

Bulletin Board

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ASIA PACIFIC

Draft evaluations – have your say – closes 17 December 2021

2021-11-30

Comment period closes on 17 December 2021

What is this about?

We have completed draft evaluations of chemicals that are in our [Rolling Action Plan](#).

We welcome your comments on these draft evaluations.

[Download and read our draft evaluation statements](#)

How to submit

Complete our [online form](#) below if you'd like to give comments. You can also provide relevant information that you believe has the potential to affect the outcome of the evaluation, for example information about exposure or hazard.

[Read More](#)

AICIS, 30 November 2021

<https://www.industrialchemicals.gov.au/consultations/draft-evaluations-have-your-say-closes-17-december-2021>

APVMA, Gazette No. 24, Tuesday 30 November 2021

2021-11-30

30 November 2021

We welcome your comments on these draft evaluations.

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- PDF (586.62 KB) | DOCX (179.24 KB)

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Content last updated: 30 November 2021

Content last reviewed: 30 November 2021

APVMA, 30 November 2021

<https://apvma.gov.au/node/94536>

Delhi's November air pollution the worst since records began

2021-12-01

India's national capital Delhi witnessed its worst ever air quality in the month November this year after recording 11 days of "severe" pollution — ranked as hazardous for breathing — and not one day of "good" air quality, data showed.

Eleven days of severely bad air is the highest Delhi — a city of 20 million — has recorded since India's Central Pollution Control Board (CPCB)

Eleven days of severely bad air is the highest Delhi — a city of 20 million — has recorded since India's Central Pollution Control Board (CPCB)

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[Read More](#)

Independent, 1 December 2021

<https://www.independent.co.uk/asia/india/delhi-air-pollution-november-record-b1967645.html>

AMERICA

Pittsburgh City Council passes lead safety bill aiming to curb lead exposure in children

2021-11-30

Pittsburgh City Council on Tuesday adopted a lead safety ordinance that aims to prevent potential lead exposure for city residents, and children in particular.

The ordinance is one step in a larger effort to reduce the number of lead poisoning cases in Pittsburgh, said Councilwoman Erika Strassburger, who [introduced the legislation in October](#).

From 2015 through 2019, 849 children in the city were confirmed to have lead poisoning, representing about 39% of all new cases in Allegheny County.

"One child with elevated lead levels in their body is one too many," Strassburger said. "The passage of this important bill, the Pittsburgh Lead Safety Law, moves us closer to protecting all of Pittsburgh's children and residents from lead poisoning."

Even small amounts of lead in the blood can be harmful, especially for children, according to the ordinance. Symptoms of lead poisoning in children include impaired memory, decreased academic performance and behavioral disorders. In adults, lead poisoning can lead to cardiovascular disease, adverse neurological effects, renal damage, thyroid hormone alterations and decreased fertility.

The ordinance also pointed to irreversible effects like permanent neurological and physiological damage in both kids and adults.

"This is one of the most important bills we've done this year, if not in the last five years," said Councilman Bobby Wilson, who co-sponsored the bill with Strassburger, and council members Corey O'Connor and Deb Gross.

From 2015 through 2019, 849 children in the city were confirmed to have lead poisoning, representing about 39% of all new cases in Allegheny County.

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The law aims to tackle the most common ways people are exposed to lead, focusing particularly on lead paint, which wasn't banned until 1978.

The measure calls for routine inspections of rental homes built before lead paint was outlawed in 1978. If lead is found during an inspection, it must be remedied and the residence reinspected. About 80% of the city's 70,000 rental units predate the ban on lead paint, according to Wilson.

The legislation will create a registry of child care facilities, which also will be required to be inspected for lead.

Renters and property owners can also request lead inspections.

The city has allocated \$2 million in federal American Rescue Plan funding to pay for inspections and other elements of the bill, Strassburger said.

The ordinance also calls for all demolitions to have permits that require a lead-safe work plan. Demolition sites would be inspected.

[Read More](#)

Trib Live, 30 November 2021

<https://triblive.com/local/pittsburgh-city-council-passes-lead-safety-bill-aiming-to-curb-potential-lead-exposure-in-children>

For some Alaska villages, the lack of modern water and sewer service means more health risks

2021-11-30

On a ridge rising over the Bering Strait coast lies the resting place for one community's sewage.

In Teller, an Iñupiat community of about 250, homes have no flush toilets — nor are there pipes carrying waste to municipal treatment plants. Instead, there is a dumpsite about 5 miles from town for plastic bags filled with urine and feces, many of them punctured and leaking.

This is what is known in Alaska as a "honey bucket lagoon" — a disposal site for the contents of the 5-gallon buckets that serve as toilets for Teller's residents.

"At least it's not overflowing," said Blanche Okbaok-Garnie, Teller's mayor, who shielded her nose at times when the wind carried the stench from deposited waste and the containers that held it.

In Teller, an Iñupiat community of about 250, homes have no flush toilets — nor are there pipes carrying waste to municipal treatment plants.

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That makes the current site is an improvement over a previous honey bucket lagoon, Obkaok-Garnie said. The old site, at a slightly lower elevation, was "too tiny and too full" and was, through repeated freeze-thaw cycles, threatening the drinking water source below, she said. But even this new site, started in 2017, is on borrowed time, she believes. "I think it needs to be designed for permafrost more. It just won't last," she said.

Managing sewage and protecting clean water for drinking and washing can be a daunting challenge for many communities — often predominately Indigenous — in rural Alaska and elsewhere in the Arctic, where the lack of facilities combines with challenging conditions made increasingly uncertain as the Arctic quickly warms.

Arctic residents without piped water or sewage service — or with service that is substandard — have long faced higher rates of contagious diseases. The COVID-19 pandemic is no different; Alaska Natives make up 16 percent of the state's population but as of early September, accounted for 29 percent of the state's COVID deaths.

[Read More](#)

Arctic Today, 30 November 2021

<https://www.arctictoday.com/for-some-alaska-villages-the-lack-of-modern-water-and-sewer-service-means-more-health-risks>

How toxic wildlife smoke affects pregnant people

2021-11-29

Sonny, a 10-month old, crawls through the tunnel of a playground surrounded by fresh cedar wood chips as the sun sets in October. His 4-year-old sister, Lenny, climbs the rungs of the jungle gym as their parents, Rebecca and Omar Chowaiki, keep watch.

"He is the happiest baby. He is so smiley," Rebecca Chowaiki said of her son. "We named him Sonny because it was a hard pregnancy, and we knew there would be some obstacles he needed to get over, so we wanted him to have a sunny disposition."

Sonny was diagnosed with a condition called bilateral clubfoot. A specialist put casts on his feet, he underwent surgery to cut his achilles tendon, and he wore orthotic shoes connected by a bar. He also received physical therapy for another condition called hypotonia, which meant he

Sonny was diagnosed with a condition called bilateral clubfoot.

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slouched when sitting and his head drooped. This amounted to months of medical appointments. "You just take it as it comes," his mother said.

Smoking cigarettes during pregnancy can significantly increase the risk of a baby having clubfoot, but Sonny's mother has never smoked a cigarette. "We've been breathing in buildings burning for the last four years," she told EHN. "We've all been smoking in one way or another."

The sky is blue today, but the grass and shrubs are crisp as kindling. Officials declared red flag warnings in recent weeks, meaning the dry and windy conditions are perfect for wildfires to ignite and rapidly spread. "When that happens, we brace ourselves," Chowaike said.

Since 2017, wildfires have swept Napa and nearby Sonoma each fall. The summers are hotter and last longer, and rain is less frequent. The fires have cast a thick fog of smoke over the region, lasting for weeks or months. Chowaike breathed the smoke in 2017, 2018, and 2019 leading up to Sonny's conception.

[Read More](#)

EHN, 29 November 2021

<https://www.ehn.org/wildfire-smoke-births-2655744649/slideshow>

EUROPE

French authorities detect high rate of non-compliance on nanomaterials in cosmetics

2021-11-26

The French Directorate-General for Competition Policy, Consumer Affairs and Fraud Control (DGCCRF) has found a high rate of non-compliance from businesses on the provisions to the cosmetic products Regulation regarding nanomaterials following a 2020 investigation published last week.

The DGCCRF identified 11 ingredients initially declared as "non-nano" by the ingredient suppliers and found that nine (82%) of them were nanomaterials upon further analysis. The suppliers were asked to comply with the provisions of the cosmetics Regulation.

The directorate also looked at 27 cosmetic products and found that 24 of them contained nanomaterials. However, only one complied with

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the provisions concerning the presence of nanomaterials, resulting in 85% non-compliance. Since the DGCCRF started conducting market surveillance on nanomaterials in cosmetics in 2017, the investigations have led to several labelling changes and voluntary market withdrawals.

For French nanotechnology NGO Avicenn, this investigation is indicative of the country's leading role in enforcing legislative provisions on nanomaterials. "These checks lead cosmetic brands to be more demanding about the information they get from their suppliers and thus about the quality of the ingredients they are using," Avicenn said.

While the NGO admits that not all French businesses play by the rules, they are generally more informed and aware of the presence of nanomaterials in the ingredients they are using as opposed to the rest of the EU industry. "Companies outside of France seem, on average, even less respectful of the cosmetics Regulation, which is worrying from a consumer's perspective."

According to Chiara Venturini, director general of the Nanotechnology Industries Association (NIA), there is no comparable market surveillance activity recently carried out in the EU but the overlapping obligations for French companies could explain the high rate of non-compliance.

France has its own national nanomaterial register with relevant provisions from REACH but Ms Venturini said that "the cosmetics Regulation provides a separate cosmetic products notification portal (CPNP) with a different definition of nanomaterial from REACH, adding a further layer of complexity".

Revision proposal

The NIA expects French authorities to bring their experience to the table in discussing the revision to the cosmetic products Regulation. For example, Ms Venturini pointed out the contribution of the French Directorate-General for Health during the stakeholder consultation to the revision earlier this month, which disagreed with the option of simplified labels and supported the possibility to have more detailed information on the CPNP portal.

For Cosmed, the French cosmetic association for SMEs, it is important to tackle industry concern over the interpretation of cosmetic definition for nanomaterials. Sybille Millet, regulatory affairs manager at Cosmed, said that the harmonisation of the sectoral definition of nanomaterials will be discussed as part of the cosmetics Regulation revision.

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The cosmetic products Regulation revision is part of the wider chemicals strategy for sustainability, which will include revisions to key pieces of chemicals legislation such as REACH, CLP and detergents Regulations.

The Commission expects to present the cosmetic products Regulation revision proposal in the fourth quarter of 2022. The proposal will go through the ordinary legislative procedure and enforcement of the revised Regulation will begin in 2023 or 2024.

[Read More](#)

Chemical Watch, 26 November 2021

<https://chemicalwatch.com/379275/french-authorities-detect-high-rate-of-non-compliance-on-nanomaterials-in-cosmetics>

INTERNATIONAL

Rain to replace snow in the Arctic as climate heats, study finds

2021-11-30

Climate models show switch will happen decades faster than previously thought, with 'profound' implications. Rain will replace snow as the Arctic's most common precipitation as the climate crisis heats up the planet's northern ice cap, according to research.

Today, more snow falls in the Arctic than rain. But this will reverse, the study suggests, with all the region's land and almost all its seas receiving more rain than snow before the end of the century if the world warms by 3C. Pledges made by nations at the recent Cop26 summit could keep the temperature rise to a still disastrous 2.4C, but only if these promises are met.

Even if the global temperature rise is kept to 1.5C or 2C, the Greenland and Norwegian Sea areas will still become rain dominated. Scientists were shocked in August when rain fell on the summit of Greenland's huge ice cap for the first time on record.

The research used the latest climate models, which showed the switch from snow to rain will happen decades faster than previously estimated, with autumn showing the most dramatic seasonal changes. For example, it found the central Arctic will become rain dominated in autumn by 2060

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or 2070 if carbon emissions are not cut, instead of by 2090 as predicted by earlier models.

The implications of a switchover were "profound", the researchers said, from accelerating global heating and sea level rise to melting permafrost, sinking roads, and mass starvation of reindeer and caribou in the region. Scientists think the rapid heating in the Arctic may also be increasing extreme weather events such as floods and heatwaves in Europe, Asia and North America by changing the jet stream.

[Read More](#)

The Guardian, 30 November 2021

<https://www.theguardian.com/environment/2021/nov/30/rain-replace-snow-arctic-climate-heats-study>

Nigerian farmers using large amounts of toxic pesticides banned in EU

2021-11-27

The report says nearly half of all pesticides in Nigeria are highly hazardous products banned in European markets.

A new report has revealed that about 40 per cent of all pesticides in use in Nigeria are dangerous substances that have been banned or heavily restricted in European markets.

The report by the Alliance for Action on Pesticide in Nigeria was launched Thursday at a two-day conference on pesticides regulation and use in Nigeria, hosted by the AAPN and Trade Network Initiative, and supported by the Heinrich Böll Stiftung (HBS), in Abuja.

"40% of all the pesticide products registered in Nigeria have been withdrawn from the European market or are heavily restricted," the report says.

The report, a product of studies conducted in Kano, Oyo, Ebonyi and Benue States, noted that the 40 per cent represents 57 active ingredients in 402 products that are still in use in Nigeria. Many of those belong to the group of Highly Hazardous Pesticides (HHPs) that are especially dangerous for human health, animals and the environment.

"40% of all the pesticide products registered in Nigeria have been withdrawn from the European market or are heavily restricted," the report says.

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The report said 25 registered products in Nigeria have been proven carcinogenic, while 63 to be mutagenic, and 47 are endocrine-disrupting chemicals. Also, 262 products show neurotoxicity and 224 show clear effects on reproduction.

The report stated that 65 per cent of the active ingredients (26 out of 40) used by farmers in Nigeria as sampled in the field study belong to the group of Highly Hazardous Pesticides (HHPs).

“2 of these pesticides were found to be carcinogens and 2 are mutagens, 5 are known endocrine disruptor compounds (EDCs), 11 are proven neurotoxins and 12 are proven to affect the human reproductive system,” the report made available to participants showed.

[Read More](#)

Premium Times, 27 November 2021

<https://www.premiumtimesng.com/news/headlines/497623-nigerian-farmers-using-large-amount-of-toxic-pesticides-banned-in-eu-report.html>

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REACH Update

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UK REACH approach to including substances of very high concern on the candidate list

2021-12-09

The approach to including substances of very high concern on the UK REACH candidate list.

Applies to England, Scotland and Wales

Documents

[Approach to including substances of very high concern on the UK REACH candidate list](#)

Details

This policy statement sets out the UK REACH approach to including substances of very high concern (SVHC) on the UK REACH candidate list. It includes information on:

- interim principles for adding substances to the UK REACH candidate list
- assessment of substances in the EU REACH candidate list pipeline
- inclusion of substances on the UK REACH candidate list

[Read More](#)

GOV.UK, 9 December 2021

<https://www.gov.uk/government/publications/uk-reach-approach-to-including-substances-of-very-high-concern-on-the-candidate-list>

UK REACH authorisation decisions

2021-12-09

The Secretary of State for the Department for Environment, Food and Rural Affairs (Defra), with the consent of Scottish and Welsh Ministers,

This policy statement sets out the UK REACH approach to including substances of very high concern (SVHC) on the UK REACH candidate list.

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has made decisions on two transitional applications for authorisation for the time-limited use of SVHC under UK REACH.

The Defra Secretary of State has granted authorisation to the applicant Chemetall Limited for the following use of **4-nonylphenol, branched and linear, ethoxylated (4-NPnEO)**:

- Mixing, by aerospace companies, and their associated supply chains, including the Applicant, of base polysulfide sealant components with 4-NPnEO-containing hardener, resulting in mixtures containing <0.1% w/w of 4-NPnEO for aerospace uses that are exempt from authorisation under Art. 56(6)(a) of EUR 2006/1907.

The Defra Secretary of State has granted authorisation to the applicant Siemens Healthcare Diagnostics Products Ltd for the following use of **4-(1,1,3,3-tetramethylbutyl)phenol, ethoxylated (4-tert-OPnEO)**:

- 4-tert-OPnEO as a detergent in the production of bead components for in-vitro diagnostic kits for an immunoassay platform.

These authorisation decisions were made under Article 127G which relates to a transitional measure of UK REACH.

Transitional applications received by the Defra Secretary of State are published on GOV.UK

Decisions made by the Defra Secretary of State are published on GOV.UK

[Read More](#)

GOV.UK, 9 December 2021

<https://www.gov.uk/government/publications/uk-reach-approach-to-including-substances-of-very-high-concern-on-the-candidate-list>

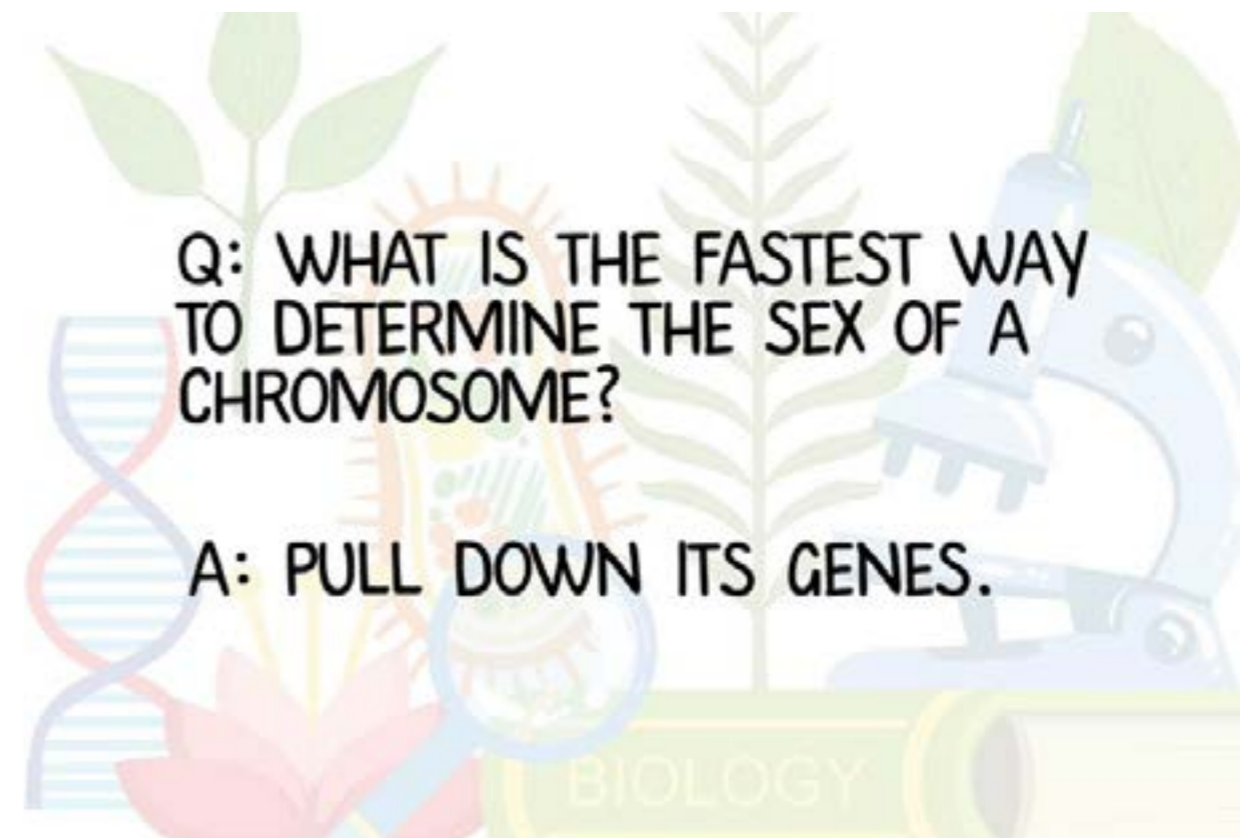
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Janet's Corner

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Genes

2021-12-17



<https://www.rd.com/list/funny-science-jokes/>

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Hazard Alert

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Vinyl Chloride

2021-12-17

Vinyl chloride is the organochloride with the formula $H_2C:CHCl$. It is also called vinyl chloride monomer, or VCM. This colourless compound is an important industrial chemical chiefly used to produce the polymer polyvinyl chloride (PVC). At ambient pressure and temperature, vinyl chloride is a gas with a sickly sweet odour. It is highly toxic, flammable and carcinogenic. [1]

USES [2]

Vinyl chloride is used to make polyvinyl chloride (PVC). PVC is used to make a variety of products, including plastics, hoses, pipes and fittings for outdoor irrigation, wire and cable coatings, packaging materials, furniture and automobile upholstery, flooring, windows, credit or ATM cards, wall coverings, house wares, outdoor furniture, plastic containers, wrapping film, automotive parts and many others. In the past VCM has been used as a refrigerant.

IN THE ENVIRONMENT [3]

- Liquid vinyl chloride evaporates easily.
- Vinyl chloride in water or soil evaporates rapidly if it is near the surface.
- Vinyl chloride in the air breaks down in a few days to other substances, some of which can be harmful.
- Small amounts of vinyl chloride can dissolve in water.
- Vinyl chloride is unlikely to build up in plants or animals that you might eat.

SOURCES & ROUTES OF EXPOSURE [2]

Sources of Emission

- Industry sources: Industries that manufacture or use vinyl chloride in production are the primary sources of this substance. Some of these industries include the chemical industry (for the manufacture of PVC and other chemicals) and the plastics industry. Emissions of vinyl chloride are primarily to air, with a small percentage to water.
- Diffuse sources: Landfills which contain vinyl chloride or other chlorinated hydrocarbons will release vinyl chloride. The treatment of

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wastewater containing vinyl chloride or chlorinated hydrocarbons may release vinyl chloride.

- Natural sources: vinyl chloride does not form naturally in the environment.
- Transport sources: There are no sources of vinyl chloride that arise from transport.
- Consumer products: Many consumer products are made from or contain PVC. New PVC products may have trace amounts of vinyl chloride seep from new plastic parts.

Routes of Exposure

The most likely exposure to vinyl chloride will occur in a workplace that uses this substance, by breathing contaminated air, or by contact with the eyes or skin. Exposure can also occur by breathing vinyl chloride released from hazardous waste sites, landfills, or by drinking water from contaminated bodies of water. Although such a situation is possible, it is not considered likely.

HEALTH EFFECTS [3]

Acute Effects

- Acute exposure of humans to high levels of vinyl chloride via inhalation in humans has resulted in effects on the CNS, such as dizziness, drowsiness, headaches, and giddiness.
- Vinyl chloride is reported to be slightly irritating to the eyes and respiratory tract in humans.
- Acute exposure to extremely high levels of vinyl chloride has caused loss of consciousness, lung and kidney irritation, and inhibition of blood clotting in humans and cardiac arrhythmias in animals.
- Tests involving acute exposure of mice have shown vinyl chloride to have high acute toxicity from inhalation exposure.

Chronic Effects

- Liver damage may result in humans from chronic exposure to vinyl chloride, through both inhalation and oral exposure.
- A small percentage of individuals occupationally exposed to high levels of vinyl chloride in air have developed a set of symptoms termed "vinyl chloride disease," which is characterised by Raynaud's phenomenon (fingers blanch and numbness and discomfort are experienced upon exposure to the cold), changes in the bones at

Vinyl chloride is the organochloride with the formula $H_2C:CHCl$.

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the end of the fingers, joint and muscle pain, and scleroderma-like skin changes (thickening of the skin, decreased elasticity, and slight oedema).

- CNS effects (including dizziness, drowsiness, fatigue, headache, visual and/or hearing disturbances, memory loss, and sleep disturbances) as well as peripheral nervous system symptoms (peripheral neuropathy, tingling, numbness, weakness, and pain in fingers) have also been reported in workers exposed to vinyl chloride.
- Animal studies have reported effects on the liver, kidney, and CNS from chronic exposure to vinyl chloride.
- EPA has established a Reference Concentration (RfC) of 0.1 milligrams per cubic metre, and a Reference Dose (RfD) of 0.003 milligrams per kilogram per day for vinyl chloride.

Reproductive/Developmental Effects

- Several case reports suggest that male sexual performance may be affected by vinyl chloride. However, these studies are limited by lack of quantitative exposure information and possible co-occurring exposure to other chemicals.
- Several epidemiological studies have reported an association between vinyl chloride exposure in pregnant women and an increased incidence of birth defects, while other studies have not reported similar findings.
- Epidemiological studies have suggested an association between men occupationally exposed to vinyl chloride and miscarriages in their wives' pregnancies although other studies have not supported these findings.
- Testicular damage and decreased male fertility have been reported in rats exposed to low levels for up to 12 months.
- Animal studies have reported decreased foetal weight and birth defects at levels that are also toxic to maternal animals in the offspring of rats exposed to vinyl chloride through inhalation.

Cancer Risk

- Inhaled vinyl chloride has been shown to increase the risk of a rare form of liver cancer (angiosarcoma of the liver) in humans.
- Animal studies have shown that vinyl chloride, via inhalation, increases the incidence of angiosarcoma of the liver and cancer of the liver.
- Several rat studies show a pronounced early-life susceptibility to the carcinogenic effect of vinyl chloride, i.e., early exposures are associated

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with higher liver cancer incidence than similar or much longer exposures that occur after maturity.

- EPA has classified vinyl chloride as a Group A, human carcinogen.
- EPA uses mathematical models, based on animal studies, to estimate the probability of a person developing cancer from breathing air containing a specified concentration of a chemical. EPA has calculated an inhalation unit risk estimate of 8.8×10^{-6} ($\mu\text{g}/\text{m}^3$)-1 for lifetime exposure to vinyl chloride. Please see IRIS for current information.
- EPA has calculated an oral cancer slope factor of 1.5 (mg/kg/d)-1 for lifetime exposure to vinyl chloride.

SAFETY [4]

First Aid Measures

- Eye Contact: Check for and remove any contact lenses. Immediately flush eyes with plenty of water for at least 15 minutes, occasionally lifting the upper and lower eyelids. Get medical attention immediately.
- Skin Contact: In case of contact, immediately flush skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. To avoid the risk of static discharges and gas ignition, soak contaminated clothing thoroughly with water before removing it. Wash clothing before reuse. Clean shoes thoroughly before reuse. Get medical attention immediately.
- Frostbite: Try to warm up the frozen tissues and seek medical attention.
- Inhalation: Move exposed person to fresh air. If not breathing, if breathing is irregular or if respiratory arrest occurs, provide artificial respiration or oxygen by trained personnel. Loosen tight clothing such as a collar, tie, belt or waistband. Get medical attention immediately.
- Ingestion: As this product is a gas, refer to the inhalation section.

Fires & Explosion Information

- vinyl chloride is flammable
- Auto-ignition temperature is 471.85°C (81.3°F)
- Flash point: open cup -79.15°C (-10.5°F).
- In case of fire, use water spray (fog), foam or dry chemical.
- In case of fire, allow gas to burn if flow cannot be shut off immediately. Apply water from a safe distance to cool container and protect surrounding area.

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- If involved in fire, shut off flow immediately if it can be done without risk.
- In a fire or if heated, a pressure increase will occur and the container may burst, with the risk of a subsequent explosion.
- Fire fighters should wear appropriate protective equipment and self-contained breathing apparatus (SCBA) with a full face-piece operated in positive pressure mode.

Exposure Controls & Personal Protection

Engineering Controls

Use only with adequate ventilation. Use process enclosures, local exhaust ventilation or other engineering controls to keep worker exposure to airborne contaminants below any recommended or statutory limits. The engineering controls also need to keep gas, vapour or dust concentrations below any lower explosive limits. Use explosion proof ventilation equipment.

Personal Protective Equipment

The following personal protective equipment is recommended when handling vinyl chloride:

- Safety eyewear complying with an approved standard should be used when a risk assessment indicates this is necessary to avoid exposure to liquid splashes, mists or dusts.
- Personal protective equipment for the body should be selected based on the task being performed and the risks involved and should be approved by a specialist before handling this product.
- Use a properly fitted, air-purifying or air-fed respirator complying with an approved standard if a risk assessment indicates this is necessary. Respirator selection must be based on known or anticipated exposure levels, the hazards of the product and the safe working limits of the selected respirator.
- Chemical-resistant, impervious gloves complying with an approved standard should be
- worn at all times when handling chemical products if a risk assessment indicates this is
- necessary.

In case of a large spill: Self-contained breathing apparatus (SCBA) should be used to avoid inhalation of the product.

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REGULATION [2,5,6]

United States

OSHA: The United States Occupational Safety & Health Administration has set the following Permissible Exposure Limit (PEL) for vinyl chloride:

- General Industry: 29 CFR 1910.1017 - Vinyl chloride - 1 ppm TWA; 0.5 ppm Action Level
- Construction Industry: 29 CFR 1926.1117 - Vinyl chloride requirements identical to 1910.1017
- Maritime: 29 CFR 1915.1017 - Vinyl chloride requirements identical to 1910.1017

ACGIH: The American Conference of Governmental Industrial Hygienists (ACGIH) Threshold Limit Value (TLV) for vinyl chloride is 1 ppm TWA; Appendix A1 - Confirmed Human Carcinogen

NIOSH: The National Institute for Occupational Safety and Health (NIOSH) has classified vinyl chloride as Appendix A - NIOSH Potential Occupational Carcinogens

EPA: The Environmental Protection Agency regulates vinyl chloride in drinking water, food, and air. The EPA requires that the amount of vinyl chloride in drinking water not exceed 0.002 milligrams per litre (mg/L) of water.

FDA: The Food and Drug Administration (FDA) regulates the vinyl chloride content of various plastics. These include plastics that carry liquids and plastics that contact food. The limits for vinyl chloride content vary depending on the nature of the plastic and its use.

Australia

Safe Work Australia: Currently, the eight-hour time weighted average (TWA) exposure limit is 13 milligrams of vinyl chloride per cubic metre of air. A 15-minute short-term exposure limit (STEL) has not been recommended.

Australian Drinking Water Guidelines: In 2004, the National Health and Medical Research Council (NHMRC) and National Resource Management Ministerial Council (NRMMC) established that no safe concentration level can be confidently set for vinyl chloride, however the concentration should be less than 0.0003 milligrams per litre of water, the limit of scientific determination for this substance.

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REFERENCE

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3. <http://www.epa.gov/ttn/atw/hlthef/vinylchl.html>
4. <http://www.airgas.com/documents/pdf/001067.pdf>
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Microplastics cause damage to human cells, study shows

2021-12-09

Microplastics cause damage to human cells in the laboratory at the levels known to be eaten by people via their food, a study has found.

The harm included cell death and allergic reactions and the research is the first to show this happens at levels relevant to human exposure. However, the health impact to the human body is uncertain because it is not known how long microplastics remain in the body before being excreted.

Microplastics pollution has contaminated the entire planet, from the summit of Mount Everest to the deepest oceans. People were already known to consume the tiny particles via food and water as well as breathing them in.

The research analysed 17 previous studies which looked at the toxicological impacts of microplastics on human cell lines. The scientists compared the level of microplastics at which damage was caused to the cells with the levels consumed by people through contaminated drinking water, seafood and table salt.

They found specific types of harm – cell death, allergic response, and damage to cell walls – were caused by the levels of microplastics that people ingest.

“Harmful effects on cells are in many cases the initiating event for health effects,” said Evangelos Danopoulos, of Hull York Medical School, UK, and who led the research published in the Journal of Hazardous Materials. “We should be concerned. Right now, there isn’t really a way to protect ourselves.”

Future research could make it possible to identify the most contaminated foods and avoid them, he said, but the ultimate solution was to stop the loss of plastic waste: “Once the plastic is in the environment, we can’t really get it out.”

Research on the health impact of microplastics is ramping up quickly, Danopoulos said: “It is exploding and for good reason. We are exposed to these particles every day: we’re eating them, we’re inhaling them. And we don’t really know how they react with our bodies once they are in.”

The research also showed irregularly shaped microplastics caused more cell death than spherical ones. This is important for future studies as many

The harm included cell death and allergic reactions and the research is the first to show this happens at levels relevant to human exposure.

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microplastics bought for use in laboratory experiments are spherical, and therefore may not be representative of the particles humans ingest.

"This work helps inform where research should be looking to find real-world effects," said microplastics researcher Steve Allen. "It was interesting that shape was so important to toxicity, as it confirms what many plastic pollution researchers believed would be happening - that pristine spheres used in lab experiments may not be showing the real-world effects."

Danopoulos said the next step for researchers was to look at studies of microplastic harm in laboratory animals – experiments on human subjects would not be ethical. In March, a study showed tiny plastic particles in the lungs of pregnant rats pass rapidly into the hearts, brains and other organs of their fetuses.

In December, microplastics were revealed in the placentas of unborn babies, which the researchers said was "a matter of great concern". In October, scientists showed that babies fed formula milk in plastic bottles were swallowing millions of particles a day.

theguardian.com, 9 December 2021

<https://www.theguardian.com>

The world is unprepared for the next pandemic, report says

2021-12-08

Nearly two years into the Covid-19 pandemic, the world remains "dangerously unprepared" for the next major outbreak, according to a new report.

The 2021 Global Health Security Index, released on Wednesday, ranks 195 countries according to their capacity to respond to epidemics and pandemics. The inaugural version of the index, published just months before the first Covid-19 cases were detected, concluded that no nation was ready for such a crisis.

Overall, the world is not any better prepared today, according to the 2021 index, which was created by the Nuclear Threat Initiative, a global security nonprofit group, and the Johns Hopkins Center for Health Security at the Johns Hopkins University Bloomberg School of Public Health.

"The world is not ready."

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"I would call this a damning report," said Dr. Rick Bright, the chief executive of the Rockefeller Foundation's Pandemic Prevention Institute, who was not involved in creating the index. "The world is not ready."

More than 90 percent of countries have no plan for distributing vaccines or medications during an emergency, while 70 percent lack sufficient capacity in hospitals, clinics and health centers, the report found. Political and security risks have risen worldwide, and public confidence in government is declining.

Although many nations have funneled resources into addressing the acute Covid-19 crisis, few have made dedicated investments in improving overall emergency preparedness, the report found.

"We documented the places where improvements for Covid were made," said Jennifer Nuzzo, an epidemiologist at the Bloomberg School and one of the two lead authors of the report.

But, she said, unless political leaders "act to ensure that what we've worked hard to develop in the midst of Covid doesn't just erode after the event is over, we could find ourselves back where we started, or worse."

The researchers rated each country on a variety of factors, evaluating their health care systems, workforces, laboratories, supply chains, infrastructure, trust in government and more. Each nation was assigned a score from 0 to 100.

The average score was 38.9, roughly the same as the 2019 average of 40.2, and no country broke into the top preparedness tier, which began at 80.1 points.

The United States, which was ranked first in the 2019 index, retained its position atop the rankings, with a score of 75.9, while Australia, Finland, Canada and Thailand rounded out the top five.

The top ranking surprised some experts, given what has been widely regarded as a failed pandemic response.

"Really, U.S. No. 1?" said Dr. Ezekiel J. Emanuel, a bioethicist at the University of Pennsylvania who was a member of President Biden's Covid-19 Advisory Board during the transition between presidential administrations. "I don't think that's a credible ranking."

But Dr. Nuzzo noted that the index was designed to measure the tools and resources that a nation has at its disposal and could not predict how effectively those resources would be used in an emergency.

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“Just because it exists on paper doesn’t mean it’s going to function,” she said.

The United States had “the lowest possible score on public confidence in the government,” the report noted. Other vulnerabilities include financial barriers to health care and fewer hospital beds per capita than other high-income countries, which could compromise the United States’ ability to respond to future emergencies. “Any missing capacity could be crippling,” Dr. Nuzzo said.

Rebecca Katz, who directs the Center for Global Health Science and Security at Georgetown University, said she agreed with the assessment that the world was not ready for another pandemic. And she was not surprised that the scores had not improved since 2019.

“We’re still in the middle of a pandemic,” Dr. Katz said. “Everything’s on fire. So there hasn’t been a lot of longer-term, strategic-capacity building.”

The report recommends that countries include funding for health security in their national budgets and review their performance in the current pandemic so they can learn from the experience, among other actions.

Given the events that have unfolded over the past two years, it might also be smart to focus on elements of pandemic preparedness that go beyond technical capacities and capabilities, said Dr. Nahid Bhadelia, the founding director of the Boston University Center for Emerging Infectious Diseases Policy and Research.

“We need to think about our ability to sustain healthy communities when a crisis becomes prolonged,” she said. “What’s important to communities is not just the pandemic response, but also how well you’re managing everyday business when you have that crisis.”

nytimes.com, 8 December 2021

<https://www.nytimes.com>

Meat-eating dinosaurs were terrifyingly fast, footprints reveal

2021-12-10

Three-toed, meat-eating dinosaurs may have sprinted as fast as a car driving on city streets, new research shows. That finding comes from analyzing the footprints these theropods left behind as they dashed over squishy lake bed mud tens of millions of years ago.

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Two sets of fossilized footprints at a site in La Rioja, Spain show that the makers of the tracks were galloping along at speeds up to 27.7 mph (44.6 km/h), reaching “some of the top speeds ever calculated for theropod tracks,” according to the new study.

According to researchers’ analysis of the tracks, one dinosaur sped up steadily and consistently as it ran, while the other quickly changed its speed while still on the move. Together, these two sets of footprints from the early part of the Cretaceous period (145 million to 66 million years ago) offer a unique snapshot of dinosaur mobility and behavior.

PLAY SOUND

Paleontologists use several methods to calculate running speeds in extinct dinosaurs, said Pablo Navarro-Lorbés, a researcher at the University of La Rioja in Logroño, Spain and lead author of the new study. One method builds biomechanical models based on dinosaur bones and limb proportions, “and the other main one is the speed estimation from tracks,” Navarro-Lorbés told Live Science in an email.

One set of the La Rioja tracks, dubbed La Torre 6A-14, preserves five three-toed footprints that were each about 12.9 inches (32.8 centimeters) long and 11.9 inches (30.2 cm) wide. The other trackway, La Torre 6B-1, includes seven three-toed footprints that were a little smaller, measuring 11.4 inches (28.9 cm) long and 10.6 inches (26.9 cm) wide. Based on the size of the prints, hip height of the theropods would have been between 4 to 5 feet (1.1 to 1.4 meters), so the animals would have stood about 7 feet (2 m) tall and measured around 13 to 16 feet long (4 to 5 m) “from the snout to the tip of the tail,” Navarro-Lorbés said.

While it isn’t possible to tell what genus of theropod made the tracks, similarities between the footprints hinted that the two dinosaurs belonged to the same taxonomic group, were non-avian — not one of the lineages directly related to modern birds — and were “very agile,” according to the study.

One of the footprints of the 6A tracksite. Scale bar is 10 centimeters. (Image credit: Pablo Navarro-Lorbés)

To calculate the theropods’ running speeds, the researchers used a formula that incorporated the dinosaurs’ hip heights and stride length. This enabled them to not only calculate the animals’ speed with every step but also detect speed variations “like acceleration or deceleration,” Navarro-Lorbés explained. They found that the dinosaur that made the 6A-

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14 trackway reached just over 23 mph (37 km/h), while the speedier 6B-1 dinosaur scampered into the lead with a top speed of nearly 28 mph (45 km/h).

By comparison, the fastest speed ever clocked in a human runner is 27.5 mph (44.3 km/h), which was achieved very briefly by the famed Jamaican sprinter Usain Bolt in 2009, according to The New York Times.

But while Bolt's running prowess has been well-documented, extinct dinosaurs aren't so lucky. Trackways that can reveal their running speeds are exceptionally rare, so these footprints from northern Spain provided a unique opportunity for the researchers to corroborate theropod speed estimates that were previously produced by other scientists who were analyzing the animals' bones, Navarro-Lorbés said.

"Fast-running theropod tracks are scarce in the fossil record," Navarro-Lorbés said. "Being able to study them and confirm some other studies made from different approaches are great news for us."

The findings were published online Thursday (Dec. 9) in the journal Nature.

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[livescience.com](https://www.livescience.com), 10 December 2021

<https://www.livescience.com>

Storm drains keep swallowing people during floods

2021-12-09

On the night of Sept. 1, Dhanush Reddy and his fiancée, Kavya Mandli, were returning home from a North Jersey mall when the remains of Hurricane Ida turned their drive perilous.

Rain pounded down, soaking the streets with so much water that cars stalled and police shut down traffic. They felt their own car rattling, and they abandoned it in a nearby lot. Deciding they'd walk to safer ground where Mandli's brother could pick them up, they waded hand-in-hand into murky water "until we reached the middle point of the road," Mandli recalled, "where it just sucked us both inside."

They were both suddenly underwater, being pulled toward a large black vacuum that seemed to be guzzling anything and everything into its wide, open mouth. Mandli managed to grab part of a bridge railing, but Reddy clutched only her hand. She shouted for help as she tried to wrest

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her fiancée from the vortex. But it was just too wet, too slippery. Reddy disappeared. Mandli was left holding his empty jacket.

As South Plainfield police searched for Reddy, who had been sucked into a 3-foot-wide stormwater drainage pipe that ran underground, they looked where they thought it might spit him out, on the other side of the road. Mandli's heart jumped when they told her they found a man hanging from a tree branch and calling for help.

But it was 18-year-old Kevin Rivera, who had also been pulled into a drainage pipe. "I was completely underwater," he told ProPublica. "I couldn't grab a grip to hold on to anything. I just covered my head with my arms and just sort of tried to ride it out till I came out on the other side or maybe got a little gasp of air."

Reddy's body was found the next day in a wooded area, blocks away from where he got pulled in. The engineer and construction project manager was dead at 31.

During the same storm, in the same state, three others died the same way.

There's no official count of how many Americans get pulled into storm drains, pipes or culverts during flood events, but ProPublica identified 35 such cases since 2015 using news accounts and court records. Twenty-one of those people died; nearly half of those lost were children. Thirteen of the deaths happened in the past three years alone. The numbers are likely an undercount, since reports of flood deaths often don't give details other than the fact that someone was swept away.

Despite records of horrific cases that span the country and stretch back decades — and the scientific consensus that climate change will only worsen flooding — federal, state and local government agencies have failed to take simple steps to prevent such tragedies from happening, ProPublica found, after more than a dozen interviews with government officials, engineers and weather experts, as well as a review of documents including death investigations, government meeting minutes and emails, and academic papers. Officials are not surveying the nation's aging stormwater drainage systems, which are being taxed beyond capacity by record downpours, to flag openings that could pose a hazard and install grates to prevent people from being sucked in.

The National Institute for Occupational Safety and Health, an arm of the Centers for Disease Control and Prevention, has recommended these steps, but it has no authority to compel cities or counties to act on that

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advice. It issued two reports on storm drain hazards after the near-identical deaths of firefighters during flood rescues. The first died in 2000. The second died in 2015. The first report did not reach the officials who could have prevented the second death.

ProPublica found instances in which local and state governments knew about a hazard but didn't secure it. A man who died on the same night as Reddy, in Maplewood, New Jersey, was among a group of neighbors who had warned town and state officials that a storm pipe near their homes was dangerous; the man was pulled into the large opening while trying to clear out debris. That same night, in Passaic, New Jersey, two college students were sucked into the very same drain where, just one year earlier, a DoorDash driver had been pulled in. She had been dumped into a river and survived; they were expelled into the same river, but they died.

Some local and state government leaders have pushed back against recommendations to put in grates; they can be expensive to install, they trap debris and they can make flooding worse, opponents said. People can also become pinned to them and drown. But other municipal leaders and engineers said these problems can be overcome by using angled grates that provide victims an escape, and by investing in maintenance schedules so that covered drains don't get clogged.

"It's life or death," said Ken MacKenzie, the executive director of Denver's Mile High Flood District, who has for years tried to rally officials across the country to install grates and address the problem. He worked up his own count of deaths from 1996 to 2015, and he tallied at least 20 lives lost during that period. "It's a hidden danger in nearly every community. And yes, it might cost a couple thousand dollars. But it's worth it to not kill someone's child in a culvert."

Stormwater drainage is the type of infrastructure that people rarely think about until water is rushing down the road and cars are floating away. But when you walk around your neighborhood, you'll see evidence of these systems all around you, from the small openings that run along curbs to larger pipes and culverts designed to channel rainwater into local waterways, retention ponds or stormwater treatment facilities. These systems are built to handle only so much water, and when the amount of rain exceeds the system's capacity, it can lead to dangerous flooding in unexpected locations.

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Many of these drainage systems were built decades ago and are designed based on historical rainfall data, which was used to help predict what capacity the systems should be able to handle. But Marouane Temimi, an associate professor at Stevens Institute of Technology who researches rainfall and flooding, said those predictions rely on one big assumption: "That the climate will continue to behave the same way it has been behaving for decades now," he said. "If the climate changes — that's what we are witnessing — then the past is no longer a good guide for the future."

In the Northeast, for example, the amount of rainfall from heavy events increased by more than 70% from 1958 to 2010. Ida unleashed record-breaking rainfall on the region this year. So did the remnants of last year's Hurricane Isaias, during which at least three good Samaritans were pulled into a culvert in Hockessin, Delaware, while trying to rescue a man trapped in his flooded car, and a 16-year-old boy in Bethlehem Township, Pennsylvania, watched a 6-year-old boy get sucked into a pipe and went in after him. They all survived.

The higher the floodwater, and the more of it that's rushing toward a culvert or pipe in a maxed-out drainage system, the more dangerous the conditions can get. To get a sense of how much force can be in play at the entrance of these pipes, consider that every cubic foot of water weighs 62.4 pounds. So if someone is standing in 4 feet of water, that's nearly 250 pounds of force. "And that's not including any velocity that's heading toward the pipe," said MacKenzie, the Denver flood district director. "And so if you have a full-grown man at maybe 200 pounds, he's up against 250 pounds of water pressure pushing into the inlet of that pipe."

Rainfall has also increased in St. Louis in the past decade, said Jim Sieveking, a science and operations officer for the National Weather Service who's based in the area. The city is particularly at risk for flooding because the Mississippi, Missouri and Illinois rivers converge around the same region, and urban sprawl and development have reduced the amount of permeable land that can absorb excess water. "We've seen our fair share of flooding in these past years," he said.

On July 10 near St. Louis, Aaleya Carter and her family were on their way home after seeing the latest Fast and Furious movie. It was Aaleya's birthday celebration. She had just turned 12.

There were heavy rains and thunderstorms that night as her aunt drove a small SUV along Interstate 70. The aunt spotted a flooded area in the road and turned around, but the wind and the slippery conditions made the car

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slide down an embankment toward a drainage culvert, which was filling with water.

Bridgette Carter, Aaleya's mom, had to think and move quickly. Her three babies — including Skylar, 8, and Carter, 6 — were in the back seat, and water was starting to pour into the car. "My first instinct was to get out the car because the doors weren't opening," Bridgette said.

It was a frantic rush to unbuckle all of the children and then climb out of the front driver's side window, the only one that would open. While Bridgette was placing her two youngest on a roadway that was safely out of the water, Aaleya was clinging to the vehicle. "I was reaching for Leya," the mother said. "And it swept her in the drain. The current was so strong."

Aaleya, a goofy, funny kid who loved making TikTok videos and often helped her mom get dinner ready, was found a few hours later in a tree near a creek where the drainage pipe emptied. She had drowned.

Missouri's Department of Transportation is responsible for the drain that Aaleya was pulled through. It was last updated in 1975. State officials wouldn't say whether they have ever reviewed drains to determine if some should have safety measures like warning signs and grates. They pointed ProPublica to the Federal Highway Administration, which couldn't name an instance when it had done such a safety evaluation, but noted that states have the autonomy to determine whether a grate is needed and to place flood warning and depth gauge signs at drains.

The loss of Aaleya was so unbearable that Bridgette decided to move her family to McKinney, Texas. "It's hard," she said in a conversation punctuated by tears. "It's too much. ... Everything just reminds me of my baby."

The danger that large pipes and culverts pose to people during floods is not unknown to the federal government. NIOSH, the occupational safety arm of the CDC, issued a key recommendation two decades ago that could have saved lives. It came after a tragedy in Denver.

On Aug. 17, 2000, the city was drenched with up to 3 and a half inches of rain, causing flooding. Firefighter Robert Crump and his partner got an alert about a woman in distress. The water surrounding the woman appeared to be about waist deep. The firefighters didn't know she was standing on the edge of a culvert near 10 feet of water. Crump's partner, Will Roberts, jumped into the water to save the woman and was pulled

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under the surface by the drainage vacuum. Crump jumped in after his partner and was able to pull him to safety.

While his partner was trying to tie a cord to himself to attempt another rescue, Crump plunged back into the water to save the woman. He was pulled into the open drainage system that runs under the road. His body was found hours later, several blocks away from where he went missing.

NIOSH investigated Crump's death and, in 2002, issued a report with recommendations for cities everywhere to prevent similar accidents, holding up as an example what it said Denver had done in the aftermath: covered the drainage pipe with a grate and then identified all similar open sewers, drains and culverts to start planning for more possible grates. (When contacted by ProPublica, Denver officials couldn't find those records or say how much of that they wound up doing.)

Fifteen years after Crump died, another firefighter died after being pulled into an open drainage pipe during heavy rains, this time in Claremore, Oklahoma.

Jason Farley and his colleagues were wading through floodwater while trying to rescue people trapped in their homes when he stepped into a catch basin and was pulled into a drainage pipe. Another firefighter jumped in after him and was also pulled in. The other firefighter traveled almost 280 feet through the pipe and was expelled into a creek. Farley got tangled up in the pipe and drowned.

NIOSH once again released an investigative report, with recommendations that echoed those it had issued after Crump's death: Government agencies should consider requirements for "identifying, marking, and guarding underground storm drains," the report said. Sean Douglas, chief of the Claremore Fire Department, had requested that NIOSH investigate Farley's death. He said he sees NIOSH reports from time to time in trade journals and firefighter magazines, but that he hadn't seen the Denver report or its recommendations. "They're not really in front of everybody all the time," he said of the reports. "A lot of fire departments may not even talk to other fire departments, let alone an appendage of the CDC."

A spokesperson with NIOSH said they post the reports on their website and send them out to 79,000 announcement and newsletter subscribers. The spokesperson also said that the group's investigations have contributed to important safety improvements for firefighters. But fire agencies aren't responsible for the stormwater drainage reforms that NIOSH proposed; city and county public works managers usually are.

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ProPublica could identify no federal agency set up to inform local officials directly of these safety hazards and recommendations.

At the spot where Farley died, Claremore put up guardrails but opted against a grate, out of a concern that people would get pinned against it during a flood, but also because it would need extra maintenance to keep it free from debris that could stop water from flowing in. Douglas said the city has identified areas prone to flooding, cleared out debris before and after storms, raised awareness of the hazards through signs and instituted road closures in problem areas. He said he continues to work with the city to install more markings of the open drains and where they may lead, and Garrett Ball, the city's engineer, said Claremore began mapping its storm drain system, an effort he hopes will be completed in the next year or two.

A few communities have aggressively tackled storm drain safety in reforms that followed tragedy. Bolingbrook, Illinois, a suburb of Chicago, reviewed more than 40 storm drain inlets and grated some of them after a 6-year-old boy was pulled into one and drowned in 1998; the community also settled a lawsuit with the boy's family for \$2.8 million.

And Cedar Rapids, Iowa, evaluated 18 inlets and decided to place grates at 15 sites, some of which were large culverts.

The city embarked on the improvements after Logan Blake, 17, was swept into a culvert in 2014 when he went after a Frisbee during heavy rains. Logan's friend jumped in the water to attempt to save him and was also pulled into the drain. The two teenagers traveled more than a mile and a half through the drainage pipe before being dumped into Cedar Lake. Logan's friend survived and was able to walk to a nearby hospital. Logan's body was found about 19 hours later.

Instead of suing, the teen's family reached an agreement with the city to ensure it would invest in safety upgrades so that another child wouldn't die, said Mark Blake, Logan's father. "We just wanted them to fix one at that time," he said. "And they came up with a plan to fix three right away because they had two other ones right next to schools in the same exact situation."

For guidance on how to evaluate which inlets needed safety grates and which needed less aggressive improvements, Mark Blake and the Cedar Rapids officials turned to MacKenzie, whose Denver district had developed a set of criteria for reviewing the safety of open inlets. They would assess the length of pipe, size of the pipe's entrances, whether there were bends and turns in the pipe, and its proximity to schools and parks.

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Cedar Rapids also used the Mile High Flood District's latest design for grates that are installed at an angle, which are meant to prevent people from being pinned against them during a flood. "And the idea is that the bars would be spaced tightly enough that somebody couldn't get in there, but they could also act as a ladder or a walkway for someone to get out," said David Wallace, Cedar Rapids' utilities engineering manager. For larger culverts, ones that Wallace said were simply impractical to grate, the city put up fencing and signage warning people of the danger during floods.

Cedar Rapids has put grates on 11 drains, with four more expected to be completed by the end of 2022. The city expects to spend a total of about \$700,000 on the 15 locations. Flooding caused by debris clogs is a risk, Wallace said, but it can be remedied with a consistent maintenance plan. The city's teams go out after every rain to pull debris from the grates. It takes one workday for two crews of three people with a backhoe to clear the debris after big storms. They have to do that several times a year, Wallace said. With the diligent maintenance schedule, the grates have not added any additional flooding.

"The idea is to prevent the tragedy that we had here," Wallace said. "So sure, it adds to the maintenance activities and adds some costs that we otherwise wouldn't have had to do, but the idea is to prevent what happened. ... It's just a safety, prevention measure that we think is necessary."

The Mile High Flood District, Colorado's Larimer County Dive Rescue Team, Colorado State University's Hydraulics Lab and the engineering company AECOM have been researching how people are injured or killed in drainpipes and have been working on grate designs for different pipe and culvert configurations. The group created a physical model at the university to test its research in simulated flood waters. Part of the team's work looks into pitch angles, bar spacing and how far away from the pipe entrance a grate should be placed — all aimed at making grates safer and less expensive. The group plans to release detailed data from its work at the World Environmental and Water Resources Congress conference in June. "What we found is really going to allow us to make the grates smaller, which will really bring down the cost," said Holly Piza, an engineer for the Mile High Flood District. "Which is great because then local governments and municipalities will be more likely to put in safety grates where they're appropriate."

The bipartisan Infrastructure Investments and Jobs Act includes funding that could help communities upgrade their drainage systems' capacity

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and safety. More than \$50 billion in new spending from the bill will go to drinking water, wastewater and stormwater investments over 10 years. A spokesperson with the Environmental Protection Agency told ProPublica that \$1.9 billion of that money was going to the Clean Water program, which allows awarded communities to install grates in addition to making other upgrades.

The storm drain accidents recorded across New Jersey during Ida show just how preventable these deaths can be.

Residents of Maple Terrace in the town of Maplewood had been complaining for years about the dangerous and inadequate drainage structure there, a 48-inch pipe sitting on three properties, one on the north side of the street and on two on the south side. Patrick Jeffrey and his wife, Beth, who lived next to one of those homes, had been among those voicing concerns. The flooding caused by the pipe routinely spilled into their yard, and they worried its large opening could be dangerous to adults walking around it or children playing near it.

Over the years, a group of the neighborhood dads developed a routine before and during rainstorms: They'd work together to remove debris from the two inlets to try to keep the flooding down. On Sept. 1, Patrick Jeffrey was doing what he always did; a neighbor was going to meet him near the inlet and help remove debris. But when the neighbor arrived at the hole, he couldn't find Jeffrey. Fred Meyer, who lived across the street from Jeffrey, joined the search effort.

"There was like a 360-degree waterfall ... charging down this hole. There was water everywhere," said Meyer. "It was terrifying."

The next morning, Jeffrey's body was found along a neighboring roadway. He had been pulled into the drainage system and emerged out of a manhole. The father of two, who worked as a vice president and portfolio manager at U.S. Bank in New York, was 55.

"We were always thinking that a kid might fall into this thing," said Meyer, Jeffrey's neighbor. "I never thought something would happen to an adult and I never thought it would be someone dying. I still can't believe it happened. The absolute worst thing that could possibly happen in this scenario actually has."

One year earlier, in Pennsylvania's Sewickley Township, a 38-year-old man died the exact same way, trying to clear debris from a pipe in his backyard.

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Transcripts from Maplewood town meetings show residents had been asking since at least 2018 for the area where Jeffrey fell to be replaced by an underground pipe, but town leadership was resistant to the idea at the time. When town officials eventually came around to it, officials with New Jersey's environmental department were against it because they said the area had a natural waterway designation that prevented such a move, according to emails. Had the problem been dealt with years ago, Meyer said, there would have been no open pipe for Jeffrey to remove debris from. He'd be alive to coach his son's flag football team and cheer on his daughter's softball team.

After Jeffrey's death, state officials gave the town permission to install grates over the pipe and said they would grant an exemption that would allow the town to replace the area with an underground pipe, according to meeting minutes. The state didn't directly answer ProPublica's questions about why its officials had changed their minds, but in reference to the grates, a spokesperson told ProPublica the state and the town agreed that Maplewood would ask for permission to install the grates to "address the immediate concern for safety."

The city of Passaic, too, had discussed a dangerous drain before best friends Nidhi Rana, 18, and Ayush Rana (no relation), 21, abandoned their flooded-out car and died after being sucked into the drain during Ida. In July 2020, DoorDash driver Nathalia Bruno had wound up in the same drain but survived after she fled her car during a flash flood.

Bruno recounted her harrowing story in news accounts, and city officials talked about grates and warning signs. But city engineers said that a grate would become clogged, leading to more flooding, and that people might get pinned to them. Mayor Hector Lora also said property owners voiced concerns about permanent flash flood warning signage because of what it could do to property values. Instead, the city focused on strengthening its barricades and moving them further away from problem areas. It also rolled out temporary LED warning signs with each heavy rain and began pursuing grants to elevate the roadway.

Lora said there wasn't pressure for more urgent reforms back then because Bruno "miraculously survived."

When asked if there was anything the city could have done more immediately after Bruno's accident that could have helped save the two friends who later died, Lora said he believes the city did the best it could with the information it had and that no one could have planned or prepared for the devastation brought by Ida. "I think we did everything

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that municipalities are supposed to do," he said. "Sometimes crisis and tragedy become the genesis for good policy and initiatives that come later."

The city is now moving with more urgency, Lora said. He hadn't heard of the idea of putting grates at an angle, but after speaking with ProPublica and being shown examples of the Denver design, Lora said he has asked his engineers to review the new model. "The tragedy compels me to explore every option," he said. Officials with MacKenzie's team in Denver reviewed an image of the Passaic culvert and said their early assessment is that a safe grate could be designed for the location.

Permanent warning signs have also been put in place near the culvert, and the city is pursuing grants to buy a sign that will monitor water depth and alert police and the fire department when it reaches a certain height. Lora is also looking for funds to surround the culvert with a large fence that curves at the top.

As for the pipes in South Plainfield, where Dhanush Reddy and Kevin Rivera were pulled in, it's not clear if there are plans to do anything; Middlesex County officials, who are responsible for the maintenance of the pipes, declined to answer ProPublica's questions.

Kavya Mandli no longer lives in New Jersey. She moved to the Atlanta area after the death of her fiancé. "My life just went upside down since then," she said. "I'm still really figuring out what to do. I had to move away from that place because I really couldn't be myself there anymore."

She hasn't escaped the reminders of her loss. There was the trip they were supposed to take to Puerto Rico, two days after his death. There was what would have been his birthday gift — tickets she'd already bought to his first-ever Formula 1 race in October. Then there is their white labrador, Kush, whose name is a combination of their own first names. They were trying to get home to him quickly on Sept. 1; Reddy knew Kush would be frightened by the weather.

Every day, when Reddy got home from work, Kush would run toward the door and the two would tussle like kids. "Kush is so huge, he's like 90 pounds, but Dhanush just picks him up like a baby and rocks him," Mandli said.

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"I sometimes think, 'It's around 5 o'clock, maybe he'll come home.'"

propublica.org, 9 December 2021

<https://www.propublica.org>

Water's ultimate freezing point just got lower

2021-12-11

"Ice cold" just got even colder: By creating ice from tiny droplets only a few hundred molecules in size, researchers have pushed water's freezing point lower than ever before and changed what we know about how ice forms.

Knowing how and why water transforms into ice is essential for understanding a wide range of natural processes. Climate fluctuations, cloud dynamics and the water cycle are all influenced by water-ice transformations, as are animals that live in freezing conditions.

Wood frogs, for example, survive the winter on land by allowing their bodies to freeze. This allows them to come out of hibernation faster than species that spend the winter deep underwater without freezing. But ice crystals can rupture cell membranes, so animals that use this technique need to find a way to prevent ice from forming in their cells and tissues. A better understanding of how water freezes could lead to a better understanding of these extreme species.

PLAY SOUND

While the rule of thumb is that water freezes at 32 degrees Fahrenheit (0 degrees Celsius), water can actually stay liquid over a range of chilly temperatures under certain conditions. Until now, it was believed that this range stopped at minus 36 F (minus 38 C); any lower than that, and water must freeze. But in a study published Nov. 30 in the journal *Nature Communications*, researchers managed to keep droplets of water in a liquid state at temperatures as low as minus 47.2 F (minus 44 C).

There were two keys to their breakthrough: very small droplets and a very soft surface. They began with droplets ranging from 150 nanometers, barely bigger than an influenza virus particle, to as small as 2 nanometers, a cluster of only 275 water molecules. This range of droplet sizes helped the researchers uncover the role of size in the transformation from water to ice.

"We covered all of these ranges so that we can understand at which condition ice is going to form — which temperature, which size of the

Knowing how and why water transforms into ice is essential for understanding a wide range of natural processes.

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droplets," study co-author Hadi Ghasemi, a mechanical engineering professor at the University of Houston, told Live Science. "And more importantly, we found that if the water droplets are covered with some soft materials, the freezing temperature can be suppressed to a really low temperature."

The soft material they used was octane, an oil that surrounded each droplet within the nanoscale pores of an anodized aluminum oxide membrane. That allowed the droplets to take on a more rounded shape with greater pressure, which the researchers say is essential for preventing ice formation at these low temperatures.

Because it's basically impossible to observe the freezing process at these small scales, the researchers used measures of electrical conductance — since ice is more conductive than water — and light emitted in the infrared spectrum to catch the exact moment and temperature at which the droplets transformed from water to ice.

They found that the smaller the droplet, the colder it had to be for ice to form — and for droplets that were 10 nanometers and smaller, the rate of ice formation dropped dramatically. In the smallest droplets they measured, ice didn't form until the water had reached a bone-chilling minus 44 C.

Does this mean that the microscopic droplets within clouds and biological cells can get even colder than we thought? "As a scientist, I would say we don't know yet," Ghasemi said.

But this discovery could mean big things for ice prevention on human-made materials, like those in aviation and energy systems, Ghasemi said. If water on soft surfaces takes longer to freeze, engineers could incorporate a mix of soft and hard materials into their designs to keep ice from building up on those surfaces.

"There are so many ways that you can use this knowledge to design the surfaces to avoid ice formation," Ghasemi said. "Once we have this fundamental understanding, that next step is just the engineering of these surfaces based on the soft materials."

Originally published on Live Science.

[livescience.com](https://www.livescience.com), 11 December 2021

<https://www.livescience.com>

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Lights from ships disorients, and even kills, seabirds

2021-12-06

Scientists have known since the 1970s that artificial lights at night pose a problem for seabirds. Trapped in the glow of bright lights shining from streetlights, cars, and buildings close to their breeding colonies, disoriented seabirds fly around until they fall to the ground exhausted, a phenomenon known as grounding. But new research led by Peter Ryan, an ornithologist at the University of Cape Town in South Africa, shows that far out at sea, the light from passing ships can have a similar, sometimes deadly, effect.

Previous research by Ryan in the 1980s showed that spotlights on the deck of a lobster boat in the Tristan da Cunha archipelago, in the remote southern Atlantic Ocean, were grounding hundreds of seabirds on deck each night. Fishers on the vessel—the only large ship in the region's rock lobster fishery—attempted to curb the groundings by using fewer lights on deck and shielding cabin lights with heavy drapes. More than 20 years later, Ryan and his colleagues set out to determine if these mitigation measures undertaken by the Tristan rock lobster fishery were effective. Unfortunately, Ryan and his colleagues' new study shows that though these mitigation measures have had an effect, even this reduced light is grounding large numbers of birds.

Analyzing records collected by observers stationed on the fishing vessel by the local Tristan government from 2013 to 2021, Ryan and his colleagues' latest paper shows that over this period more than 1,800 birds grounded on the ship. Of these, 70 birds died, likely from head trauma or other injuries caused by colliding with the boat. The rest were released overboard and are presumed to have survived. Shockingly, the vast majority of these groundings—65 percent—happened on just seven nights.

These big grounding events "happen on dark, misty nights when there's no other light source," Ryan says. The birds are "drawn in like moths to a candle."

Martyna Syposz, an ornithologist at the University of Gdańsk in Poland who was not involved with the study, says that many seabirds, such as shearwaters and petrels, are very clumsy on flat surfaces, like a ship's deck. For these species, taking off from flat ground is nearly impossible. Grounded on a ship, seabirds sometimes crawl into small spaces for protection, like under a lifeboat, where they dehydrate or starve to death if

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not rescued. If birds fall into oily water on a vessel, Ryan says, their feathers can lose their waterproofing—a disaster for species that dive to catch fish.

Though Ryan's study only looked at one lobster boat in a remote part of the South Atlantic, the results demonstrate how dangerous ship-based light pollution can be for seabirds. Globally, fishing boats and seabirds congregate where fish are abundant, so brightly lit vessels in these same areas will certainly be problematic, says André Raine, the science director of Archipelago Research and Conservation, a Hawai'i-based NGO. Cruise ships can also attract seabirds, he adds, like "brightly glowing beacons through the night."

Unlike many of the other threats faced by seabirds, such as plastic pollution, climate change, habitat loss, and invasive predators, Ryan says that it's fairly easy to do something about light pollution.

Raine agrees: with light pollution on land or at sea, "you can actually deal with it in a cost-effective and safe way." Shielding lights with blinds, using warmer lights (with more red hues), and installing motion-triggered lights can reduce seabirds' attraction to their harmful glow. The easiest and most effective solution, adds Syposz, is to just keep a light off if you don't need it.

[hakaimagazine.com](https://www.hakaimagazine.com), 6 December 2021

<https://www.hakaimagazine.com>

University of Portsmouth study finds 9,000% increase in face mask litter

2021-12-08

University researchers are urging the government to prevent an "environmental disaster" caused by face mask litter.

A study from the University of Portsmouth found mask litter increased by 9,000% in the first seven months of the pandemic and could have led to further spread of the virus.

During their study, researchers discovered two million littered masks were collected across 11 counties.

A government spokeswoman said it is "vital" waste is correctly disposed of.

Researchers from the university believe the plastic pollution caused by face mask litter could last hundreds of years.

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Professor Steve Fletcher, from the University of Portsmouth, said: "Without better disposal practices, an environmental disaster is looming."

The university is now calling on the government to create new policies for enforcing waste disposal.

The study, published in the journal *Nature Sustainability*, was based on findings from March to October 2020 using the Covid-19 Government Response Tracker database and a litter collection app called Litterati.

University researchers warn face masks can act as a 'vector' to spread coronavirus, as well as cause infrastructure problems like blocking sewers and pose a threat to animals, as they can choke on them.

Professor Fletcher added: "The majority of masks are manufactured from long-lasting plastic materials, and if discarded can persist in the environment for hundreds of years. This means they can have a number of impacts on the environment and people."

Lead researcher Dr Keiron Roberts said: "We need to avoid this pandemic litter becoming a lasting legacy."

"Government policies and legislation can have a large impact on the composition of litter. There is a clear need to ensure the use of these items is accompanied with education campaigns to limit their release into the environment."

A spokeswoman from the Department for Environment, Food and Rural Affairs, said: "Our priority is rightly to protect public health during the ongoing coronavirus pandemic, but this does not dilute our existing commitments to tackling single-use plastics and combating litter."

"It is vital we all dispose of our waste - including face coverings and other PPE - in the correct manner. Face coverings should be disposed of in normal waste bins."

[bbc.com](https://www.bbc.com), 8 December 2021

<https://www.bbc.com>

Antarctica's Thwaites Glacier ice shelf could collapse within five years

2021-12-13

The demise of a West Antarctic glacier poses the world's biggest threat to raise sea levels before 2100 — and an ice shelf that's holding it back

Right now, its melting is responsible for about 4 percent of global sea level rise.

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from the sea could collapse within three to five years, scientists reported December 13 at the American Geophysical Union's fall meeting in New Orleans.

Thwaites Glacier is "one of the largest, highest glaciers in Antarctica — it's huge," Ted Scambos, a glaciologist at the Boulder, Colo.-based Cooperative Institute for Research in Environmental Sciences, told reporters. Spanning 120 kilometers across, the glacier is roughly the size of Florida, and were the whole thing to fall into the ocean, it would raise sea levels by 65 centimeters, or more than two feet. Right now, its melting is responsible for about 4 percent of global sea level rise.

But a large portion of the glacier is about to lose its tenuous grip on the seafloor, and that will dramatically speed up its seaward slide, the researchers said. Since about 2004, the eastern third of Thwaites has been braced by a floating ice shelf, an extension of the glacier that juts out into the sea. Right now, the underbelly of that ice shelf is lodged against an underwater mountain located about 50 kilometers offshore. That pinning point is essentially helping to hold the whole mass of ice in place.

But data collected by researchers beneath and around the shelf in the last two years suggests that brace won't hold much longer. Warm ocean waters are inexorably eating away at the ice from below (SN: 4/9/21; SN: 9/9/20). As the glacier's ice shelf loses mass, it's retreating inland, and will eventually retreat completely behind the underwater mountain pinning it in place. Meanwhile, fractures and crevasses, widened by these waters, are swiftly snaking through the ice like cracks in a car's windshield, shattering and weakening it.

This deadly punch-jab-uppercut combination of melting from below, ice shattering and losing its grip on the pinning point is pushing the ice shelf to imminent collapse, within as little as three to five years, said Erin Pettit, a glaciologist at Oregon State University in Corvallis. And "the collapse of this ice shelf will result in a direct increase in sea level rise, pretty rapidly," Pettit added. "It's a little bit unsettling."

Satellite data show that over the last 30 years, the flow of Thwaites Glacier across land and toward the sea has nearly doubled in pace. The collapse of this "Doomsday Glacier" alone would alter sea levels significantly, but its fall would also destabilize other West Antarctic glaciers, dragging more ice into the ocean and raising sea levels even more.

That makes Thwaites "the most important place to study for near-term sea level rise," Scambos said. So in 2018, researchers from the United

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States and the United Kingdom embarked on a joint five-year project to intensively study the glacier and try to anticipate its imminent future by planting instruments atop, within, below it as well as offshore of it.

This pull-out-all-the-stops approach to studying Thwaites is leading to other rapid discoveries, including the first observations of ocean and melting conditions right at a glacier's grounding zone, where the land-based glacier begins to jut out into a floating ice shelf. Scientists have also spotted how the rise and fall of ocean tides can speed up melting, by pumping warm waters farther beneath the ice and creating new melt channels and crevasses in the underside of the ice.

As Thwaites and other glaciers retreat inland, some scientists have pondered whether they might form very tall cliffs of ice along the edge of the ocean — and the potential tumble of such massive blocks of ice into the sea could lead to devastatingly rapid sea level rise, a hypothesis known as marine ice cliff instability (SN: 2/6/19). How likely researchers say such a collapse is depends on our understanding of the physics and dynamics of ice behavior, something about which scientists have historically known very little (SN: 9/23/20).

The Thwaites collaboration is also tackling this problem. In simulations of the further retreat of Thwaites, glaciologist Anna Crawford of the University of St. Andrews in Scotland and her colleagues found that if the shape of the land beneath the glacier dips deep enough in some places, that could lead to some very tall ice cliffs — but, they found, the ice itself might also deform and thin enough to make tall ice cliff formation difficult.

The collaboration is only at its halfway point now, but these data already promise to help scientists better estimate the near-term future of Thwaites, including how quickly and dramatically it might fall, Scambos said. "We're watching a world that's doing things we haven't really seen before, because we're pushing on the climate extremely rapidly with carbon dioxide emissions," he added. "It's daunting."

sciencenews.org, 13 December 2021

<https://www.sciencenews.org>

The faces of the reptiles were so messed up, Matthew Allender says, experts first thought they'd been run over by cars.

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A fatal fungal disease is spreading among North America's snakes

2021-12-08

In 2008, scientists found three eastern massasauga rattlesnakes dead, their faces swollen and disfigured, in a forest near Carlyle, Illinois. It was the ninth year of a long-term monitoring program of the threatened species, and no one had ever seen anything like it before.

The faces of the reptiles were so messed up, Matthew Allender says, experts first thought they'd been run over by cars.

"So we took samples, we ran a lot of tests, and lo and behold, these were the first reported cases of *Ophidiomyces ophiodiicola* in free-ranging snakes," says Allender, a veterinarian and wildlife epidemiologist at the University of Illinois and Chicago Zoological Society, who published his results in 2011.

A close relative of the fungus *O. ophiodiicola*, which likely kills by overwhelming the snake's immune system, had been found once before in a captive snake, but never in the wild. In the decade since the findings in Illinois, Allender and his colleagues have identified *O. ophiodiicola* in 25 snake species across 19 U.S. states and Canadian territories. The sometimes fatal affliction now has a common name: snake fungal disease. (Fortunately, the fungus appears to pose no threat to humans.)

"I think it's everywhere," says Allender, who has detected the snake fungus in as far-ranging locales as the western U.S. and Puerto Rico. Though the fungus may not infect every snake species, "we're finding it in remote places." (Read more about the mysterious disease.)

Now, a study published in July in *Emerging Infectious Diseases* shows that the fungus is present in some museum snake specimens dating back as early as 1945 and collected from locations around the U.S.

Tracing the history of the disease may be critical in determining what, if anything, scientists can do to combat the latest emerging wildlife disease, says study leader Jeffrey Lorch, a microbiologist with the U.S. Geological Survey.

If it's something people brought to North America, "we might need to focus on trying to prevent the spread," he says. "Whereas if it's something that's been here for longer, we might be looking more at how to help snakes cope with the pathogen itself."

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That's why he and his colleagues are now running genetic analyses of the pathogen to find out if it was inadvertently introduced to the continent, as was the case with *Pseudogymnoascus destructans*, the likely European fungus that causes the devastating white-nose syndrome in bats. (Read how some bat species are starting to develop immunity against the disease.)

And it can't come too soon. Of the 11,000 known reptiles, nearly one in five is threatened by extinction due to human-caused perils, such as habitat destruction and climate change. Add in a fungal disease, and many species simply may not be able to weather another hazard, Lorch says.

A discovery in New Hampshire

The first major sign of the fungus' emergence came in 2006, when experts at the New Hampshire Fish and Game Department noticed some of their endangered timber rattlesnakes had brown, crusty blisters on their necks and face.

"Initially, there didn't seem to be a huge level of concern," says Michael Marchand, a wildlife biologist and supervisor of the state's Nongame and Endangered Wildlife Program.

But they soon found the body of one of their rattlers, apparently dead due to a "severe fungal infection in the mouth," he and his co-authors wrote in a 2011 study.

The outbreak, later associated with snake fungal disease, ultimately claimed around 50 percent of the state's timber rattlesnake population, which dropped from 40 to 19 adult snakes.

"It was significant," he says, "and concerning."

Fortunately, the population survived, and now numbers around 50, Marchand says. It's unclear how they rebounded, though he says it's possible the surviving snakes were able to pass on some level of immunity to the fungus.

Unraveling a snake disease

Whether snakes gain immunity is just one of many mysteries that Lorch and Allender have been investigating over the past decade.

For instance, the team has revealed snake fungal disease is systemic, first attacking the skin and later causing internal lesions in some cases. But

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it's not the lesions that are deadly. Allender thinks the animals die from overactive immune responses.

So far, scientists have confirmed that snakes spread the disease through contact with each other. Not only does this mean that species that den or hibernate together are at risk of infection, but courtship and mating are also modes of transmission. The fungus can also be transferred from mother snakes to their offspring, says Lorch. (Related: Rattlesnake mothers and babies can turn their bodies into bowls to harvest rain.)

The fungus also seems to grow well under a wide variety of soil conditions and habitats, Allender says.

"It's got broader and wider growth conditions than even white-nose syndrome," says Allender. The *P. destructans* fungus has killed more than six million bats in North America. (Read how people are trying to save bats from white-nose syndrome.)

While *Ophidiomyces* has been found in dozens of different snake species, it seems to hit some harder than the rest. For instance, scientists have recorded infection rates of 80 percent in some populations of common water snakes, says Allender, though their mortality rates are relatively low. Rattlesnakes and other vipers, on the other hand, are particularly susceptible to infection and death.

At one point, Allender says, the mortality rate of infected eastern massasauga rattlesnakes—native to the Northeast and the Midwest—was more than 90 percent, he says. Though the massasauga outbreak has not drastically reduced the population, as of 2021, "it's not in good shape," he says.

Reason for optimism

Conservationists say the good news is that the fungus overall does not seem to be as dire to snake populations as white-nose syndrome or the chytrid fungus, *Batrachochytrium dendrobatidis*, which has led to 100 percent mortality in some amphibian populations, particularly in Central America. (Read how chytrid also indirectly harms tropical snakes, which prey on amphibians.)

"Things like chytrid and white-nose syndrome have come in and caused massive population declines in a very short period of time, but other diseases take their toll much more slowly," says Lorch. Snake fungal disease, he says, "could potentially be more of a slow burn-type disease."

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In the meantime, the largest concern seems to be for rare snakes, such as the eastern indigo snake, which is endangered in Georgia and Florida due to development of its habitat. These black, iridescent snakes also rely on old burrows created by gopher tortoises, another reptile species in decline, says Houston Chandler, science director of the Georgia-based Orianne Society, which specializes in indigo snake conservation.

In other words, indigo snakes already have enough problems. But in some areas of southern Georgia, more than half of the eastern indigo snakes sampled have snake fungal disease, Chandler says. So far, the scientists have not recorded any mass mortality events in the infected snakes.

"So it's not encouraging, but it doesn't appear to be an immediate conservation concern, either," Chandler says.

Finding solutions to the fungus

Curiously, some studies have shown the fungal infection changes the way snakes behave, says Steven Price, a conservation biologist at the University of Kentucky and National Geographic Explorer who studies queen snakes.

For instance, his research shows infected queen snakes in Kentucky stayed outside of their underground burrows longer than those without the disease.

While he can't say for sure, Price suspects infected snakes are spending more time in the sun than non-infected snakes, perhaps to raise their body temperature in an attempt to fight off the fungus.

In New Hampshire, Marchand and colleagues have found timber rattlers gravitate to breaks in the forest canopy, suggesting that exposure to sunlight can keep the snakes healthy.

To this end, Marchand and his colleagues have begun experimenting with clearing patches of timber in an effort to give their serpents more basking areas. (Read about how rattlesnakes trick the human ear with their rattle.)

Likewise, Allender's team has been testing potential anti-fungal treatments.

They've discovered that a popular, over-the-counter fungicide called propiconazole, commonly used on fruit trees and shrubs, has no effect on *Ophidiomyces*—if anything, it boosted the fungus's growth in laboratory experiments, Allender says.

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Yet another option, called terbinafine, is already used to combat nail fungus in people. In a 2017 study, Allender showed that cottonmouths placed in a nebulizer tank built up significant concentrations of the drug in their bodies. Slow-release terbinafine implants also proved effective in supplying the snakes with the medicine.

If further research shows terbinafine kills off *O. ophiodiicola*, both delivery methods could prove useful as non-invasive, safe ways to treat wild, venomous species that are particularly at risk of extinction.

In general, there isn't enough funding to study reptile pathogens, adds Lorch, in part because "snakes are still a pretty maligned group of wildlife, so there isn't a ton of public interest."

But "we don't want to look back decades later," he says, "and realize that we should have been investing more into studying this disease."

[nationalgeographic.com](https://www.nationalgeographic.com), 8 December 2021

<https://www.nationalgeographic.com>

New footage shows bizarre deep-sea fish that sees through its forehead

2021-12-14

Thousands of feet beneath the surface of Monterey Bay off California, scientists recently captured footage of a fish with a bulbous, translucent head and green orb-like eyes that peer out through its forehead.

This bizarre creature, known as a barreleye fish (*Macropinna microstoma*), is very rarely seen. Researchers with the Monterey Bay Aquarium Research Institute (MBARI) have only spotted the species nine times, despite having sent their remotely operated vehicles (ROV) on more than 5,600 dives in the fish's habitat, MBARI tweeted on Dec. 9.

But last week, a team of scientists deployed MBARI's ROV *Ventana* and caught sight of a barreleye fish suspended in the water.

At the time, the ROV was cruising at a depth of about 2,132 feet (650 meters) in the Monterey Submarine Canyon, one of the deepest submarine canyons on the Pacific coast, Thomas Knowles, a senior aquarist at the Monterey Bay Aquarium, told Live Science in an email. "The barreleye first appeared very small out in the blue distance, but I immediately knew what I was looking at. It couldn't be mistaken for anything else," he said.

"We all knew that this was likely a once in a lifetime experience," since the elusive creature is seen so very rarely, Knowles said.

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As a buzz of excitement rippled through the control room, Knowles kept the ROV camera in focus while the ROV pilot Knute Brekke kept the underwater robot pointed at the barreleye. "We all knew that this was likely a once in a lifetime experience," since the elusive creature is seen so very rarely, Knowles said.

In the light of the ROV, the barreleye's eyes glowed bright green and could be easily seen through the clear, fluid-filled shield that covers the fish's head. These eyes are incredibly light-sensitive and can be oriented straight up, towards the top of the fish's head, or straight ahead, according to MBARI. Two dark-colored capsules sit in front of the fish's eyes and contain the organs the animal uses to smell.

The barreleye fish's habitat ranges from the Bering Sea to Japan and Baja California. The fish live in the ocean twilight zone, which lies about 650 to 3,300 feet (200 to 1,000 m) underwater; specifically, barreleyes live about 2,000 to 2,600 feet (600 to 800 m) beneath the ocean surface, near the depth where the water plunges into complete darkness, according to MBARI.

Scientists have little sense how many of these gelatinous helmet-heads float in the ocean's depths.

"We have no handle on population size, except in a relative sense," Bruce Robison, an MBARI senior scientist, told Live Science in an email. Barreleyes are less abundant than commonly-seen twilight zone fish, such as lanternfish or bristlemouths, and the MBARI team encounters barreleye fish about as often as they do anglerfish, whalefish and gulpers, "which is very rarely," he said.

Based on past observations by MBARI researchers, published in 2008 in the journal *Copeia*, scientists think that barreleye fish mostly remain motionless as they wait for unwary prey, like zooplankton and jellyfish, to drift overhead. The fish can hover this way thanks to a set of broad, flat fins that extend out from its body. By pointing their verdant eyes straight upward, barreleyes can spot the silhouettes of their prey from above, and the green pigment in their eyes likely helps filter out sunlight from the ocean surface.

Once a barreleye fish spots a bioluminescent jelly or tiny crustacean floating by, it zooms upward to snag the creature in its mouth while rotating its eyes forward, so it can see where it's going. Scientists speculate that *M. microstoma* may sometimes swipe food from siphonophores — jellyfish-like organisms that cling together in long lines and capture prey

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in their tentacles, according to a 2009 MBARI video. The barreleye fish's transparent head shield might protect it against the stinging cells in the siphonophores' tentacles — but again, this is speculation.

"Most aspects of their natural history remain unknown and much of what we think we know about them is based on speculation," Robison said. Although *M. microstoma* was first described in 1939, fishers caught these early specimens in nets that destroyed their transparent head shields. So scientists didn't know about the shields until the 2000s, when MBARI scientists saw a barreleye fish in its natural habitat, he said. As of today, there's still much to learn about the funky fish.

On their recent dive, the team avidly watched the *M. microstoma* specimen until it swam away and then continued their search for jellies and comb jellies of the deep sea. "We had no ambition to collect this animal," as the aquarium is not adequately set up to care for the poorly understood fish, Knowles said. That said, many other bizarre and wondrous creatures from the deep sea will soon be on display at the aquarium.

In spring 2022, the Monterey Bay Aquarium will open a new exhibition called "Into the Deep: Exploring Our Undiscovered Ocean," which will feature all sorts of deep-sea creatures, from giant isopods to sea spiders to blood-belly comb jellies, according to the aquarium's website. And like the barreleye fish, many of these creatures look like something plucked straight from a sci-fi novel.

[livescience.com](https://www.livescience.com), 14 December 2021

<https://www.livescience.com>

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Gut bacteria let vulture bees eat rotting flesh without getting sick

2021-12-08

Mention foraging bees and most people will picture insects flitting from flower to flower in search of nectar. But in the jungles of Central and South America, "vulture bees" have developed a taste for decaying flesh.

They are "the weirdos of the bee world," says insect biologist Jessica Maccaro of the University of California, Riverside. Most bees are vegetarian.

Scientists have puzzled over why the stingless buzzers seem to prefer rotting carcasses to nectar (SN: 2/11/04). Now, Maccaro and colleagues think they have cracked the riddle by looking into the bees' guts.

Vulture bees (*Trigona* spp.) have a lot more acid-producing gut bacteria than their vegetarian counterparts do, Maccaro and colleagues report November 23 in *mBio*. And those bacteria are the same types that protect carrion feeders such as vultures and hyenas from getting sick on rotting meat.

To probe the bees' insides, Maccaro's colleagues trekked into a Costa Rican jungle. Since vulture bees feed on almost any dead animal, including lizards and snakes, the researchers cut up store-bought chicken and suspended the raw flesh from tree branches. To deter ants, the team smeared petroleum jelly on the string that the meat dangled from.

"The funny thing is we're all vegetarians," says entomologist Quinn McFrederick, also of UC Riverside. "It was kind of gross for us to cut up the chicken." That gross factor quickly intensified in the warm, humid jungle: The meat rotted, turning slimy and stinky.

Bees took the bait within a day. As the scavengers stopped by to dine, the researchers trapped about 30 bees. The team also captured another 30 or so of two other types of local bees — one that feeds on only flowers and one type that dines on both flowers and rotting meat. All bees were stored in alcohol-filled vials to preserve the insects' DNA for analysis, as well as the DNA of any gut microbes.

Strictly meat-eating bees had between 30 percent and 35 percent more acid-producing gut bacteria than strictly vegetarian bees and the ones that sometimes eat meat, the team found. Some types of these microbes showed up only in the solely carnivorous bees.

They are "the weirdos of the bee world," says insect biologist Jessica Maccaro of the University of California, Riverside.

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Similar acid-producing bacteria in the guts of vultures and hyenas keep toxin-producing microbes in rotting meat from making the animals sick. The microbes probably do the same for the meat-eating bees, the team says.

The health benefit extends beyond individual bees, says David Roubik, an evolutionary ecologist at the Smithsonian Tropical Research Institute in Balboa, Panama, who was not involved in the work. Vulture bees regurgitate some of the meat they consume, storing it in their nests where it serves as food for young bees. Some of the acid-loving gut bacteria end up in this food reserve, Roubik says. "Otherwise, destructive bacteria would ruin the food and release enough toxins to kill the colony."

In the end, Maccaro says, it's hard to know which evolved first — the gut bacteria or the bees' ability to eat meat. But the bees probably first turned to meat because there was so much competition for nectar for food, she suspects.

Sciencenews, 8 December 2021

<https://www.sciencenews.org>

Dermal filler do's and don'ts for wrinkles, lips and more

2021-12-09

People are seeking treatments to smooth smile lines and crow's feet and plump up their lips, cheeks, and hands.

Injecting dermal fillers into the face and hands can improve the appearance of facial lines and volume loss caused by age or certain medical conditions. In studies of dermal fillers approved by the U.S. Food and Drug Administration, people generally report they are satisfied with their treatment results.

However, dermal fillers are not for everyone. Dermal fillers may not be appropriate for people with certain conditions, such as bleeding disorders or some allergies. If your health care provider confirms that dermal fillers are an option for you, know that all medical products have benefits and risks. The FDA advises you work with a licensed health care provider who is experienced in injecting dermal fillers, knowledgeable about fillers, anatomy, managing complications, and most importantly, tells you about the risks and benefits before receiving treatment.

What are dermal fillers?

However, dermal fillers are not for everyone.

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Dermal fillers are gel-like substances injected under the skin. Dermal fillers are meant to create a smoother or fuller appearance, or both.

The FDA regulates dermal fillers as medical devices. As reported in clinical trials, the effects of most FDA-approved dermal fillers are temporary because they are made from materials that the body eventually breaks down and absorbs. The injection procedure may have to be repeated to maintain the desired effect.

Types of dermal fillers

Temporary fillers include the following materials:

- Hyaluronic acid, a sugar that is naturally found in the body
- Calcium hydroxylapatite, a mineral and a major component of bone
- Poly-L-lactic acid (PLLA), a biodegradable, synthetic material

There's only one FDA-approved dermal filler that is not absorbed by the body. It is made with polymethylmethacrylate (PMMA) beads suspended in a solution that contains bovine (cow) collagen. PMMA beads are tiny round, smooth, plastic beads.

FDA-approved uses of dermal fillers

Dermal fillers are approved for specific uses in people aged 22 and older. Those uses include:

- Correcting moderate-to-severe facial wrinkles and skin folds
- Increasing fullness of lips, cheeks, chin, under-eye hollows, jawline, and back of the hand
- Restoring facial fat loss in people with human immunodeficiency virus (HIV)
- Correcting acne scars on the cheek

FDA warnings about unapproved fillers

- The FDA has not approved injectable silicone or any injectable fillers for body contouring or enhancement. The FDA has warned against getting filler injected into the breasts, buttocks, or spaces between the muscles. Using injectable filler for large-scale body contouring or body enhancement can lead to serious injury, including long-term pain, infection, permanent scarring or disfigurement, and even death.

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- The FDA has not approved needle-free devices for the injection of dermal fillers and warns against using them to inject hyaluronic acid or other lip and facial fillers. The injectors use high pressure and do not provide enough control over where filler will be placed. Serious injuries and in some cases, permanent harm to the skin, lips or eyes have occurred.
- The FDA also warns against buying or using lip or facial fillers that are sold directly to the public. They are not FDA approved and may be contaminated with chemicals and infectious organisms. The only FDA-approved dermal fillers are supplied by a prescription for injection by a licensed health care professional using a syringe with a needle or a cannula (a small flexible tubing with a blunt tip that is inserted under the skin).

Risks of FDA-approved fillers

As with any medical procedure, there are risks involved with the use of dermal fillers. Most side effects reported in clinical trials and post-market surveillance occur shortly after injection and go away within a few weeks. In some cases, side effects may emerge weeks, months, or years later.

Common risks include:

- Bruising
- Redness
- Swelling
- Pain
- Tenderness
- Itching
- Rash
- Difficulty in performing activities (only observed when injected into the back of the hand)

People should be tested for allergies before receiving dermal fillers made with certain materials, especially materials derived from animals, such as collagen.

Unintended injection into blood vessels

The most serious risk associated with dermal fillers is accidental injection into a blood vessel. Filler that enters a blood vessel can cause skin necrosis

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(death of tissue), stroke, or blindness. While the chances of this happening are low, if it does happen, the resulting complications can be serious and may be permanent.

Removing Dermal Fillers

If you want to have fillers removed or reduced because of side effects, you may need additional procedures to reduce the filler or surgery to remove it. These procedures carry their own risks. Be aware that it may be difficult or impossible to remove some filler materials.

6 Tips for Consumers About Injectable Dermal Fillers

1. Do work with a licensed health care provider who has experience in the fields of dermatology or plastic surgery and is trained to inject dermal fillers. The provider should use properly labeled, sealed vials or pre-filled syringes of FDA-approved filler.
2. Do request and read the patient labeling information on FDA-approved injectable dermal fillers from your licensed health care provider.
3. Do know the type of product to be injected and the possible risks. Know where each product you will be receiving is to be injected. Talk to your licensed health care provider if you have any questions.
4. Do not buy dermal fillers that are sold directly to the public. They may be fake, contaminated, or not approved for use in the U.S. FDA-approved dermal fillers are indicated for prescription use only.
5. Do not inject yourself with dermal fillers or with needle-free injection "pens."
6. Do not get any type of filler or liquid silicone injected for body contouring.

Dermal Fillers and Botulinum Toxin Products

The FDA also has approved botulinum toxin products such as Botox, Dysport, Xeomin and Jeuveau to treat facial wrinkles. These products are not dermal fillers. They are injectable drugs that work by keeping muscles from tightening, so the wrinkles don't show as much. The safe use of dermal fillers in combination with Botox and other treatments has not been evaluated in clinical studies.

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Although botulinum toxin products are derived from the same bacteria that cause botulism, the amounts used for cosmetic purposes are purified and many orders of magnitude smaller.

The FDA has approved these injectable drugs for the temporary improvement in the appearance of one, or perhaps several types of facial lines, including frown lines, forehead lines, and crow's feet.

Side effects reported in clinical trials include facial weakness, eyelid drooping, and brow drooping. Other adverse events included localized pain, swelling, reddening, and bruising at the injection site. In rare cases, injections have resulted in double vision, dry eyes, or difficulty swallowing or breathing. The injection of botulinum toxin products for cosmetic purposes is not recommended for use while pregnant or lactating.

Additional Information

If you have experienced a problem with a dermal filler product or other product regulated by the FDA, you can voluntarily report it to MedWatch, the FDA safety information and adverse event reporting program.

[fda.gov](https://www.fda.gov), 9 December 2021

<https://www.fda.gov>

Newfound flavor of omicron variant may be harder to track

2021-12-09

Scientists have identified an additional version of the omicron coronavirus variant, one that carries many of the same mutations as the original but lacks one key genetic quirk, The Guardian reported. That quirk makes it easy for standard PCR tests to distinguish new cases of omicron from delta or other variants, so the newfound version of omicron might be harder to spot.

Researchers have now proposed splitting the omicron lineage, known as B.1.1.529, into two sublineages: BA.1, for the version of omicron that was initially identified, and B.2, for the newfound version. The split was suggested and implemented within the last few days on Cov-Lineages, an online system used to document SARS-CoV-2 lineages and their spread.

"There are two lineages within Omicron, BA.1 and BA.2, that are quite differentiated genetically," Francois Balloux, the director of the University College London Genetics Institute, told The Guardian. "The two lineages

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may behave differently," although that has yet to be confirmed. **PLAY SOUND**

One key difference between the two sublineages may make BA.2 slightly harder to track, The Guardian reported.

That's because BA.1 has a "deletion" in the gene that codes for its spike protein, which the virus uses to infect cells. This deletion, called 69-70del for short, eliminates six bases from the overall RNA sequence, which in turn deletes two "building blocks" from the final spike protein, according to the American Society for Microbiology.

PCR tests scan for multiple genes on the coronavirus, including this spike protein gene, but variants with 69-70del won't test positive for the spike. Instead, they cause the PCR test to display an error that reads "S gene target failure." This quirk actually makes the variants with 69-70del, namely omicron and alpha, easier to spot on PCR. After flagging such cases, scientists then run the samples through a full genomic analysis, to confirm which variant caused a given infection.

"The S-gene dropout was critical to get that quick view in many different parts of South Africa," and thus track the spread of the BA.1 sublineage, Sarah Otto, a professor in evolutionary biology at the University of British Columbia, told the Financial Times. But BA.2 does not carry the 69-70del mutation, meaning it won't stand out from other variants on standard PCR tests and scientists may need to look harder to find it.

So far, there have been seven cases of BA.2 reported globally, with the cases appearing in South Africa, Australia and Canada, according to The Guardian.

While there are a number of differences between the two omicron sublineages, there's no immediate reason to think that one will behave differently from the other, David Stuart, a professor of structural biology at Oxford University, told the Financial Times. "I don't think there's any reason to think that the new outlier is any more of a threat than the form of omicron that's knocking around at the moment in the U.K., but it is terribly early," he said.

Read more about the "stealth" omicron lineage in The Guardian and the Financial Times.

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<https://www.livescience.com>

What killed millions of honey bees at this Everett farm?

2021-12-12

EVERETT — The honey bee cadavers may have numbered in the millions.

Mounds of black-and-yellow stripes littered the ground last summer at Getchell Ranch, a small organic farm on Ebey Island, along the Snohomish River. All those legs and wings and mandibles and stingers, usually buzzing with activity, lay motionless.

State investigators and entomologists suspect pesticides that can be bought over the counter were the cause of death. Likely, they surmised, the bees foraged nectar and pollen from flowering plants laden with the toxic chemicals, or drank from a contaminated water source. But they couldn't figure out where the pesticides came from.

Nor could they confirm the exact death toll. By the time investigators got to the farm, the beekeeper had cleaned out some of the hives and moved many others to a nearby property, fearing more would get poisoned.

Bee kills like this have become rare in Washington in recent years, but the event in June serves as a cautionary tale: Misusing pesticides can bring harm to honey bees, a vital part of the state's agriculture, and a livelihood to those who keep them. Experts urge people to avoid applying pesticides on plants while they're in bloom, or near water sources that could attract thirsty bees, particularly on hot days. And they suggest using less toxic products.

The beekeeper in this case stands to lose a considerable amount of money, from replacing contaminated equipment to losing income in the pollination season. He takes his hives to California to pollinate almond trees, and to the Midwest for canola crops.

He arrived at Getchell Ranch on June 16 to find his bees dead and dying, according to a report by state investigators. He reported he lost 240 hives — each with tens of thousands of bees — out of about 1,400. In the decades he has been tending to hives at the farm, he had rarely seen so many die at the same time.

undefined.

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The bees had been alive just a couple of days before, the keeper reported, according to documents. A Herald reporter could not reach him for an interview.

The farm's owner, Maria Foster, got in touch with Charlie Coslor, an entomologist with the Washington State University extension in Skagit County.

Coslor, also the director of Skagit County's pest control board, has been working with bugs for over a decade. He said he hasn't seen a scene quite like it before. He went to the farm, collected samples, froze them and sent them along to the state for testing.

The state Department of Agriculture's pesticide compliance program reviewed the incident. Investigators started with a lineup of suspects: It could have been a nearby farm, or perhaps the county or the state played a role. Maybe the city of Everett was doing something at Rotary Park, just across the river. Or a water source might have been contaminated.

One by one, the suspects offered their alibis.

The state Department of Fish and Wildlife and the Snohomish County agriculture coordinator reported they didn't spray in the area.

A maintenance supervisor with Everett Public Works said they used to treat some nearby detention ponds, but hadn't done so since 2019. They also haven't used any pesticides at Rotary Park, he reported.

Investigators tested nearby water sources, but didn't find any noticeable amounts of contaminants.

Foster said she doesn't think anybody on her side of the river had anything to do with it. She called her neighbors and knocked on their doors to make sure. She didn't know anyone who would use pesticides on blooming plants.

She doesn't use any herself, she said. Her farm is completely organic.

"I think chemicals are bad for the world," Foster said. "I don't like eating them and I don't like them in my water and I don't like to breathe them, so I'm not going to use them."

She isn't trying to bring anyone to justice, she said. She just wants to raise awareness around pesticides.

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"I don't think people realize, on one hand they say, 'Save the bees, figure out why they're disappearing,'" she said, "and then on the other hand they say, 'Oh, we got bugs, let's spray them.'"

Foster inherited the 94-acre farm a couple of years ago from her adopted father, Alex Alexander. Founded in 1873, Getchell Ranch is one of the oldest homesteads in the region. Foster is currently using it for sheep and goats and a small orchard, she said. And ranchers will rent out some pasture to let their livestock graze.

This summer, Foster worked with the Washington Farmland Trust to secure a conservation easement, a legal agreement that permanently limits uses on the property, effectively preserving it as a farm into the future.

Because bees can forage up to a couple miles away, pinpointing the source of the pesticides proved to be an impossible task, said Tim Schultz, compliance manager for the state's pesticide management division. Around Getchell Ranch, there are other properties used for pasture, hay and grain. And across the river, there is a plethora of homes and businesses along the I-5 corridor.

If a source could be found, the state would have a couple of options, Schultz said. It could give a notice of correction, where the violator has a chance to correct course, or it could issue a fine. There would also be a chance for the beekeeper to get restitution for his losses.

"In this case, unfortunately, we weren't able to find the source just because of the nature of the location, so we had to close it out," Schultz said.

The whodunit may never have a suspect.

It has Coslor scratching his head.

"We know the murder weapon, I suppose," Coslor said, "but not who did what, in what room, on the Clue board."

After the state completed its testing, Coslor reviewed the chemical analysis of the bees and discovered high concentrations of pesticides.

"I saw the numbers and was like, 'Wow, carbaryl was off the charts,'" he said.

At least one bee had over 15 times the lethal dosage.

Anyone can buy carbaryl at the store. It's less toxic than pesticides that have been used in the past, but it can still be potent, especially to bees.

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According to the U.S. Environmental Protection Agency, people who have prolonged exposure to carbaryl can suffer headaches, memory loss, muscle weakness and cramps. It was banned from store shelves in California last year because misuse would sometimes make people sick. A news release from the California Department of Pesticide Regulation notes most misuse happened in residential application, where people aren't trained in the use of pesticides. Commercial users, meanwhile, must be licensed, the same as in Washington.

Historically, the pesticide has been sold under the brand name Sevin, though the company GardenTech has been moving away from using carbaryl in recent years. Sevin products have a warning that it could kill honey bees in substantial numbers if sprayed on blooming plants.

Labels on pesticide products carry the weight of federal law. Stray from the instructions and you could be penalized.

"In this case it just seems like the label wasn't followed at all," Coslor said.

Doing some back-of-the-napkin math, Coslor estimated it would take 24 grams of carbaryl to cause a bee kill of the scale seen at Getchell Ranch. That's about the equivalent of what's found in a one-pound container of Sevin "Ready-to-Use 5% Dust." (Though if bees picked up the pesticide while foraging, it's unlikely a single container was responsible for all those deaths.)

Thanks to restrictions and education, bee kills now happen in Washington just once or twice a year, said Katie Buckley, the state's pollinator health coordinator.

"But unfortunately, either mistakes happen or malpractice happens," she said.

Overall, farmers in the state have worked well with bees, Buckley said. Many keep pollinators in mind when using pesticides.

"Growers out here need the bees too," she said. "They don't want to kill the bees ... they're very tightly interwoven together."

Buckley said June's bee kill is a reminder that more work can be done. She leads a new state task force assigned to protecting pollinators, with a focus on education. In the near future, she said, the task force will start reaching out to people who might buy pesticides at local nurseries, as well as professionals who use pesticides commercially.

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But pesticides are just one of many challenges confronting bees, Buckley said. They also have to deal with habitat loss, diseases and invasive species, like the now-infamous “murder hornets.”

Despite those obstacles, not everything is bad news for pollinators, Buckley said. She said more people are stepping up to help them. They’re thinking about how to grow pollinator-friendly gardens, how best to use pesticides or avoid them altogether, and how to pass laws with the critters in mind.

“I think there’s a lot of cause to be hopeful,” she said.

heraldnet.com, 12 December 2021

<https://www.heraldnet.com>

Are teeth considered bones?

2021-12-11

Teeth are a vital indicator of our overall health, but are teeth considered bones? We need them for biting and chewing, but our teeth also ensure our jaw develops properly and aid speech. Not looking after our teeth can cause tooth decay and gum disease, leading to the removal of the offending teeth. And although they may resemble bones, what are they really?

We take a closer look at what teeth are made of, the different types of teeth and whether we can do without any of them. If you want to keep your pearly whites clean and healthy, learning how to use an electric toothbrush is a great way to take better care of your teeth. Make sure to check out our Philips electric toothbrush deals if you’re in the market for a new toothbrush as well.

ARE TEETH CONSIDERED BONES?

Bones and teeth are the hardest substances in the human body. They both contain calcium and together they account for 99% of the mineral in your body; the remaining 1% of calcium is found in your blood.

But that’s where the similarities end. Bone is a living tissue consisting of a collagen scaffold framework, filled in with calcium phosphate. This makes it strong but flexible, and because it is a living entity, it is constantly being regenerated and undergoing repair if damaged.ve Science Video in 13 secondsAY SOUND

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“Teeth are a very different structure to bone,” Cat Edney, a dental hygienist and therapist, told LiveScience. “Teeth are made of nerve tissue, dentine and a hard shell-like structure: enamel. Enamel is the hardest tissue in the human body but it can also be worn away by bacteria, acid or chipped if we don’t look after our teeth properly.”

The innermost layer of your teeth is called pulp and contains blood vessels, nerves and connective tissue. Inflammation of the pulp is what causes pain when you have toothache. The pulp is covered by dentine, the hard supporting structure of the tooth, and then enamel, which is made of calcium phosphate. Under the gum line, you’ll find cementum; this covers the root and helps the tooth stay in place.

Because the outer part of our teeth is not a living tissue, our teeth cannot naturally repair themselves when damaged. Enamel can be remineralized, but it can’t regenerate if significantly damaged. This is why it’s so important to look after our teeth and treat tooth decay and cavities as soon as possible.

WHAT ARE THE FOUR TYPES OF TEETH?

We are all born with a full set of baby teeth within our jaw; we’re just not aware of them until they start to come through! Babies tend to get their first teeth between six and 12 months – 10 at the top and 10 at the bottom, according to the NHS. By the time a child’s 13 or 14, these baby teeth will have been replaced with a set of 32 larger, permanent adult teeth.

We have four different types of teeth: the incisors, canines, premolars and molars. The incisors are the first to come through, the bottom two first and then the top two, followed by the lateral incisors either side. These are usually the first to fall out.

“Incisors are the front teeth and are used for slicing food when we bite into it,” said Edney. “They protect our lips and tongue and help us with creating sounds when we speak.”

Next to erupt are the premolars; these are bigger and wider than the incisors and are used for crushing, grinding and chewing. Then come the canines. We have four in total, located next to each of the outermost incisors.

“Canines are the pointy corner teeth and are used for tearing food,” explained Edney. “They also are very important to the other teeth because they protect them from being worn away – canines have a ramp-like

And although they may resemble bones, what are they really?

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shape on the back of them so that when we slide our jaw from side to side, they force our bite open, stopping us from breaking the edges of the other teeth.”

The molars are the last to come through. These are the main chewing and food-grinding teeth; they ensure that food is small enough to swallow and they also support the jaw and protect the tongue, explained Edney. There are 12 in total, six at the top and six at the bottom, and they include our wisdom teeth. If you're curious, we've also explored the question, 'Can wisdom teeth grow back?'

DO WE NEED ALL OF OUR TEETH?

Each type of tooth has its own role in helping us bite, tear and chew food, but they also help maintain the shape and structure of the jaw. Baby teeth act as a guide for our permanent teeth and aid in the development of speech.

The baby teeth are replaced with adult teeth once the jaw has stopped growing and we need both sets to accommodate the change in our jaw size over time. But do we really need them all, and what happens if we don't have a full set of 32 teeth?

“Really all of the teeth have their own role and function in our mouths but we are lucky to have three molars on each quarter and two premolars,” said Edney. “Some people have one premolar per quarter removed to make space for braces to straighten their teeth.”

The third molars, or wisdom teeth, are the furthest back in the mouth and come through last, between the ages of 17 and 21, according to Mouth Healthy, part of the American Dental Association (ADA). For some people they cause no issues, but for others they can be problematic, either causing pain or not erupting properly.

“Some people do not have enough space for their third molar or Wisdom teeth and these can often be removed without causing too much upset to the person's chewing function,” added Edney.

So, if you have teeth removed to accommodate braces or your wisdom teeth are impacted, it's unlikely to affect your chewing capabilities too much. But if you have lost a tooth for any other reason, your other teeth may shift into the gap, say The Mayo Clinic. If tooth loss is widespread

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this can affect the shape of your jaw and face, and your ability to eat, so implants may be necessary to restore the structure and your smile.

livescience.com, 11 December 2021

<https://www.livescience.com>

Astronomers anxiously watch Comet Leonard to see if it will live up to predictions as a Christmas treat over Australia

2021-12-09

Like many astronomers around the world, Michael Mattiazzo is anxiously watching the sky right now.

The veteran comet chaser is monitoring the progress of Comet Leonard as it streaks towards the Sun.

The small comet is not yet visible in the southern hemisphere, but if it survives the next seven days, it could put on a nice show in Australian skies for Christmas.

But as the saying goes, comets are like cats: they both have tails and they do precisely what they want.

“[Comets] are difficult to predict and that's what makes them so interesting,” said Mr Mattiazzo, an amateur astronomer from Victoria who runs the Southern Comet Homepage.

“They can sometimes surprise you and they can often disappoint you.”

And right now, C/2021 A1 Comet Leonard is threatening to break apart.

“It's hanging by a thread,” said Mr Mattiazzo, who has been observing comets since 1986 and has discovered several of these astronomical objects.

“Given my observing experience, I know that this comet is slightly in trouble because it's at the borderline of whether it will survive its approach to the Sun or not.

“It's a day-to-day wait.”

Where did Comet Leonard come from?

Comet Leonard was discovered on January 3 this year by US astronomer Greg Leonard.

But as the saying goes, comets are like cats: they both have tails and they do precisely what they want.

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At about just 1 kilometre across, the dirty snowball – or snowy dirtball – hails from way out in the icy reaches of our Solar System, astronomer Jonti Horner said.

‘It’s a lump of ice and rubble that is left over from the formation of the Solar System 4.5 billion years ago.’

The comet moves on a highly elliptical orbit that takes it out about 3,700 times further from the Sun than we are.

Whizzing along at speeds of up to 70 kilometres per second, it has probably taken tens of thousands of years to reach us.

‘The last time it came through the inner Solar System was probably 80,000 years ago,’ Professor Horner said.

The comet is predicted to swing around the Sun on January 3, 2022 – if it makes it that far.

‘One good thing is the Earth approach happens before the Sun approach,’ Mr Mattiazzo said.

As a comet gets closer to the Sun, it heats up and can break apart.

‘If it ends up [breaking apart] after its Sun approach, that’s fine.’

When can we see it?

If the comet hangs together, we’ll see it in the skies above Australia from December 17 onwards.

The comet is currently visible to the naked eye in the early morning from dark-sky sites in the northern hemisphere.

Images Mr Mattiazzo has remotely taken using a US telescope show the comet has a halo of blue gas and a straight dust tail.

‘When you see a flattened head on a comet, you know it’s a small object, so it’s going to battle to win the solar encounter,’ Mr Mattiazzo said.

It will sweep past Earth on December 12.

As it comes closer – flying past about 35 million kilometres away – it will get brighter but drop from view in the northern hemisphere.

‘The northerners will lose out, they will only see it up to about December 11,’ Mr Mattiazzo said.

Then the southern hemisphere will get the prime view.

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‘The fun will start when it is visible from December 17, that’s when I’ll be out every night trying to capture it with a telescope and a camera,’ Mr Mattiazzo said.

On December 18, the comet has a close encounter with Venus, coming to within just 4 million kilometres of our closest planetary neighbour.

That will make it the closest approach of a comet to Venus in recorded history, Professor Horner said.

‘That means from the point of view of Venus, it would be really, really spectacular,’ he said.

It also means we will be able to use Venus as a guide to find it in the sky.

You’ll see comet to the left of Venus low above the western horizon on December 17 and 18, once the sky gets dark enough after twilight.

Then each night after that it gets higher and higher in the sky.

By Christmas night it should be relatively high, Mr Mattiazzo said.

‘It should be 25 degrees above the horizon and also there will be a beautiful alignment of the planets with Venus, Saturn and Jupiter.’

What will it look like?

We don’t know yet, but as far as comets go, it’s not predicted to be as spectacular as Comet Lovejoy, the great Christmas comet of 2011.

‘For a comet to reach great status, it needs to be very bright. We usually get one of those every 10 years,’ Mr Mattiazzo said.

But if it stays together it could reach a magnitude that will look like a fuzzy blob to the naked eye, or clearer in binoculars.

‘Even though it will be potentially naked-eye visible, I would strongly recommend people use a pair of binoculars to observe it and a camera to photograph it,’ Mr Mattiazzo said.

If we are lucky we may see a bright tail as sunlight reflects off the dust trail stretching away from the Sun towards us, in what is known as forward scattering.

‘It’s like an aeroplane contrail at sunset,’ Mr Mattiazzo said.

And the comet could put on a good show even if it does start to break up.

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“All the dust in the comet will be in that forward-scatter position, so it would be very well lit up by the Sun,” Mr Mattiazzo said.

“Even if it does break up, it may be a fascinating sight.”

But first, it has to survive the next week.

abc.net, 9 December 2021

<https://www.abc.net.au>

Bugs across globe are evolving to eat plastic, study finds

2021-12-15

Microbes in oceans and soils across the globe are evolving to eat plastic, according to a study.

The research scanned more than 200m genes found in DNA samples taken from the environment and found 30,000 different enzymes that could degrade 10 different types of plastic.

The study is the first large-scale global assessment of the plastic-degrading potential of bacteria and found that one in four of the organisms analysed carried a suitable enzyme. The researchers found that the number and type of enzymes they discovered matched the amount and type of plastic pollution in different locations.

The results “provide evidence of a measurable effect of plastic pollution on the global microbial ecology”, the scientists said.

Millions of tonnes of plastic are dumped in the environment every year, and the pollution now pervades the planet, from the summit of Mount Everest to the deepest oceans. Reducing the amount of plastic used is vital, as is the proper collection and treatment of waste.

But many plastics are currently hard to degrade and recycle. Using enzymes to rapidly break down plastics into their building blocks would enable new products to be made from old ones, cutting the need for virgin plastic production. The new research provides many new enzymes to be investigated and adapted for industrial use.

“We found multiple lines of evidence supporting the fact that the global microbiome’s plastic-degrading potential correlates strongly with measurements of environmental plastic pollution – a significant demonstration of how the environment is responding to the pressures

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we are placing on it,” said Prof Aleksej Zelezniak, at Chalmers University of Technology in Sweden.

Jan Zrimec, also at Chalmers University, said: “We did not expect to find such a large number of enzymes across so many different microbes and environmental habitats. This is a surprising discovery that really illustrates the scale of the issue.”

The explosion of plastic production in the past 70 years, from 2m tonnes to 380m tonnes a year, had given microbes time to evolve to deal with plastic, the researchers said. The study, published in the journal *Microbial Ecology*, started by compiling a dataset of 95 microbial enzymes already known to degrade plastic, often found in bacteria in rubbish dumps and similar places rife with plastic.

The team then looked for similar enzymes in environmental DNA samples taken by other researchers from 236 different locations around the world. Importantly, the researchers ruled out potential false positives by comparing the enzymes initially identified with enzymes from the human gut, which is not known to have any plastic-degrading enzymes.

About 12,000 of the new enzymes were found in ocean samples, taken at 67 locations and at three different depths. The results showed consistently higher levels of degrading enzymes at deeper levels, matching the higher levels of plastic pollution known to exist at lower depths.

The soil samples were taken from 169 locations in 38 countries and 11 different habitats and contained 18,000 plastic-degrading enzymes. Soils are known to contain more plastics with phthalate additives than the oceans and the researchers found more enzymes that attack these chemicals in the land samples.

Nearly 60% of the new enzymes did not fit into any known enzyme classes, the scientists said, suggesting these molecules degrade plastics in ways that were previously unknown.

“The next step would be to test the most promising enzyme candidates in the lab to closely investigate their properties and the rate of plastic degradation they can achieve,” said Zelezniak. “From there you could engineer microbial communities with targeted degrading functions for specific polymer types.”

The first bug that eats plastic was discovered in a Japanese waste dump in 2016. Scientists then tweaked it in 2018 to try to learn more about how it evolved, but inadvertently created an enzyme that was even better at

The results “provide evidence of a measurable effect of plastic pollution on the global microbial ecology”, the scientists said.

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breaking down plastic bottles. Further tweaks in 2020 increased the speed of degradation sixfold.

Another mutant enzyme was created in 2020 by the company Carbios that breaks down plastic bottles for recycling in hours. German scientists have also discovered a bacterium that feeds on the toxic plastic polyurethane, which is usually dumped in landfills.

Last week, scientists revealed that the levels of microplastics known to be eaten by people via their food caused damage to human cells in the laboratory.

[theguardian.com](https://www.theguardian.com), 15 December 2021

<https://www.theguardian.com>

When did scientists first warn humanity about climate change?

2021-12-13

Climate change warnings are coming thick and fast from scientists; thousands have signed a paper stating that ignoring climate change would yield “untold suffering” for humanity, and more than 99% of scientific papers agree that humans are the cause. But climate change wasn’t always on everyone’s radar. So when did humans first become aware of climate change and the dangers it poses?

Scientists first began to worry about climate change toward the end of the 1950s, Spencer Weart, a historian and retired director of the Center for History of Physics at the American Institute of Physics in College Park, Maryland, told Live Science in an email. “It was just a possibility for the 21st century which seemed very far away, but seen as a danger that should be prepared for.”

The scientific community began to unite for action on climate change in the 1980s, and the warnings have only escalated since. However, these recent warnings are just the tip of the melting iceberg; people’s interest in how our activities affect the climate actually dates back thousands of years. **PLAY SOUND**

As far back as ancient Greece (1200 B.C. to A.D. 323), people debated whether draining swamps or cutting down forests might bring more or less rainfall to the region, according to Weart’s *Discovery of Global Warming* website, which is hosted by the American Institute of Physics

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and shares the name with his book “*The Discovery of Global Warming*” (Harvard University Press, 2008).

The ancient Greek debates were among the first documented climate change discussions, but they focused only on local regions. It wasn’t until a few millennia later, in 1896, that Swedish scientist Svante Arrhenius (1859-1927) became the first person to imagine that humanity could change the climate on a global scale, according to Weart. That’s when Arrhenius published calculations in *The London, Edinburgh, and Dublin Philosophical Magazine and Journal of Science* showing that adding carbon dioxide to the atmosphere could warm the planet.

This work built on the research of other 19th-century scientists, such as Joseph Fourier (1768-1830), who hypothesized that Earth would be far cooler without an atmosphere, and John Tyndall (1820-1893) and Eunice Newton Foote (1819-1888), who separately demonstrated that carbon dioxide and water vapor trapped heat and suggested that an atmosphere could do the same, *JSTOR Daily* reported.

Arrhenius’ climate change predictions were largely spot on. Human activities release carbon dioxide, methane and other greenhouse gases that trap radiation from the sun and hold them in the atmosphere to increase temperature like a warming greenhouse, hence the term “greenhouse effect.” However, Arrhenius’ work was not widely read or accepted at the time, nor was it even intended to serve as a warning to humanity; it can be viewed as such only in hindsight. At the time, his work simply recognized the possibility of humans influencing the global climate and for a long time, people viewed warming as beneficial, according to Weart.

There was some coverage of fossil fuels affecting climate in the general media, according to a now-viral 1912 article first published in the magazine *Popular Mechanics*, *USA Today* reported. The article, which ran in a few newspapers in New Zealand and Australia later that year, recognized burning coal and releasing carbon dioxide could increase Earth’s temperature, noting that “the effect may be considerable in a few centuries.”

Why the 1950s?

The scientific opinion on climate change wouldn’t begin to shift until two significant experiments some 60 years after Arrhenius’ realization. The first, led by scientist Roger Revelle (1909-1991) in 1957 and published in the journal *Tellus*, found that the ocean will not absorb all of the carbon

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dioxide released in humanity's industrial fuel emissions and that carbon dioxide levels in the atmosphere could, therefore, rise significantly. Three years later, Charles Keeling (1928-2005) published a separate study in *Tellus* that detected an annual rise in carbon dioxide levels in Earth's atmosphere. With carbon dioxide levels known to affect the climate, scientists began to raise concerns about the impact human-related emissions could have on the world.

From there, more studies began highlighting climate change as a potential threat to species and ecosystems around the world. "Scientists first began in 1988 to insist that real action should be taken," Weart said. This occurred at the Toronto Conference on the Changing Atmosphere, where scientists and politicians from around the world gathered to address what was framed as a global threat to Earth's atmosphere, with calls to reduce emissions and knock-on effects such as acid rain.

"By the 1990s, most scientists thought action was necessary, but opposition from fossil fuel companies and ideologists opposed to any government action were effective in obscuring the facts and blocking action," Weart said. "Plus, normal human inertia and unwillingness to do anything without immediate benefits for oneself."

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<https://www.livescience.com>

Antibiotic use in US farm animals was falling. Now it's not

2021-12-14

NEW FEDERAL DATA released Tuesday shows that efforts in the United States to reduce unnecessary antibiotic use in livestock—a persistent generator of drug-resistant superbugs that can harm human health—have lost momentum, five years after the Obama administration imposed long-awaited rules to control misuse.

The US Food and Drug Administration's 2020 report on sales of antibiotics for use in cattle, swine, and poultry—which include many classes of antibiotics also used in human medicine—shows that a sharp drop in sales in 2016 and 2017 stalled out in 2018, moving just a few percentage points up and down since. All told, sales of what the agency calls "medically important" antibiotics totaled 6 million kilograms (13.23 million pounds) in

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2020, a 3 percent dip from the previous year and 8 percent higher than the 5.55 million-kilogram (12.25 million pounds) low point in 2017.

The data comes from an FDA document cumbersomely titled the "Summary Report on Antimicrobials Sold or Distributed for Use in Food-Producing Animals," commonly known as the ADUFA Report (for its enabling legislation, the Animal Drug User Fee Act). It has been published every December since 2009, part of a deal struck during the Obama administration as the first step in a long reform program aimed at changing the way livestock is raised.

Meanwhile, an analysis that matches the first 10 years of those reports with parallel sales data for human medications—gathered not by the FDA but by the private sector—shows that antibiotic use in people has been stable for more than a decade. The analysis, released in November by two science-focused nonprofits, the Natural Resources Defense Council and the Center for Disease Dynamics, Economics and Policy, shows that sales for animal use are twice as high as those for people. In 2019, the year their analysis stopped, animals accounted for 65.3 percent of medically important antibiotics sold.

That is an extraordinary proportion, given that most antibiotics used in animal agriculture are not administered to cure infections—which is what antibiotics are for—but instead as a form of insurance, for preventing infections in crowded feedlots and barns.

Researchers working on the topic are dismayed that farm antibiotic use has not been forced down further. Almost no one, though, seems surprised. They say those Obama-era rules—which outlawed using tiny doses of antibiotics known as growth promoters, used to speed up weight gain—were never adequate. If the US is ever going to make significant progress in curbing animal antibiotic use and the superbugs that flow from it, tougher action is needed.

"We need the FDA to step up," says Matthew Wellington, the public health campaigns director for the US Public Interest Research Group, which leads a coalition that pressures big restaurant chains to buy meat raised without antibiotic overuse. "When they made their initial regulations around growth promotion use, we told them that's not going to be enough: You have to completely eliminate routine use of antibiotics, and make sure that the drugs are only used to treat sick animals in very limited circumstances."

That's a big ask, but there's evidence that it's possible. The European Medicines Agency announced last month that, between 2011 and 2020,

In 2019, the year their analysis stopped, animals accounted for 65.3 percent of medically important antibiotics sold.

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farmers in the European Union cut antibiotic use by 43 percent. The bloc outlawed growth promoters in 2005, and is set to enact a ban next year on giving antibiotics to livestock to prevent future infections. That would restrict European farms to only using antibiotics to treat sick animals—the way we use antibiotics in people and, according to researchers, the only way that balances the benefit of a cure against the risk of provoking resistance. Cutting use on US farms down to that stringent EU standard is a long-sought goal, but given the new FDA data it may be out of reach.

Maybe a little context is in order. It's been clear since the 1940s that resistance—which, broadly speaking, describes mutations that allow pathogens to defuse drugs' attacks on them—arises whenever antibiotics are used. It's evolution in action: If you expose an organism to something potentially lethal, but you don't kill it outright, it can develop defenses to protect itself the next time.

Resistant bacteria have gotten very good at defending themselves: Each year, they kill an estimated 700,000 people around the globe, according to the World Bank, a number that has been predicted to rise to 10 million by 2050. Estimates of annual US deaths range from almost 49,000 people to more than 162,000, plus 2.8 million nonlethal infections. (The World Health Organization's most recent global report identifies approximately 3 million infections per year globally, but that is considered a vast undercount, as it includes only 70 nations whose surveillance systems are up to the task.) Even during the Covid pandemic, the WHO called resistance "one of the biggest threats to global health, food security, and development" worldwide.

Because the volume of antibiotics given to farm animals outstrips what is used in humans, that makes agriculture a petri dish for breeding resistant bacteria; hundreds of studies have shown a clear connection. Those bombproof pathogens harm livestock, cut into farm productivity, and sicken people, crossing to us via meat and manure and through the environment. It's also clear that when farmers stop using so many antibiotics, the incidence of resistant bacteria diminishes. In just one example, the Canadian government mandated cuts in farm antibiotic use in 2014, and by 2019 resistant food-borne bacteria dropped by 38 percent.

The connection between farm antibiotic use and human illness was established in the 1970s, and for just about that long, the FDA attempted unsuccessfully to control the practice. (Its first bold attempt in 1977—when it tried to take away pharma companies' licenses to make farm antibiotics—was foiled by members of Congress from agricultural states

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who threatened to retaliate by holding up the agency's entire budget.) Finally, in 2015, the Obama White House created a national strategy for combating antibiotic-resistant bacteria, including in agriculture. And on January 3, 2017, two weeks before Obama left office, the FDA locked in its prohibition on growth promoters, in a rule titled "Guidance for Industry #213." That rule made growth-promoting doses illegal, and required that any other antibiotic use be approved by a veterinarian. But it left big holes in controlling farm antibiotic use: The rule allowed some to be purchased over the counter, didn't set any limits on how long drugs could be used, and permitted routine preventive use to dose entire flocks or herds.

That was thought to be the best the US could do, especially with the pro-business Trump administration about to take over. But researchers knew in advance that a growth promoter ban would be inadequate. They already had an example of why it wouldn't work: A few years earlier, the government of the Netherlands had noticed that, despite the EU ban in 2006, sales of antibiotics to Dutch farms kept rising. An investigation by academics working with regulatory agencies revealed that companies selling ag antibiotics in the Netherlands had changed the labeling on growth promoters to "preventative use" to circumvent the new law.

That seems to be what has happened in the US. One means of using antibiotics was made illegal, so producers found a different path. "There was a huge increase in 'therapeutic' use right after the elimination of growth promotion," says Lance Price, a microbiologist and professor at the George Washington University's Milken Institute School of Public Health and founding director of its Antibiotic Resistance Action Center. "It was a perfect parallel to what happened in the Netherlands, where they just changed what they called it."

The new federal data does hold one bright spot. The 2020 report reveals that of all the antibiotics sold for agricultural use, raising chickens—the most commonly consumed meat in the US—accounts for only 2 percent of the drugs. That's compared to 41 percent each for cattle and hogs, and 12 percent for turkeys. It represents a complete turnaround for the US chicken industry that began in 2014, when Perdue Foods, then the nation's fourth-largest producer, announced it was taking its entire operation antibiotic-free.

"Only 1 percent of broiler chickens in the US are produced with what the industry calls 'full-spectrum antibiotics,'" Wellington says. "And more than half are raised 'No Antibiotics Ever.' That's incredible. But it means that we're at a standstill with pig and cattle production."

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In 2018, the year after the growth-promoter ban went into effect, the FDA announced it was launching a 5-year plan to further regulate farm antibiotics. But progress has been slow. In June, the agency introduced new rules that would reclassify those remaining over-the-counter drugs—a small number of injectable and topical antibiotics—as prescription-only.

Activists are impatient for the agency to do more. An open letter by researchers published earlier this year, asking the Biden administration for big sweeping actions, did not provoke any response. So advocates are focusing on smaller changes that they feel are reasonable for the FDA to make: more regulation, especially on how long antibiotics can be used in any single animal or herd, and more data-gathering that would allow better insight into how antibiotics are being misused. Annual reporting that tracks resistance rates in bacteria taken from humans and animals, and matches it to both sales and use data, is routine in the EU. In the US, no such comprehensive reports exist.

“First, if the FDA had actually done what it proposed in 2017, we would know more—that is, instead of just reporting sales, report sales with a denominator that reflects the size of the animal population,” says David Wallinga, a physician and senior officer at NRDC and coauthor of the analysis of FDA data. “That’s what they’ve been doing in Europe since 2010. And the second thing is to actually collect data at the farm level on antibiotic use.”

It’s urgent to keep forcing down antibiotic use, because research increasingly is showing how far-reaching the influence of farm antibiotics may be. It’s been clear for a year that resistant infections are affecting people being treated for Covid and also increasing the stress on overwhelmed hospitals; scientists believe some of those infections, particularly resistant fungi, emerged because of agricultural antibiotics. Research published in September shows that when farm antibiotics get into soil, from direct dispersion or via manure, they interfere with microbial communities and reduce carbon storage.

And for five years now, a team based primarily at the Ohio State University has been piecing together a complex cycling of resistance that flows back and forth through farms, hospitals, and sewage, affected by both ag and medical antibiotics and posing hazards in both places. Their research started with the shocking discovery that resistance to a medical last-resort antibiotic, one not used in agriculture, could be isolated from swine on a farm. They then showed the same resistant bacteria, known broadly as

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CREs, slipping past treatment in sewage plants and flowing through US waterways, including toward livestock farms. Most recently they found—though this part is only lab work, so far—that when those bacteria bearing last-resort resistance slip onto farms, the inexpensive old antibiotics already used on animals can help those most dangerous bacteria flourish, by changing the dynamics of a mixed-microbe population in ways that favors their survival.

It’s all one cycle, in other words. “One of the big things to investigate right now is environmental dissemination of high-consequence, antibiotic-resistant bacteria,” according to Thomas Wittum, who leads that research project and is a professor and chair of veterinary preventive medicine at Ohio State. He describes a continuous flow of the genetic material that confers resistance to antibiotics, spiraling from hospitals to sewage to farms to the environment to households and pets and then back to hospitals again—and the need to interrupt that cycle at any available point.

Reducing farm antibiotic use would be one way to put the brakes on. But the data in the FDA report suggests that won’t be happening soon.

wired.com, 14 December 2021

<https://www.wired.com>

In 2021, COVID-19 vaccines were put to the test. Here’s what we learned

2021-12-15

2021 was the year the COVID-19 vaccines had to prove their mettle. We started the year full of hope: With vaccines in hand in record-breaking time and their rollout ramping up, we’d get shots in arms, curb this pandemic and get life back to normal. That was too optimistic.

Roughly 200 million people in the United States — and billions globally — have now been fully vaccinated. Three vaccines — one from Pfizer and its partner BioNTech, and the other two from Moderna and Johnson & Johnson — are available in the United States. Pfizer’s is even available for children as young as 5. About two dozen other vaccines have also been deployed in other parts of the world. In some higher-income countries, the United States included, people have already queued up for booster shots.

But 2021 has also been the year of learning the limits of the vaccines’ superpowers. With the vaccines pitted against aggressive coronavirus

But 2021 has also been the year of learning the limits of the vaccines’ superpowers.

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variants, inequitable distribution, some people's hesitancy and the natural course of waning effectiveness, there's still a lot of work to do to bring this pandemic to an end. As if to hammer home that point, the detection of the omicron variant in late November brought new uncertainty to the pandemic's trajectory. Here are some of the top lessons we've learned in the first year of the COVID-19 vaccine. — Macon Morehouse

The shots work, even against emerging variants

Many COVID-19 vaccines proved effective over the last year, particularly at preventing severe disease and death (SN: 10/9/21 & 10/23/21, p. 4). That's true even with the emergence of more transmissible coronavirus variants.

In January, in the midst of a bleak winter surge that saw average daily cases in the United States peaking at nearly 250,000, the vaccination rollout here began in earnest. Soon after, case numbers began a steep decline.

Over the summer, though, more reports of coronavirus infections in vaccinated people began to pop up. Protection against infection becomes less robust in the months following vaccination in people who received Pfizer's or Moderna's mRNA vaccines, multiple studies have shown (SN Online: 9/21/21). Yet the shots' original target — preventing hospitalization — has held steady, with an efficacy of about 80 percent to 95 percent.

A single dose of Johnson & Johnson's vaccine is less effective at preventing symptoms or keeping people out of the hospital than the mRNA jabs. The company claims there's not yet evidence that the protection wanes. But even if that protection is not waning, some real-world data hint that the shot may not be as effective as clinical trials suggested (SN Online: 10/19/21).

Evidence of waning or lower protection ultimately pushed the United States and some other countries to green-light COVID-19 booster shots for adults (SN: 12/4/21, p. 6).

Much of the worry over waning immunity came amid the spread of highly contagious variants, including alpha, first identified in the United Kingdom in September 2020, and delta, first detected in India in October 2020 (SN Online: 7/30/21). Today, delta is the predominant variant globally.

The good news is that vaccinated people aren't unarmed against these mutated foes. The immune system launches a multipronged attack against invaders, so the response can handle small molecular tweaks to viruses,

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says Nina Luning Prak, an immunologist at the University of Pennsylvania. Dealing with variants "is what the immune system does."

Vaccine-prompted antibodies still attack alpha and delta, though slightly less well than they tackle the original virus that emerged in Wuhan, China, two years ago. Antibodies also still recognize more immune-evasive variants such as beta, first identified in South Africa in May 2020, and gamma, identified in Brazil in November 2020. Although protection against infection dips against many of these variants, vaccinated people remain much less likely to be hospitalized compared with unvaccinated people.

"This is the first time in history that we're basically monitoring virus mutations in real time."

Müge Çevik, infectious diseases physician

Experts will continue to track how well the vaccines are doing, especially as new variants, like omicron, emerge. In late November, the World Health Organization designated the omicron variant as the latest variant of concern after researchers in South Africa and Botswana warned that it carries several worrisome mutations. Preliminary studies suggest that, so far, omicron is spreading fast in places including South Africa and the United Kingdom, and can reinfect people who have already recovered from an infection. The variant might be at least as transmissible as delta, though that's still far from certain, according to a December 9 report from researchers with Public Health England, a U.K. health agency. How omicron may affect vaccine effectiveness is also unclear. Pfizer's two-dose shot, for instance, may be about 30 percent effective at preventing symptoms from omicron infections while a booster could bring effectiveness back up to more than 70 percent, according to estimates from Public Health England. But those estimates are based on low case numbers and could change as omicron spreads.

"This is the first time in history that we're basically monitoring virus mutations in real time," says Müge Çevik, an infectious diseases physician and virologist at the University of St. Andrews in Scotland. "This is what the viruses do. It's just that we're seeing it because we're looking for it."

But it's unlikely that any new variant will take us back to square one, Çevik says. Because of the immune system's varied defenses, it will be difficult for a coronavirus variant to become completely resistant to vaccine-induced protection. The vaccines are giving our immune systems the tools to fight back. — Erin Garcia de Jesús

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The shots are safe, with few serious side effects

With billions of doses distributed around the world, the shots have proved not only effective, but also remarkably safe, with few serious side effects.

“We have so much safety data on these vaccines,” says Kawsar Talaat, an infectious diseases physician at the Johns Hopkins Bloomberg School of Public Health. “I don’t know of any vaccines that have been scrutinized to the same extent.”

Commonly reported side effects include pain, redness or swelling at the spot of the shot, muscle aches, fatigue, fever, chills or a headache. These symptoms usually last only a day or two.

“We have so much safety data on these vaccines. I don’t know of any vaccines that have been scrutinized to the same extent.”

Kawsar Talaat, infectious diseases physician

More rare and serious side effects have been noted. But none are unique to these shots; other vaccines — plus infectious diseases, including COVID-19 — also cause these complications.

One example is inflammation of the heart muscle, known as myocarditis, or of the sac around the heart, pericarditis. Current estimates are a bit squishy since existing studies have different populations and other variables (SN Online: 10/19/21). Two large studies in Israel estimated that the risk of myocarditis after an mRNA vaccine is about 4 of every 100,000 males and 0.23 to 0.46 of every 100,000 females, researchers reported in October in the *New England Journal of Medicine*. Yet members of Kaiser Permanente Southern California who had gotten mRNA vaccines developed myocarditis at a much lower rate: 5.8 cases for every 1 million second doses given, researchers reported, also in October, in *JAMA Internal Medicine*.

What all the studies have in common is that young males in their teens and 20s are at highest risk of developing the side effect, and that risk is highest after the second vaccine dose (SN Online: 6/23/21). But it’s still fairly rare, topping out at about 15 cases for every 100,000 vaccinated males ages 16 to 19, according to the larger of the two Israeli studies. Males in that age group are also at the highest risk of getting myocarditis and pericarditis from any cause, including from COVID-19.

Components of the mRNA vaccines may also cause allergic reactions, including potentially life-threatening anaphylaxis. The U.S. Centers for

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Disease Control and Prevention calculated that anaphylaxis happens at a rate of about 0.025 to 0.047 cases for every 10,000 vaccine doses given.

But a study of almost 65,000 health care system employees in Massachusetts suggests the rate may be as high as 2.47 per 10,000 vaccinations, researchers reported in March in *JAMA*. Still, that rate is low, and people with previous histories of anaphylaxis have gotten the shots without problem. Even people who developed anaphylaxis after a first shot were able to get fully vaccinated if the second dose was broken down into smaller doses (SN Online: 6/1/21).

The only side effect of the COVID-19 vaccines not seen with other vaccines is a rare combination of blood clots accompanied by low numbers of blood-clotting platelets. Called thrombosis with thrombocytopenia syndrome, or TTS, it’s most common among women younger than 50 who got the Johnson & Johnson vaccine or a similar vaccine made by AstraZeneca that’s used around the world (SN Online: 4/23/21).

About 5 to 6 TTS cases were reported for every 1 million doses of the J&J vaccine, the company reported to the U.S. Food and Drug Administration. The clots may result from antibodies triggering a person’s platelets to form clots (SN Online: 4/16/21). Such antibodies also cause blood clots in COVID-19 patients, and the risk of developing strokes or clots from the disease is much higher than with the vaccine, Talaat says. In one study, 42.8 of every 1 million COVID-19 patients developed one type of blood clot in the brain, and 392.3 per 1 million developed a type of abdominal blood clot, researchers reported in *EClinicalMedicine* in September.

“Your chances of getting any of these side effects, except for the sore arm, from an illness with COVID are much higher” than from the vaccines, Talaat says. — Tina Hesman Saey

Getting everyone vaccinated is ... complicated

The quest to vaccinate as many people as quickly as possible this year faced two main challenges: getting the vaccine to people and convincing them to take it. Strategies employed so far — incentives, mandates and making shots accessible — have had varying levels of success.

“It’s an incredibly ambitious goal to try to get the large majority of the country and the globe vaccinated in a very short time period with a brand-new vaccine,” says psychologist Gretchen Chapman of Carnegie Mellon University in Pittsburgh, who researches vaccine acceptance. Usually “it takes a number of years before you get that kind of coverage.”

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"It's an incredibly ambitious goal to try to get the large majority of the country and the globe vaccinated in a very short time period with a brand-new vaccine."

Gretchen Chapman, psychologist

Globally, that's sure to be the case due to a lack of access to vaccines, particularly in middle- and lower-income countries. The World Health Organization set a goal to have 40 percent of people in all countries vaccinated by year's end. But dozens of countries, mostly in Africa and parts of Asia, are likely to fall far short of that goal.

In contrast, the United States and other wealthy countries got their hands on more than enough doses. Here, the push to vaccinate started out with a scramble to reserve scarce appointments for a free shot at limited vaccination sites. But by late spring, eligible people could pop into their pharmacy or grocery store. Some workplaces offered vaccines on-site. For underserved communities that may have a harder time accessing such vaccines, more targeted approaches where shots are delivered by trusted sources at community events proved they could boost vaccination numbers (SN Online: 6/18/21).

Simply making the shot easy to get has driven much of the progress made so far, Chapman says. But getting people who are less enthusiastic has proved more challenging. Many governments and companies have tried to prod people, initially with incentives, later with mandates.

Free doughnuts, direct cash payments and entry into million-dollar lottery jackpots were among the many perks rolled out. Before the pandemic, such incentives had been shown to prompt some people to get vaccines, says Harsha Thirumurthy, a behavioral economist at the University of Pennsylvania. This time, those incentives made little difference nationwide, Thirumurthy and his colleagues reported in September in a preliminary study posted to SSRN, a social sciences preprint website. "It's possible they moved the needle 1 or 2 percentage points, but we've ruled out that they had a large effect," he says. Some studies of incentives offered by individual states have found a marginal benefit.

"People who are worried about side effects or safety are going to be more difficult to reach," says Melanie Kornides, an epidemiologist at the University of Pennsylvania. And with vaccination status tangled up in personal identity, "you're just not going to influence lots of people with a mass communication campaign right now; it's really about individual conversations," she says, preferably with someone trusted.

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"You're just not going to influence lots of people with a mass communication campaign right now; it's really about individual conversations."

Melanie Kornides, epidemiologist

"Or," she adds, "they're going to respond to mandates." Historically, sticks such as being fired from a job or barred from school are the most effective way of boosting vaccination rates, Kornides says. For example, hospitals that require flu shots for workers tend to have higher vaccination rates than those that don't. For decades, mandates in schools have helped push vaccination rates up for diseases like measles and chickenpox, she says.

As COVID-19 mandates went into effect in the fall, news headlines often focused on protests and refusals. Yet early anecdotal evidence suggests some mandates have helped. For instance, after New York City public schools announced a vaccine requirement in late August for its roughly 150,000 employees, nearly 96 percent had received at least one shot by early November. Still, about 8,000 employees opted not to get vaccinated and were placed on unpaid leave, the New York Times reported.

Many people remain vehemently opposed to the vaccines, in part because of rampant misinformation that can spread quickly online. Whether more mandates, from the government or private companies, and targeted outreach will convince them remains to be seen. — Jonathan Lambert

Vaccines can't single-handedly end the pandemic

One year in, it's clear that vaccination is one of the best tools we have to control COVID-19. But it's also clear vaccines alone can't end the pandemic.

While the jabs do a pretty good job preventing infections, that protection wanes over time (SN Online: 3/30/21). Still, the vaccines have "worked spectacularly well" at protecting most people from severe disease, says Luning Prak, the University of Pennsylvania immunologist. And as more people around the world get vaccinated, fewer people will die, even if they do fall ill with COVID-19.

"We have to make a distinction between the superficial infections you can get — [like a] runny nose — versus the lower respiratory tract stuff that can kill you," such as inflammation in the lungs that causes low oxygen levels, Luning Prak says. Preventing severe disease is the fundamental target that most vaccines, including the flu shot, hit, she notes. Stopping infection entirely "was never a realistic goal."

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“We have to make a distinction between the superficial infections you can get — [like a] runny nose — versus the lower respiratory tract stuff that can kill you.”

Nina Luning Prak, immunologist

Because vaccines aren't an impenetrable barrier against the virus, we'll still need to rely on other tactics to help control spread amid the pandemic.

“Vaccines are not the sole tool in our toolbox,” says Saad Omer, an epidemiologist at Yale University. “They should be used with other things,” such as masks to help block exposure and COVID-19 tests to help people know when they should stay home.

For now, it's crucial to have such layered protection, Omer says. “But in the long run, I think vaccines provide a way to get back to at least a new normal.” With vaccines, people can gather at school, concerts or weddings with less fear of a large outbreak.

Eventually the pandemic will end, though when is still anyone's guess. But the end certainly won't mean that COVID-19 has disappeared.

Many experts agree that the coronavirus will most likely remain with us for the foreseeable future, sparking outbreaks in places where there are pockets of susceptible people. Susceptibility can come in many forms: Young children who have never encountered the virus before and can't yet get vaccinated, people who choose not to get the vaccine and people whose immunity has waned after an infection or vaccination. Or the virus may evolve in ways that help it evade the immune system.

The pandemic's end may still feel out of reach, with the high hopes from the beginning of 2021 a distant memory. Still, hints of normalcy have returned: Kids are back in school, restaurants and stores are open and people are traveling more.

Vaccines have proved to be an invaluable tool to reduce the death and destruction that the coronavirus can leave in its wake. — Erin Garcia de Jesús

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