, because in real life the two creatures are far from friends. "This species of starfish has been observed feeding on sponges," Mah said. And it is possible that this may have happened after the camera stopped rolling, he added.

SpongeBob Squarepants was created by animator and marine scientist Stephen Hillenburg to help educate children about marine life. The TV show debuted in 1999 and is still going strong today.

"I'm happy that the photo has brought delight to so many people," Mah said. "I hope it also brings awareness to the deep sea as a habitat, which has been threatened by mining and deep-sea fishing."

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## What does the edge of the solar system look like?

*2021-07-02*

Earth is the sixth planet from the edge of the solar system, meaning we're none too near this cold and inhospitable frontier. But we've sent out various spacecraft over the years, so do we have any idea what the edge of the solar system looks like?

The answer is yes, but it's a work in progress. One of the latest developments, a 3D map of the solar system's edge that took 13 years to create, revealed a few more secrets about this mysterious boundary, called the outer heliosphere.

The outer heliosphere marks the region of space where the solar wind, or the stream of charged particles emitted from the sun, is "deflected and draped back" by the interstellar radiation that permeates the empty space beyond the solar system, said Dan Reisenfeld, a space science researcher

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at Los Alamos National Laboratory in New Mexico and head of the team that conducted the research on the 3D map. In other words, solar wind and interstellar particles meet and form a boundary at the far reaches of the solar system.

PLAY SOUND

Earthlings first got a glimpse of the solar system's outer edge in 2012, when Voyager I, a NASA spacecraft that launched in 1977, crossed into interstellar space, according to NASA. Voyager 2 was not far behind, repeating the feat in 2018. Equipped with golden records full of Bach, Louis Armstrong and humpback whale songs, in addition to their scientific instruments, Voyagers 1 and 2 reported a sudden dropoff in solar particles and a substantial increase in galactic radiation when they left the solar system, according to NASA's Jet Propulsion Laboratory at the California Institute of Technology.

The new 3D map reveals even more about the heliosphere. The inner layer — where the sun and its planets are nestled — is roughly spherical and is thought to extend roughly 90 astronomical units (AU) in all directions. (One AU is the average distance between Earth and the sun, about 93 million miles, or 150 million kilometers.) The outer layer is much less symmetrical. In one direction — that in which the ever-moving sun plows through the space in front of it, encountering cosmic radiation — the outer heliosphere extends about 110 AU, but in the opposite direction, it's much longer, at least 350 AU, according to Reisenfeld.

That lack of symmetry comes from the sun's movement through the Milky Way, as it experiences friction with the galactic radiation in front of it and clears out a space in its wake. "There's a lot of plasma [charged particles] in the interstellar medium, and… the inner heliosphere, which is pretty round, is an obstacle in this stream of plasma which is flowing past it," Reisenfeld told Live Science. "It has the same effect as water going around a rock in a stream," with a rush of water crashing into the rock in front and a sheltered calm behind it.

Measurements for the 3D map were gathered using the Interstellar Boundary Explorer (IBEX), which was launched in 2008 and is "the size of a bus tire," according to NASA. It's pronounced "like the animal," Reisenfeld said, referring to the ibex mountain goats known for their gravity-defying treks up alpine cliffs. But the animal that IBEX really takes after is the bat.

Many bats hunt insects, such as mosquitoes, by emitting a pulse of sound and using the time delay of the echo to figure out the distance to their

prey. Likewise, IBEX detects solar-wind particles that have bounced back from the edges of the solar system, allowing Reisenfeld and his colleagues to determine the distances involved by measuring how long their round trip took. "The sun will send out a pulse … and then we passively wait for a return signal from the outer heliosphere, and we use that time delay to determine where the outer heliosphere must be," Reisenfeld explained.

As the sun circles the outer rim of the Milky Way, the solar wind keeps cosmic radiation at bay, forming a protective bubble. This is good for us, since "that radiation can damage spacecraft and it can be a health hazard for astronauts," Reisenfeld said.

However, the boundaries may not stay this way in the long term. Reisenfeld noted that there is a correlation between the strength of the solar wind and the number of spots on the sun. A sunspot is a relatively dark patch that temporarily appears on the surface of the sun as a result of intense magnetic disturbances within. From 1645 to 1715, a period known to sun watchers as the Maunder minimum, there were very few sunspots, and thus there may have been only weak solar winds.

"The sunspots disappeared for almost a century, and if that happens, the shape of the heliosphere could have also changed significantly," Reisenfeld said. "We do see variations in solar activity, and at any time, another Maunder minimum could happen. It's not a pie-in-the-sky concern to be worried that the [heliosphere's] effectiveness at shielding could change over time."

To learn more about the heliosphere, NASA plans to launch a new mission called the Interstellar Mapping and Acceleration Probe (IMAP) in 2025. If all goes according to plan, IMAP will reveal further details about interactions between solar winds and cosmic radiation at the solar system's edge.

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## What's the hottest temperature the human body can endure?

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With climate change causing temperatures to rise across the globe, extreme heat is becoming more and more of a health threat. The human

**So what is the highest temperature people can endure?**



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body is resilient, but it can only handle so much. So what is the highest temperature people can endure?

The answer is straightforward: a wet-bulb temperature of 95 degrees Fahrenheit (35 degrees Celsius), according to a 2020 study in the journal Science Advances. Wet-bulb temperature is not the same as the air temperature you might see reported by your local forecaster or favorite weather app. Rather, a wet-bulb temperature is measured by a thermometer covered in a water-soaked cloth, and it takes into account both heat and humidity. The latter is important because with more water in the air, it's harder for sweat to evaporate off the body and cool a person down.

If the humidity is low but the temperature is high, or vice versa, the wet-bulb temperature probably won't near the human body's tipping point, said Colin Raymond, a postdoctoral researcher at NASA's Jet Propulsion Laboratory who studies extreme heat. But when both the humidity and the temperature are very high, the wet-bulb temperature can creep toward dangerous levels. For example, when the air temperature is 115 F (46.1 C) and the relative humidity is 30%, the wet-bulb temperature is only about 87 F (30.5 C). But when the air temperature is 102 F (38.9 C) and the relative humidity is 77%, the wet-bulb temperature is about 95 F (35 C).This video file cannot be played.(Error Code: 102630)

The reason people can't survive at high heat and humidity is that they can no longer regulate their internal temperature. "If the wet-bulb temperature rises above the human body temperature, you can still sweat, but you're not going to be able to cool your body to the temperature that it needs to operate at physiologically," Raymond told Live Science.

At this point, the body becomes hyperthermic — above 104 F (40 C). This can lead to symptoms such as a rapid pulse, a change in mental status, a lack of sweating, faintness and coma, according to the National Institutes of Health.

A wet-bulb temperature of 95 F won't cause immediate death, however; it probably takes about 3 hours for that heat to be unsurvivable, Raymond said. There's no way to know for sure the exact amount of time, he said, but studies have tried to estimate it by immersing human participants in hot water tanks and removing them when their body temperatures began to rise uncontrollably. There also isn't a way to confirm that 95 F is the exact wet-bulb temperature that's unsurvivable; Raymond estimated that the true number is in the range of 93.2 F to 97.7 F (34 C to 36.5 C).

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Although no one can live at a wet-bulb temperature higher than about 95 F, lower temperatures can also be deadly. Exercise and exposure to direct sunlight make it easier to overheat. Older people; people with certain health conditions, such as obesity; and people who take antipsychotics can't regulate their temperature as well, so it's easier for heat to kill them. This is why people sometimes die in heat that does not reach a wet-bulb temperature of 95 F.

Luckily, air conditioning can save people from unlivable heat. But, of course, not all people have access to it, and even in places where many people have air conditioning, the electrical grid may be unreliable, Raymond said.

Few locations have hit a wet-bulb temperature of 95 F in recorded history, according to the Science Advances study. Since the late 1980s and 1990s, hotspots have been the Indus River Valley of central and northern Pakistan and the southern shore of the Persian Gulf. "There are places that are already starting to experience these conditions for an hour or two," Raymond said. "And with global warming, that's only going to become more frequent." Locations that are at risk of these temperatures in the next 30 to 50 years include northwest Mexico, northern India, Southeast Asia and West Africa, he added.

"Unfortunately, with the climate change that's already locked in, we'll continue to warm up a fair bit, even if we stopped emitting greenhouse gases today," Raymond said. "I think it's inevitable that those places I mentioned will be grappling with this issue for the foreseeable future, and I hope more places don't get added to that list."

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## Technical Notes

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(Note: Open your Web Browser and click on Heading to link to section)

Towards deployable electrochemical sensors for per- and polyfluoroalkyl substances (PFAS)

### CHEMICAL EFFECTS

What is in Nigerian waters? Target and non-target screening analysis for organic chemicals

NAC antagonizes arsenic-induced neurotoxicity through TMEM179 by inhibiting oxidative stress in Oli-neu cells

### ENVIRONMENTAL RESEARCH

Detection and removal of poly and perfluoroalkyl polluting substances for sustainable environment

Blood Lead Levels and Associated Sociodemographic Factors among Children Aged 3 to 14 Years Living near Zinc and Lead Mines in Two Provinces in Vietnam

### OCCUPATIONAL

Development of a Data Visualization Tool for Occupational Exposure to Chemicals of Concern for Breast Cancer Among California Working Women, 2010-2014

Endotyping asthma related to three different work exposures

Workplace noise exposure and the prevalence and 10-year incidence of age-related hearing loss

Perceptions of heat-health impacts and the effects of knowledge and preventive actions by outdoor workers in Hanoi, Vietnam

### PHARAMACEUTICAL/TOXICOLOGY

Benzo(a)pyrene exposure in utero exacerbates Parkinson's Disease (PD)-like α-synucleinopathy in A53T human alpha-synuclein transgenic mice