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

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ASIA PACIFIC

Toothpaste and oral hygiene products

2020-11-30

What are toothpaste and oral hygiene products?

Cosmetic toothpaste and oral hygiene products are used to care for the teeth and mouth. They include:

- toothpastes, powders and gels
- mouth washes
- breath fresheners

Who regulates the ingredients in toothpaste and oral hygiene products?

In Australia, toothpaste and oral hygiene products are regulated as either **therapeutic goods** or **cosmetics**, depending on:

- how the product is advertised or presented for supply
- the claims made by the product
- the product's intended use
- the product's ingredients

The Therapeutic Goods Administration (TGA) is responsible for regulating toothpaste and oral hygiene products that are medicines or marketed as having therapeutic effects. Toothpaste and oral hygiene products are classed as 'therapeutic' goods if they:

do not meet the relevant requirements of the Therapeutic Goods (Excluded Goods) Determination 2018

contain ingredients that are prohibited in cosmetic products under the Poisons Standard

make therapeutic claims

For example:

mouthwash with a label that says it stops gum disease is a therapeutic good because it claims to prevent a disease

toothpaste with a label that says it cures gingivitis is a therapeutic good because it claims to cure a disease

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However, certain toothpaste and oral hygiene products — including dentifrices, mouth washes and breath fresheners — are excluded from TGA regulation under the Therapeutic Goods (Excluded Goods) Determination 2018 and are classed as cosmetics.

We are responsible for regulating the ingredients in these products as long as they meet the following criteria:

they **don't** contain any substance included in Schedules 2, 3, 4 or 8 to the Poisons Standard

they're advertised or presented for supply so that the only benefits claimed to result from the use of the product are consequential on improvements to oral hygiene, including for the prevention of tooth decay or the use of fluoride for the prevention of tooth decay

benefits in relation to other diseases or ailments, such as gum or other oral disease or periodontal condition, are **not** claimed to result from using the product

Full Article

Australian Chemicals Introduction Scheme, 30 November 2020

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

Victoria's environmental watchdog reverses approval for West Gate Tunnel toxic soil dumps

2020-12-09

Victoria's environmental regulator has rescinded approvals for another two toxic waste dumps connected to the West Gate tunnel project.

Earlier this week, the Environment Protection Authority (EPA) admitted it had not met state regulations when it approved a proposal to dump contaminated soil from the project at a site in Bacchus Marsh.

The soil had been contaminated with per-and poly-fluoroalkyl substances, better known as PFAS — dangerous chemicals that have been widely used in firefighting foam.

The authority reversed the approval for the Bacchus Marsh dump on Tuesday, and today the two remaining landfill sites connected to the project at Ravenhall and Bulla also had their approvals revoked.

The soil had been contaminated with per-and poly-fluoroalkyl substances, better known as PFAS — dangerous chemicals that have been widely used in firefighting foam.

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[Read more](#)

ABC News, 9 December 2020

<https://www.abc.net.au/news/2020-12-10/epa-reverses-west-gate-tunnel-toxic-soil-dumps/12972370>

AMERICA

'Forever chemical' provisions in NDAA fall short, say advocates

2020-12-09

Additional steps could include directing the EPA to regulate the chemicals under the Superfund program and the Safe Drinking Water Act

The defense policy conference report the House adopted Tuesday night included steps to address a toxic set of chemicals linked to liver failure and cancer that are nearly ubiquitous in modern America and are building up in humans' bloodstreams.

Defying a veto threat, House members voted 335-78 to adopt a final version of the legislation, which would authorize \$731.6 billion. The Senate aims to take up the conference report this week.

But the legislation stops short of wholesale steps to clean up the so-called forever chemicals, formally called per- and polyfluoroalkyl chemicals, or PFAS, such as directing the EPA to regulate the chemicals under the Superfund program and the Safe Drinking Water Act.

The House vote Tuesday marks the second time in two years that PFAS cleanup efforts have fallen short of sweeping changes through the defense bill, a setback for lawmakers and outside environmental and local advocates who want more aggressive changes.

[Read More](#)

Roll Call, 9 December 2020

<https://www.rollcall.com/2020/12/09/forever-chemical-provisions-in-ndaa-fall-short-say-advocates/>

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Representative Dingell will make regulation of PFAS chemicals top congressional priority

2020-12-08

Representative Dingell (D-MICH) said on Tuesday, November 17th that legislation which would require the EPA to regulate the so-called "forever chemicals" will be reintroduced in January as soon as Congress begins its new session. Dingell was the sponsor of the PFAS Action Act that passed the House last January, and has indicated her intention to reintroduce the bill. If the bill passes, it would require the EPA to set cleanup standards and enforceable drinking water limits for at least some PFAS chemicals, and would also ban the chemicals from materials that could touch food and cosmetics. Representatives in Congress will also urge the Biden administration to pursue PFAS controls that don't require legislation. One such measure sought would designate PFOS and PFOA, the two most well studied members of the chemical group, as hazardous substances under the CERCLA.

[Read More](#)

Mondag, 8 December 2020

<https://www.mondaq.com/unitedstates/chemicals/1012484/representative-dingell-will-make-regulation-of-pfas-chemicals-top-congressional-priority>

EPA supplemental TSCA analysis spurs renewed discussion over 1,4-Dioxane regulation

2020-12-09

The EPA's supplemental analysis includes certain consumer exposures, as well as surface/ambient water exposures, to 1,4-dioxane.

The US Environmental Protection Agency (EPA) released an expanded risk evaluation for 1,4-dioxane under the Toxic Substances Control Act (TSCA) on November 19, 2020 (the Supplemental Analysis). In its original draft risk evaluation, released in June 2019, EPA preliminarily found unreasonable risks in certain circumstances for workers, but no unreasonable risks to the environment or occupational nonusers. The Supplemental Analysis expands the scope of the review to include certain consumer exposures, as well as surface/ambient water exposures. EPA initiated its Supplemental Analysis following public comments and peer review feedback to the initial draft risk evaluation.

Dingell was the sponsor of the PFAS Action Act that passed the House last January, and has indicated her intention to reintroduce the bill.

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1,4-dioxane is one of the first 10 chemicals evaluated by EPA pursuant to the 2016 amendments to the TSCA (which directed EPA to select the first 10 chemicals for evaluation from the 2014 update of the TSCA Work Plan). EPA is supposed to finalize all of the first 10 risk evaluations by the end of 2020, but so far it does not appear to be on track to meet this deadline.

1,4-dioxane is classified by EPA as a likely human carcinogen that is often used as a stabilizer in greases, waxes, paint strippers, antifreeze, and chlorinated solvents. It is also used in some consumer products, such as deodorant, cosmetics, and shampoo, where it typically results as a byproduct from ethoxylation, a process used to make the products less harsh to consumers.

Industry groups had advocated for the expansion to the risk evaluation in the hopes of preempting state rules that are set to come into effect, including most notably rules in California and New York. New York, for example, recently amended its environmental conservation law to place maximum allowable concentrations of 1,4-dioxane in cosmetics, personal care, and household cleaning products. Under the New York legislation, household cleaning products and personal care products will be subject to a limit of 1,4-dioxane of 2 parts per million (ppm) starting on December 31, 2022, and 1 ppm starting December 31, 2023, and cosmetic products will be subject to a maximum concentration of 10 ppm starting on December 31, 2022. If EPA issues a final decision that the chemicals present no unreasonable risk, states would be preempted under the TSCA from regulating 1,4-dioxane under the conditions of use the agency evaluated.

[Read More](#)

J D Supra, 9 December 2020

<https://www.jdsupra.com/legalnews/epa-supplemental-tsca-analysis-spurs-94058/>

EUROPE

ZWE report identifies climate benefits of reusable packaging

2020-12-09

Zero Waste Europe (ZWE) publishes study comparing 32 life cycle assessments (LCAs) to evaluate single-use and reusable packaging; finds

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reusable glass bottles have 85% fewer carbon emissions than single-use with highest impacts from transport; breakeven point reached after two to three reuse cycles; suggests five key measures to increase sustainability of reusable packaging

On December 7, 2020, civil society organization Zero Waste Europe (ZWE) announced in a press release the publication of a new study finding that reusable packaging has 85% lower carbon emissions than single-use alternatives.

Single-use plastics are reported to represent 36% of municipal solid waste, and in May 2019, the EU announced a ban on some single-use plastic items (FPF reported). Current waste reduction efforts focus a lot on recycling as the main method to reduce the waste stream. Nevertheless, ZWE explains that this approach represents the least favorable of all waste management options after reusing, repurposing, or remanufacturing.

[Read More](#)

Food Packaging Forum, 9 December 2020

<https://www.foodpackagingforum.org/news/zwe-report-identifies-climate-benefits-of-reusable-packaging>

ZWE biomonitoring detects phthalates, bisphenols

2020-12-08

Zero Waste Europe (ZWE) publishes results of analyzed urine samples from 52 European decision-makers and public figures; tests for 28 chemicals commonly used in single-use plastic food packaging, shows average of 20 detected in each person; calls for decision-makers to prioritize public exposure to food contact chemicals

Food Packaging Forum, 8 December 2020

<https://www.foodpackagingforum.org/news/zwe-biomonitoring-detects-phthalates-bisphenols>

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INTERNATIONAL

Amazon announces ban on toxic chemicals and plastics in food packaging

2020-12-08

PFAS, phthalates, BPA are among the dangerous chemicals Amazon Kitchen brands now prohibit

Amazon joins a growing trend of companies eliminating toxic chemicals in food packaging

Today Amazon announced that it will ban certain toxic chemicals and plastics in the food packaging materials used for its Amazon Kitchen brand. Toxic chemicals PFAS (per- and polyfluoroalkyl substances), phthalates, BPA (bisphenol A) and other bisphenols, and the plastics polyvinyl chloride (PVC), polystyrene (PS), and expanded polystyrene (EPS) are now restricted in certain private-label food contact materials. Amazon's new commitment is the latest update to the chemicals policy it first launched in 2018, which also restricts toxic chemicals in private-label baby, household cleaning, personal care, and beauty products as well as brand-name paint-removal products.

"Amazon's new policy commitment signals a growing retail sustainability trend," explains Mind the Store Campaign Director Mike Schade in response to today's announcement. "In the past year alone, we've witnessed more than a half-dozen food retailers from across the country committing to safer alternatives when it comes to food packaging materials. It is clearly possible to do, and yet some major chains like McDonald's, Kroger, and Costco have not stood up for the health of their customers or the environment."

"No company should be using chemicals that can impair a person's immune system, especially as we are battling a worldwide pandemic," says Executive Director of Toxic-Free Future Laurie Valeriano in response to Amazon's new RSL released today. "Amazon is wise to be getting in front of regulatory bans that are soon coming their way, like in their home state of Washington. As we continue to fight for critical government policies to protect us against toxic chemicals in food packaging, it's welcome news to see how companies, like Amazon, are stepping up to do what's right."

"Market leaders like Amazon know that children thrive on healthy food that's free from toxic chemicals that escape from packaging," says Mike Belliveau, Executive Director of Defend Our Health. "Further reducing

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the use of chemicals like phthalates and PFAS that may harm brain development could help halt the epidemic of learning and developmental disabilities our children already suffer."

Amazon's new restricted substance list (RSL) applies to its Amazon Kitchen brand products sold in Amazon Go, Amazon Go Grocery, Amazon Fresh, and Fresh grocery delivery. It does not apply to other private-label or Amazon brand-name food contact materials. Today's announcement comes five months after a class-action lawsuit was filed, alleging PFAS was present in Amazon private-label disposable plates, which are not included in this new restriction.

[Read more](#)

Safer Chemicals, 8 December 2020

<https://saferchemicals.org/2020/12/08/amazon-announces-ban-on-toxic-chemicals-and-plastics-in-food-packaging/>

FPF publishes food contact chemicals database

2020-11-30

On November 30, 2020, a team of researchers led by the *Food Packaging Forum (FPF)* published a scientific [article](#) in the peer-reviewed journal *Environment International* providing an overview of intentionally used food contact chemicals and their hazards. The study is based on a new Food Contact Chemicals [database](#) (FCCdb) also developed by FPF that compiles information from over 50 governmental and industry sources. It identifies 12,285 distinct food contact chemicals (FCCs) that are potentially used in the manufacture of food contact materials and articles. 71% of these substances have been found to have publicly available toxicity data, while the remainder (29%) lack openly accessible toxicity data. Following a review of all substances, 608 FCCs were identified as the most hazardous and therefore high-priority candidates for substitution in food contact material (FCM) manufacturing.

"This database is a much-needed, freely available resource describing the universe of food contact chemicals," says Jane Muncke, managing director of the *Food Packaging Forum* and co-author of the study. "Chemical exposure from food contact articles like packaging must be systematically addressed, and any hazardous substances removed – and not replaced with other, less well-studied chemicals that turn out to be regrettable substitutions, like BPS that replaced BPA. Getting the toxics out is essential as society moves toward a circular economy and increases the use of

It identifies 12,285 distinct food contact chemicals (FCCs) that are potentially used in the manufacture of food contact materials and articles.

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recycled or alternative materials. This database enables stakeholders to tackle this task in a systematic way."

The database and accompanying journal article are the latest outcomes from the ongoing Food Contact Chemicals and Human Health (FCCH) Project led by FPF. In March 2020, the project spearheaded the publication of a [consensus statement](#) by a group of 33 international scientists urging decision-makers in government, industry, and civil society to reduce exposure to harmful chemicals that are present in food packaging and any other food contact materials (FPF reported).

[Read more](#)

Food Packaging Forum, 30 November 2020

<https://www.foodpackagingforum.org/news/fpf-publishes-food-contact-chemicals-database>

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REACH Update

DEC. 18, 2020

ECHA: 'Coordinated effort' at policy level required for alternatives to replace animal testing in EU

2020-12-09

A coordinated approach amongst European Union policy makers that considers research, method and validation is needed for non-animal alternative cosmetic testing to fully replace animal data, says the European Chemicals Agency (ECHA).

[Read More](#)

Cosmetics Design Europe, 9 December 2020

[HTTPS://WWW.COSMETICSDSIGN-EUROPE.COM/ARTICLE/2020/12/09/ECHA-SAYS-COSMETICS-ANIMAL-TESTING-ALTERNATIVES-NEED-EU-COORDINATED-POLICY-APPROACH](https://www.cosmeticsdesign-europe.com/article/2020/12/09/echa-says-cosmetics-animal-testing-alternatives-need-eu-coordinated-policy-approach)

6.5% of inspected substances miss the required registration

2020-12-10

An EU-wide REACH enforcement project has also found that 15 % of almost 1 200 chemicals needing registration did not comply with at least one registration-related duty.

Helsinki, 10 December 2020 – ECHA Forum's seventh REACH enforcement project checked how well companies comply with registration obligations after the last registration deadline of 31 May 2018. In addition, enforcement authorities from 28 EEA countries checked if substances registered as intermediates met the definition and if they were used under strictly controlled conditions.

A valid registration was completely missing for 77 out of 1 193 (6.5 %) inspected substances needing a registration. 180 (15 %) of the substances were non-compliant with at least one of the registration-related obligations checked in the scope of the project. This includes the duty to register but also, for example, the duty to update the dossier, use intermediates under strictly controlled conditions, submit correct tonnage information or comply with requirements for only representatives.

Inspectors also checked if companies had systems in place to ensure that they update their registration in a timely manner. Fewer than half of the companies inspected had a system in place to track and manage changes in tonnage bands (46 %) and uses (39 %) of the substances they registered.

A coordinated approach amongst European Union policy makers that considers research, method and validation is needed for non-animal alternative cosmetic testing to fully replace animal data, says the European Chemicals Agency (ECHA).

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Checks related to substances registered as isolated intermediates showed that 85 % were intermediates as defined by REACH and 80 % of checked companies managed them under strictly controlled conditions as required by the regulation.

Imported substances were also controlled as part of the project, with enforcement authorities cooperating closely with customs.

When inspectors found companies breaching any of the duties checked in the project, they took enforcement measures to address the non-compliance. Written advice and administrative orders were the most frequent measures used. Fines, administrative orders and, in some cases, referrals for criminal prosecution were issued by inspectors to companies who failed to register substances.

Based on these findings, the Forum has made several recommendations to companies such as to regularly verify their compliance with registration duties and to keep registration dossiers updated and synchronised with actual company operations, for example through appropriate tracking systems to monitor quantities and uses.

Background

The REACH-EN-FORCE-7 (REF-7) project is the latest in a series of three Forum enforcement projects focusing on registration duties after a registration deadline. The first two projects were finalised in 2010 (REF-1) and 2014 (REF-3).

Inspections for REF-7 targeted manufacturers, importers and only representatives with an obligation to register at least one chemical. The scope included all sectors of industry and all company sizes.

The inspections took place during 2019. The checks were carried out in 813 companies in the EEA. Out of the 1 420 substances inspected during the project, 227 were exempt from registration. So, registration duties were checked for 1 193 substances. As some of the substances were registered jointly by several companies, the inspections covered 952 different substances in total.

More than two thirds (71 %) of the checked substances were classified as hazardous according to the CLP Regulation.

An intermediate is defined as a substance that is manufactured for chemical processing to be transformed into another substance.

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Read more

ECHA, 10 December 2020

<https://echa.europa.eu/-/6-5-of-inspected-substances-miss-the-required-registration>

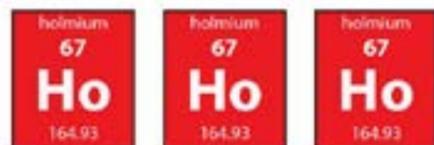
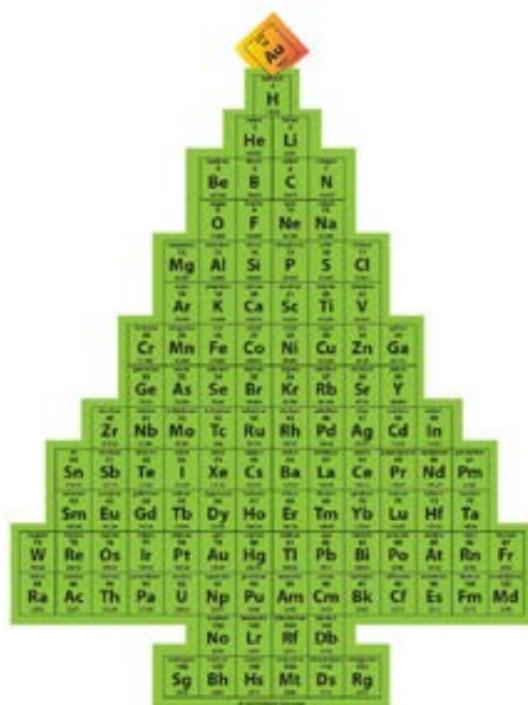
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Official Chemis-tree

2020-12-18

THE OFFICIAL
CHEMIS-TREEGetting festive
with the periodic table
of elements

<https://www.chemistryjokes.com/jokes/the-official-chemis-tree/>

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Hazard Alert

DEC. 18, 2020

1,1,2-Trichloroethane

2020-12-18

1,1,2-Trichloroethane, or 1,1,2-TCE, is an organochloride solvent with the molecular formula $C_2H_3Cl_3$. It is a colourless, sweet-smelling liquid that does not dissolve in water, but is soluble in most organic solvents. [1] 1,1,2-Trichloroethane does not burn easily and boils at a higher temperature than water. [2]

USES [3]

1,1,2-Trichloroethane is used as a chemical intermediate and a solvent. 1,1,2-Trichloroethane is primarily used as a chemical intermediate in the production of 1,1-dichloroethene. It is also used as a solvent for chlorinated rubbers, fats, oils, waxes, and resins.

IN THE ENVIRONMENT [4]

1,1,2-Trichloroethane will exist as a gas if released to the atmosphere. It dissolves only slightly when mixed with water. It also evaporates from soil and water when they are exposed to the air. In the air when it reacts into other chemicals, it takes a long time. It has moderate acute (short-term) toxicity on aquatic life. It has moderate chronic (long-term) toxicity to aquatic life. Chronic and acute effects on plants, birds or land animals have not been determined. 1,1,2-Trichloroethane does not bioaccumulate. Industrial emissions of 1,1,2-Trichloroethane can produce elevated concentrations in the atmosphere around the source. Since it takes a long time to breakdown in the air it is likely to spread far from where it is used. Most of the releases are to the air, releases to the soil and water quickly evaporate to the air. Since it does not bind to soil well, 1,1,2-Trichloroethane that makes its way into the ground, and does not evaporate may move through the ground and enter groundwater.

SOURCES OF EMISSION & ROUTES OF EXPOSURE

Sources of Emission [4]

- Industry sources: The primary sources of 1,1,2-Trichloroethane emissions are the industries that manufacture it or use it in production. Some of the industries that use it in production are the chemical industry, rubber manufacturers, heavy equipment manufacturing, the timber products industry, the plastics and synthetics industries and laundries. These are emissions to the air unless there is a spill.

1,1,2-Trichloroethane, or 1,1,2-TCE, is an organochloride solvent with the molecular formula $C_2H_3Cl_3$.

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- Diffuse sources: Other possible emitters of 1,1,2-Trichloroethane are the electronics industry (solvent use) and manufacturers of fabricated metal parts.
- Natural sources: 1,1,2-Trichloroethane does not occur naturally in the environment.
- Transport sources: No mobile sources.
- Consumer products: Aerosol paint concentrates.

Routes of Exposure [2]

1,1,2-Trichloroethane can enter the body when a person breathes air contaminated with it, or when a person drinks water containing this compound. It can also enter the body through the skin. After it enters the body, it is carried by the blood to organs and tissues such as the liver, kidney, brain, heart, spleen, and fat.

Experiments in which animals were given 1,1,2-trichloroethane by mouth have shown that most 1,1,2-trichloroethane leaves the body unchanged in the breath and as other substances that it was changed into in the urine in about 1 day. Very little stays in the body more than 2 days.

HEALTH EFFECTS

Acute Effects [3]

1,1,2-Trichloroethane is a potent central nervous system depressant. In high concentrations, in air, with closed or poorly ventilated areas, single exposures to 1,1,2-Trichloroethane may cause central nervous system effects leading to dizziness, headache, sleepiness, confusion, nausea, difficulty in speaking or walking, and possibly unconsciousness, coma and death. It is a narcotic at high levels. Exposures to vapour concentrations near 2,000 parts per million for five minutes cause central nervous system depression and the effect of being anaesthetised. Adverse liver and kidney effects have are possible from high exposures or from long-term exposure to 1,1,2-Trichloroethane. It will also defat the skin causing irritation and dryness. Other effects may include headache, tremor, dizziness, and irritation of the eyes, nose and throat.

Chronic Effects [4]

- No information is available on the chronic effects of 1,1,2-trichloroethane in humans from inhalation or oral exposure. Animal studies have not observed adverse effects from chronic inhalation exposure to 1,1,2-trichloroethane. Effects on the liver and

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immune system have been noted in chronic oral studies. EPA has not established a Reference Concentration (RfC) for 1,1,2-trichloroethane.

- The California Environmental Protection Agency (CalEPA) has established a chronic reference exposure level of 0.4 milligrams per cubic metre (mg/m³) based on liver effects in rats.
- The Reference Dose (RfD) for 1,1,2-trichloroethane is 0.004 milligrams per kilogram body weight per day (mg/kg/d) based on clinical serum chemistry in mice.

Reproductive/Developmental Effects [4]

- No information is available regarding developmental or reproductive effects of 1,1,2-trichloroethane in humans from inhalation or oral exposure.
- Animal studies have not reported developmental or reproductive effects from oral exposure to 1,1,2-trichloroethane.

Cancer Risk [4]

- No studies are available regarding cancer in humans from inhalation or oral exposure.
- A study by the National Toxicology Program reported liver tumours and adrenal tumours in mice, but no tumours in rats from exposure to 1,1,2-trichloroethane by gavage.
- EPA has classified 1,1,2-trichloroethane as a Group C, possible human carcinogen.

SAFETY [5]

First Aid Measures

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

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- Serious Skin Contact: Wash with a disinfectant soap and cover the contaminated skin with an anti-bacterial cream. Seek immediate medical attention.
- Inhalation: Allow the victim to rest in a well-ventilated area. Seek immediate medical attention.
- Serious Inhalation: Evacuate the victim to a safe area as soon as possible. Loosen tight clothing such as a collar, tie, belt or waistband. If breathing is difficult, administer oxygen. If the victim is not breathing, perform mouth-to-mouth resuscitation. Seek medical attention.
- Ingestion: Do not induce vomiting. Examine the lips and mouth to ascertain whether the tissues are damaged, a possible indication that the toxic material was ingested; the absence of such signs, however, is not conclusive. Loosen tight clothing such as a collar, tie, belt or waistband. If the victim is not breathing, perform mouth-to-mouth resuscitation. Seek immediate medical attention.

Exposure Controls & Personal Protection

Engineering Controls

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

Personal Protective Equipment

The following personal protective equipment is recommended when handling 1,1,2-trichloroethane:

- Splash goggles
- Lab coat
- Gloves

Personal Protection in Case of a Large Spill:

- Splash goggles
- Full suit
- Boots
- Gloves
- Suggested protective clothing might not be sufficient; consult a specialist BEFORE handling this product.

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REGULATION [2,4,6]

United States

OSHA: Occupational Safety & Health Administration has established the following Permissible Exposure Limits (PEL):

- General Industry: 29 CFR 1910.1000 Z-1 Table -- 10 ppm, 45 mg/m³ TWA; Skin
- Construction Industry: 29 CFR 1926.55 Appendix A -- 10 ppm, 45 mg/m³ TWA; Skin
- Maritime: 29 CFR 1915.1000 Table Z-Shipyards -- 10 ppm, 45 mg/m³ TWA; Skin

ACGIH: American Conference of Governmental Industrial Hygienists has set a Threshold Limit Value (TLV) for 1,1,2-trichloroethane of 10 ppm, 55 mg/m³ TWA for an 8-hour workday in a 40-hour workweek.

NIOSH: National Institute for Occupational Safety and Health has established a Recommended Exposure Limit (REL) for 1,1,2-trichloroethane of 10 ppm, 45 mg/m³ TWA;

EPA: The Environmental Protection Agency has set a limit of 0.005 milligrams of 1,1,2-trichloroethane per litre of drinking water (0.005 mg/L). Discharges, spills, or accidental releases of 100 pounds or more of 1,1,2-trichloroethane must be reported to the EPA.

Australia

Safe Work Australia: Safe Work Australia has established a Time Weighted Average (TWA) concentration for 1,1,2-trichloroethane of 10 parts per million over an eight-hour work shift.

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In the past 15 years, climate change has transformed the Arctic

2020-12-09

Fifteen years of grading warming's impact on the Arctic has made one thing abundantly clear: Climate change has drastically altered the Arctic in that short time period.

Breaking unfortunate records is "like whack-a-mole," says Jackie Richter-Menge, a climate scientist at the University of Alaska Fairbanks and an editor of the 2020 Arctic Report Card, released December 8 at the virtual meeting of the American Geophysical Union. From sea ice lows to temperature highs, records keep popping up all over the place. For instance, in June, a record-high 38° Celsius (100.4° Fahrenheit) temperature was recorded in the Arctic Circle (SN:6/23/20). And in 2018, winter ice on the Bering Sea shrank to a 5,500 year low (SN:9/3/20).

"But quite honestly, the biggest headline is the persistence and robustness of the warming," Richter-Menge says. In 2007, only a year after the first Arctic Report Card, summer sea ice reached a record low, shrinking to an area 1.6 million square kilometers smaller than the previous year. Then, only five years later, the report card noted a new low, 18 percent below 2007. In 2020, sea ice didn't set a record but not for lack of trying: It still was the second lowest on record in the last 42 years.

"The transformation of the Arctic to a warmer, less frozen and biologically changed region is well under way," the report concludes. And it's changing faster than expected when researchers launched the report card in 2006. The annual average air temperature in the Arctic is rising two to three times faster than the rest of the globe, Richter-Menge says. Over the last 20 years, it's warmed at a rate of 0.77 degrees C per decade, compared with the global average of 0.29 degrees C per decade.

Improvements in research techniques over the last 15 years have helped researchers more thoroughly observe warming's impact and how different aspects of Arctic climate change are linked to one another, she says. These improvements include the ability to measure ice mass via gravity measurements taken by the Gravity Recovery and Climate Experiment (GRACE) satellite. Other satellites have provided additional observations from above while on-the-ground measurements, such as by the Multidisciplinary drifting Observatory for the Study of Arctic Climate (MOSAiC), have provided up-close sea ice measurements (SN:4/8/20). The report has also begun to include on-the-ground observations of

In 2020, sea ice didn't set a record but not for lack of trying: It still was the second lowest on record in the last 42 years.

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the Arctic's Indigenous people, who experience these changes directly (SN:12/11/19).

The changes have revealed few bright spots but one is the rebound of bowhead whales, which were hunted almost to extinction around the turn of the 20th century. While researchers are careful to note that the whales are still vulnerable, the four populations of the whales (*Balaena mysticetus*) now range from 218 in the Okhotsk Sea to around 16,800 in the Bering, Chukchi and Beaufort seas. Researchers suggest that the whales' rebound is due, at least in part, to the warming that has occurred over the last 30 years. Earlier sea ice melting and warmer surface water means more krill and other food for these baleen feeders.

But don't be fooled. The potential good news is overshadowed by the bad news. There's been "this accumulation of knowledge and insights that we've gained over 15 years," says Mark Serreze, a climate scientist at the National Snow and Ice Data Center in Boulder, Colo., who wasn't involved in this year's report. The 2020 research is "an exclamation point on the changes that have been unfolding," he says. "The bowhead whales are doing OK, but that's about it."

sciencenews.org, 9 December 2020

<https://www.sciencenews.org>

Through war, wildfire and pandemic, the world's seed vaults hold strong

2020-12-08

By the time the war broke out in Syria, researchers from the International Center for Agricultural Research in the Dry Areas (ICARDA) had already duplicated and safely transported most of their genetic treasure trove to the Svalbard Global Seed Vault on the remote Arctic island of Spitsbergen, Norway.

The ICARDA facility in Tel Hadia, just south of Aleppo, Syria, once stored the largest collection of crop diversity from the Fertile Crescent, one of the world's earliest centers of agriculture. When the facility was abandoned in 2014, more than 80% of its collection was backed up in the Norwegian vault.

"When the Arab Spring started, Syria was still considered a very secure and stable country, and then it became complete chaos, as we know," Ola Westengen, an associate professor at the Norwegian University of

When the facility was abandoned in 2014, more than 80% of its collection was backed up in the Norwegian vault.

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Life Science who was coordinator of operations and management at the Svalbard Global Seed Bank at the time of the seed rescue, told Mongabay. “[B]ut one should not give the impression that the seeds were somehow smuggled out or sent out in a clandestine way, everything was by the book.”

The safe and peaceful transfer of the samples from Syria, despite extreme conditions, Westengen says, is a testament to how well the international system of gene banks is working.

Westengen is the co-author of a newly published paper in the journal *Nature Plants* that documents the seed rescue mission and lessons learned from the operation, which, the paper says, illustrates the links between food security, sociopolitical stability, and climate change. The paper also discusses the extensive global system for conserving crop diversity and why it is imperative to do so.

Diversity in farmers’ fields is decreasing, with an estimated 90% of humanity’s caloric intake reliant on just rice, maize and wheat. Threats to crop diversity are addressed in international conservation goals such as the U.N.’s Convention on Biological Diversity (CBD), the International Treaty on Plant Genetic Resources for Food and Agriculture (Plant Treaty) and the Sustainable Development Goals (SDGs).

A network of international centers preserves regional plant diversity and makes these seeds available to researchers and plant breeders under the conditions of the Plant Treaty, not only to respond to regional disasters but also to develop new varieties that are resilient in the face of challenges such as drought and disease.

Ideally, important digital information is backed up to “the cloud” or a hard drive. Likewise, the important crop genetics from regional seed banks are backed up in the Svalbard Global Seed Vault.

The vault, built inside a mountain on the remote Arctic archipelago of Svalbard, opened in 2008 with the intention of being a politically neutral and safe location to protect the world’s crop diversity. Samples sent here are duplicates from seed and gene banks, research facilities, and communities around the world, ranging from large institutions like ICARDA, to the Cherokee Nation, who, this year, became the first tribe in the U.S to send important heirloom seeds to Svalbard.

But unlike files on a hard drive, seeds in a vault cannot be stored and forgotten. Even in the ideal, supercooled (-18°C, -0.4°F) conditions of the

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Svalbard vault, seeds have a shelf life. It is up to each institution providing seeds to be sure the collections in the vaults are regularly updated with fresh, viable samples.

“In some of the stories about the seed vault, you get the impression that this is like a time capsule,” Westengen said, “but the seed vault only makes sense as part of a kind of dynamic system for conserving and keeping the seeds viable ... all seeds need to be regenerated and grown out in an environment where they will maintain their genetic integrity. And that’s a much more demanding job.”

In 2015, the ICARDA facilities in Lebanon and Morocco began undertaking the mammoth task of regenerating in the field the plants rescued from Syria, an operation requiring complex logistics and large areas to regrow thousands of different species. But they have been successful. All of the safety duplicates stored in Svalbard were regenerated by September of this year.

“It has been a massive effort,” Mariana Yazbek, co-author of the paper and gene bank manager at the ICARDA facility in Lebanon, told Mongabay. “[O]ur team sacrificed nights and weekends sometimes to ensure this limited resource of seeds was regenerated ... We are reaping the benefits of this work now, quite literally.”

This year, gene banks have faced the added challenge of keeping critical plants alive during the COVID-19 pandemic. While some seeds can be left on the shelves for months or even years, conserving roots, tubers and other crops that are not grown from seed such as potatoes, cassava (yuca), yams and some bananas require more attention. These plants cannot be stored for long, and are not backed up at Svalbard, so they must be grown nearly continuously. When the lockdowns began in Lebanon, for instance, ICARDA staff worked on a rotating schedule, traveling only between their homes and work to keep the plants alive.

At another facility, the International Center for Tropical Agriculture (CIAT) in Colombia, researchers preserve many important tropical-adapted crops such as cassava. CIAT has many different genotypes of cassava, all cultivated without seeds, requiring daily work. This year, its staff of 900 was moved to a rotating schedule, with about 300 people coming in each day to keep plants alive and critical experiments running.

“Perhaps you think that the middle of a global pandemic is not an appropriate time to be discussing seed banks. Think again,” Luigi Guarino, director of science, and Charlotte Lusty, head of programs and gene bank

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platform coordinator at Crop Trust, an organization that supports the Svalbard Global Seed Vault as well as genebanks around the world, wrote in Landscape News. "One thing is certain, to mitigate the effects of future shocks of the kind we're currently experiencing, and to allow us to bounce back from them, there needs to be diversity in all parts of the food chain."

Guarino and Lusty say that maintaining crop diversity is an essential task, even during a pandemic, to future-proof the world's crops from impacts related to climate change, natural disasters, or conflict.

"There is kind of a global system that, unfortunately, very few people appreciate until there is a tragedy," Joseph Tohme, agrobiodiversity research area director at CIAT, told Mongabay. "Every center can provide you kind of stories ... In our case, we had a major project called Seeds of Hope for Rwanda, because during and after the genocide, Rwanda lost a major collection of beans."

One tragedy, the human-caused annihilation of global plant and animal species, known as the sixth mass extinction, is currently underway. An estimated 40% of plant species are threatened with extinction, according to a report released by the Royal Botanic Gardens, Kew.

The Royal Botanic Gardens, Kew's Millennium Seed Bank is working to save some of that diversity. While the Svalbard vault store crop seeds, the Millennium Seed Bank, located in Wakehurst, U.K, safeguards seeds of the planet's imperiled wild plants.

The Millennium Seed Bank, the world's largest wild seed conservation project, celebrated its 20th anniversary this year. Its vault, built to withstand bombs, radiation and floods, holds 2.4 billion seeds from 39,681 species, coming from 190 countries and territories. The facility and its partners say they have helped to protect 16% of the world's seed-bearing plants.

Among its collection are eight species now extinct in the wild. One of these, the last known wild yellow fatu flower (*Abutilon pitcairnense*), was taken out by a landslide on Pitcairn Island in the Southern Central Pacific, the only place where it was found. The seeds were already saved at Millennium Seed Bank, and are now cultivated in its greenhouses.

"If that material hadn't already been collected, then when that landslide wiped out the one remaining plant, we would have had nothing. We would have had no trace of that species, which is now extinct in the

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wild," Elinor Breman, senior research leader in seed conservation at the Millennium Seed Bank, told Mongabay.

Like the Svalbard vault, the Millennium Seed Bank has responded in the wake of catastrophe. The massive bushfires in Australia earlier this year burned 23,200 hectares (57,300 acres) in Cudlee Creek near Adelaide. The Millennium Seed Bank sent backup seeds of clover glycine (*Glycine latrobeana*), a rare, wild pea, to its partners in Australia so that the plant could be cultivated and used to restore the ecosystem.

Research on the science of seed and gene banking is ongoing at the Millennium Seed Bank, including the development of cryopreservation methods to store roots and tubers. Along with their international partners, they are researching useful plant traits and testing species' responses to environmental stressors such as drought and higher temperatures, predicted to increase as the climate changes.

The Millennium Seed Bank also safeguards some of the wild relatives of crops, the plants from which many of our foods were cultivated. Conserving crop diversity involves protecting the entire gene pool of a crop and that includes its wild ancestors.

Gene banks are an important part of conservation, says Westengen, but they are not sufficient on their own. A continuum exists between ex situ (off-site) and in situ (in-place) conservation, so the wild places and agroecosystems these plants come from must also be protected.

"This is something that we all depend on. This is a common heritage. It's not something that especially benefits any one side in a conflict," Westengen said. "The issue of seeds is actually quite politicized globally ... but pretty much everyone agrees that we need to conserve this diversity."

news.mongabay.com, 8 December 2020

<https://www.news.mongabay.com>

Human 'stuff' now outweighs all life on Earth

2020-12-09

It's not just your storage unit that's packed to the gills. According to a new study, the mass of all our stuff—buildings, roads, cars, and everything else we manufacture—now exceeds the weight of all living things on the planet. And the amount of new material added every week equals the total weight of Earth's nearly 8 billion people.

And the amount of new material added every week equals the total weight of Earth's nearly 8 billion people.

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"If you weren't convinced before that humans are dominating the planet, then you should be convinced now," says Timon McPhearson, an urban ecologist at the New School who was not involved with the research. "This is an eye-catching comparison," adds Fridolin Krausmann, a social ecologist at the University of Natural Resources and Life Sciences, Vienna, who also was not involved in the work.

There are many measures of humanity's impact on the planet. Fossil fuels have sent greenhouse gases soaring to levels not seen in at least 800,000 years. Agriculture and dwellings have altered 70% of land. And humans have wiped out untold numbers of species in an emerging great extinction. The transformations are so great that researchers have declared we're living in a new human-dominated age: the Anthropocene.

Systems biologist Ron Milo of the Weizmann Institute of Science went looking for a new gauge of our impact. He and his colleagues synthesized previous estimates of the biomass of living plants for each year between 1900 and 2017. Those estimates account for about 90% of all living things and are based on field research and computer modeling. From 1990 onward, they also include data from satellites, which researchers have used to track global vegetation.

Then the team added in the mass of all other living things—organisms from bacteria to whales—which they had tallied up in 2018, based on field surveys. (Humans make up roughly 0.01% of the planet's biomass.) The yearly estimates of the mass of humanmade materials came from published research by Krausmann and colleagues, including objects such as cars and machines, and buildings and other infrastructure.

The change over the past 120 years has been dramatic. In 1900, the mass of human materials was just 3% of Earth's total biomass. Since then, materials have doubled about every 20 years, the team reports today in *Nature*. The glut of concrete and asphalt began during the boom years between World War II and the oil crisis of 1973, when developed countries went on a building spree. In recent decades, even more has been added. Meanwhile, total biomass declined gradually since 1900 to about 1100 billion tons, because of deforestation and other reasons. The increase in humanmade mass is driven by the use of dense geological resources: rocks, minerals, and metals.

Humanmade mass finally exceeded Earth's total living biomass this year—give or take 6 years. The timing of that transition hinges on whether biomass is tallied with or without water. If water is included, biomass will remain larger than human materials until about 2037. Even today, the

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comparisons are sobering: Buildings and other infrastructure weigh more than the world's trees and shrubs, the researchers found. And the mass of plastic is double that of all animals. The findings add weight to the concept of the Anthropocene, the researchers conclude. "It is an indication that, indeed, the transition happened and the name is appropriate," Milo says. He doesn't have a strong opinion on whether the beginning of the new geological era should be this year or decades earlier.

The new research "helps us solidify the evidence of our impact on the planet," says Josh Tewksbury, director of Future Earth, a network of sustainability scientists. But, he says, "It doesn't help us on the details of what to do about it." That's because global mass of materials is a crude metric of impact. For example, Krausmann says, it doesn't consider the toxicity of various substances. And location matters, too. The concrete in a dam has a much bigger environmental impact than the same amount of concrete in a city.

Eduardo Brondizio, an environmental anthropologist at Indiana University, Bloomington, points out that in developing countries, where cities lack adequate housing, sewage treatment plants, and other infrastructure, a dearth of human materials is unjust and environmentally damaging. "It's not that infrastructure per se is bad," he says. "It's how we do infrastructure that is the problem."

Infrastructure will continue to expand, fastest in developing cities, says Xuemei Bai, who studies urban sustainability at the Australian National University. All the energy involved in producing raw materials could jeopardize international climate goals, she notes. But cities offer an efficiency of scale not possible in rural locations, because they have fewer roads and water mains per person, for example. And technological and policy innovation could help reduce the environmental impact of humanity's massive footprint, Bai says. "I'm hopeful. It is possible."

[sciencemag.org](https://www.sciencemag.org), 9 December 2020

<https://www.sciencemag.org>

These shrews can shrink and regrow their brains

2020-12-04

The smallest terrestrial mammal, the Etruscan shrew (*Suncus etruscus*), has a neat trick to potentially save energy during the winter: It can shrink its brain, *The Scientist* reports. No heavier than a playing card, this mammal needs to eat eight times its bodyweight every day, and therefore cannot

No heavier than a playing card, this mammal needs to eat eight times its bodyweight every day, and therefore cannot hibernate.

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hibernate. Using MRI scans, researchers pinpointed this brain shrinkage to the somatosensory cortex, which processes sensory information from its whiskers. This area of the brain lost 28% of its volume in the winter, and regrew these neurons by the following summer, the researchers reported in the Proceedings of the National Academy of Sciences. The shrews' brains shrunk even when the animals had unlimited food and no changes in their light and dark cycles in the lab. The phenomenon might therefore rely on internal cues as well as external ones, like a decrease in food availability. ~ssciencemag.org, 4 December 2020

<https://www.sciencemag.org>

World's largest iceberg still barreling toward penguin habitat, new footage confirms

2020-12-12

In July 2017, a gargantuan iceberg spanning five times the area of New York's five boroughs snapped off the coast of Antarctica and began to drift northward.

Though its edges have crumbled considerably since then, the iceberg — named A-68a — is still the largest on Earth, and it's currently barreling toward an island wildlife refuge in the South Atlantic Ocean. New aerial footage taken by the United Kingdom's Royal Air Force (RAF) reveals just what that island might be up against.

For starters, the RAF footage really drives home how massive this ice giant is. (As of early April, A-68a measured about 2,000 square miles, or 5,100 square kilometers, in area, Live Science previously reported). The berg's steep walls tower 100 feet (30 meters) above the sea, according to RAF News, and are gouged with tunnels, fissures and caves. Huge chunks of ice, or "growlers," are rapidly cracking off on all sides, leaving behind a trail of debris that could impede boat traffic in the future. (The waters are occasionally used by both fishery vehicles and pleasure cruises, according to the BBC).

PLAY SOUND

Of greater concern to scientists, however, is how deep the iceberg's keel dips below the ocean's surface. When A-68a broke away from the Larsen C Ice Shelf three years ago, its bottom-most point was measured at more than 650 feet (200 m) below the surface, BBC wrote. It's possible that the iceberg has shrunken vertically as well as horizontally since then, though the RAF mission didn't immediately reveal any insights there.

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The iceberg's depth matters as the behemoth bears down on South Georgia island — a British overseas territory that's home to millions of penguins, seals, seabirds and migrating whales. If A-68a becomes grounded on the seafloor near South Georgia's coast, it could create a deadly obstruction between the animals and their usual feeding grounds.

"The actual distance [the animals] have to travel to find food (fish and krill) really matters," Geraint Tarling, an ecologist with the British Antarctic Society, said in a statement. "If they have to do a big detour, it means they're not going to get back to their young in time to prevent them starving to death in the interim."

It's still possible that A-68a will float harmlessly around South Georgia's coast before drifting further northward — however, the RAF said, it still looks to be on course for a direct hit. The berg is about 90 miles (150 km) away from the island, and could make landfall by the end of December, the BBC said.

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[livescience.com](https://www.livescience.com), 12 December 2020

<https://www.livescience.com>

Tasmanian devils claw their way back from extinction

2020-12-10

For decades a ghastly facial cancer has been decimating Tasmanian devils. Spreading from animal to animal when the stocky, raccoon-size marsupials bite each other, the transmissible cancer has killed up to 80% of the devils in Tasmania, their only home for millennia. Some researchers saw extinction as inevitable. Now, a new study in Science, suggests the remaining 15,000 devils have reached a détente with the cancer. Until recently it was spreading exponentially, like the pandemic coronavirus among humans in many parts of the world. But geneticists calculate that each infected devil now transmits tumor cells to just one—or fewer—other devils. That could mean the disease may disappear over time.

"It is a promising sign for the future," says Gregory Woods, an immunologist at the University of Tasmania, Hobart, who was not involved with the work. Along with two other recent studies, the findings hint that changes in devil behavior—and possibly the emergence of less virulent tumor cells—may be taming the cancer's spread, and that desperate efforts to breed the devils in captivity may not be needed. "[This] deeper understanding of the links between host behavior and infectious disease

Tens of thousands of devils died, and conservationists established captive breeding programs to create a reserve population for reintroduction.

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may help reveal new insights that can help both devils and other wildlife facing emerging disease threats," says Vanessa Ezenwa, a disease ecologist at the University of Georgia, Athens.

Transmissible cancers are rare in mammals, and devils—whose nocturnal screams and growls earned them their name—are mostly solitary. But starting in 1996, researchers began to notice more and more devils with tumors. Sick animals infected others with cancer cells during mating season fights and scuffles over scavenged carcasses, triggering rapid spread of devil facial tumor disease (DFTD). Tens of thousands of devils died, and conservationists established captive breeding programs to create a reserve population for reintroduction.

The dynamics of the disease are complex, according to a recent study led by cancer geneticist Elizabeth Murchison of the University of Cambridge. Her team genetically analyzed more than 600 tumor samples collected between 2003 and 2018 and found five genomic versions, three of them widespread, with some devils contracting multiple types. That complexity could hamper efforts to develop vaccines to conquer the cancer, according to their 24 November study in PLOS Biology.

To further investigate the spread of the rogue tumor cells, Washington State University, Pullman, geneticist Andrew Storfer and his graduate student Austin Patton examined differences in tumor genomes through time, an approach routinely used to trace the spread of viruses including SARS-CoV-2, the pandemic coronavirus. A mammalian tumor genome is much larger than that of a virus, so Patton and colleagues had to work out ways to analyze their data, gleaned from 51 tumors collected from 2003 to 2018.

Focusing on 28 genes that seemed to be evolving at a consistent rate, they traced how specific mutations spread through the tumor samples over time. That enabled them to infer the rate at which the cancer itself was spreading among devils. "The application of these methods for transmissible cancer is very clever," says Michael Metzger, a molecular biologist at the Pacific Northwest Research Institute.

At the disease's peak in the early 2000s, each infected devil spread the disease to at least 3.5 others, the team reports today in Science. But transmission has slowed recently, with some infected animals not passing DFTD on at all. The reduced density of devils accounts for much of the decline, Patton suggests, as animals come into contact with fewer of their fellows. Remaining devils may also have better immune systems or altered

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behavior, speculates Patton, now a postdoc at the University of California, Berkeley.

A study out on 9 December in the Proceedings of the Royal Society B supports the idea that an animal's behavior can slow transmission. Disease ecologist Rodrigo Hamede and behavioral ecologist David Hamilton from the University of Tasmania, Sandy Bay, did devil contact tracing: For 6 months they put radio collars on 22 devils that revealed when an animal came into close contact with another. The tracking showed that once infected, even dominant, aggressive devils withdrew from others as they became sicker. These individuals were "superspreaders" only early in the mating season, Hamilton, Hamede, and their colleagues report. "The fact that they behave in this way is likely to have a big impact on disease dynamics," Hamilton says.

The Science study authors argue against plans to introduce captive-bred devils into remaining wild populations. Beefing up devil populations may increase their density and rev up transmission again, and captive-bred animals may lack resistance built up in wild populations, Storfer speculates.

Though this week's news is good, "devils are still not out of the woods," warns conservationist Max Jackson of Aussie Ark, which helps breed captive devils. Indeed, researchers detected a second transmissible facial cancer in devils in 2014. But the new findings offer hope, Hamilton says. "It looks extremely unlikely that we'll be losing them any time soon."

sciencemag.org, 10 December 2020

<https://www.sciencemag.org>

There are worse viruses than COVID-19 out there. How do we avoid the next big one?

2020-12-08

I recently wrote a book about Covid-19 in six weeks. I could do that partly because I have, in a way, been covering this pandemic since the 1990s — when scientists started predicting this would happen.

It started with warnings that population growth, economic expansion and habitat destruction were rubbing humans up against wild animals with dangerous viruses, while mushrooming cities and global air travel meant any germ that jumped to us could readily travel long distances. HIV showed how. Several near misses since then further proved the point.

If nothing else, there are lots more coronaviruses — and probably infections we have no clue about yet.

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But more than that, scientists actually predicted precisely the kind of virus we are now fighting — a respiratory coronavirus from bats. In 2005, Zhengli Shi, now director of the Center for Emerging Infectious Diseases at the Wuhan Institute of Virology, found coronaviruses in bats that closely resembled the SARS virus that started in China and almost went pandemic in 2003.

In 2015, both Shi's lab and another in North Carolina discovered some of these bat viruses could infect human airways and cause severe disease without having to undergo any changes. The research team put "potential for human emergence" in the title of their scientific article so no one could miss it.

Yet we ignored the warning. There was no emergency program aimed at developing a coronavirus vaccine or antiviral drugs, no global alert to watch for new coronaviruses in humans, no blanket ban on bat-derived products — not even pandemic response plans for anything but pandemic flu.

I called my book Covid-19: The Pandemic That Never Should Have Happened and How to Stop the Next One because we were warned and did very little to respond. Even without drug and vaccine research and development, governments could have prevented many deaths and lockdowns with a more rapid, focused response based on scientific advice. South Korea, New Zealand and China proved that by containing the virus with early, aggressive testing and quarantine. Most countries did not.

Scientists agree that more viruses capable of causing a global pandemic will emerge, says Amesh Adalja of the Johns Hopkins Center for Health Security in Baltimore, who predicted respiratory RNA viruses were a particular threat a year before the emergence of Covid-19 — a respiratory RNA virus. Virologists are also worried about several flu viruses, and about the lethal Nipah virus of Asian fruit bats, which is evolving the ability to spread person-to-person. If nothing else, there are lots more coronaviruses — and probably infections we have no clue about yet. The million-dollar question is, what can we do now to prepare so that we can prevent any of them from causing another pandemic?

The good news is that Covid-19 has taught us the risk is real, and hideously expensive, making us more likely to finally act on the warnings. The question is whether we actually will.

Surveillance and Diagnosis

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First, say experts in emerging diseases, we need surveillance of viruses circulating in humans, and perhaps in animals as well, to spot any new infection fast. The 2005 International Health Regulations (IHR), a treaty governing the management of outbreaks that could cross borders, requires rich countries to help improve surveillance in poor ones — but they largely have not, says David Heymann of the London School of Hygiene and Tropical Medicine, who helped lead the negotiations that led to the current version of the IHR in 2005.

"Rich countries have funded international efforts" such as the new emergency response capability at the World Health Organization (WHO), installed after the agency responded slowly to an Ebola outbreak in 2014, Heymann says. "But it would be better to help poor countries take charge of managing their own health situation themselves."

China's hospitals have a system that automatically alerts central health authorities of any unusual clusters of disease, a good way to spot when a new virus starts spreading in people. However, Wuhan officials trying to keep the Covid-19 outbreak quiet silenced it last January, allowing the novel coronavirus to spread for weeks before serious containment measures were taken, ultimately letting it get around the world. A more fail-safe version in more countries would help to better contain potential pandemic-causing disease organisms.

Second, we must diagnose infections. Most illness is diagnosed symptomatically, for example as a cough or fever or rash; the germs responsible for the symptoms are rarely identified, even in modern hospitals. China's pneumonias started in November, but doctors reportedly didn't do a diagnostic test to identify the germ responsible until late December. And that revealed a new coronavirus only because China has state-of-the-art DNA and RNA sequencing technology available to hospitals. Not all countries could have spotted it.

New technologies can in theory identify germs we haven't even seen before. The novel IRIDICA platform, based on a mass spectrometer, spotted the 2009 pandemic flu when it first hit the U.S. But the machine was taken off the market in 2017 by the medical technology company Abbott because of low demand. Not enough big hospitals saw the need for such capability to buy it, says Ranga Sampath, chief scientific officer of FIND, a nonprofit dedicated to developing diagnostics in Geneva, Switzerland, who was involved in developing IRIDICA.

Other diagnostic technologies, like the rapid tests now being used to screen people for Covid-19 infection, could also be used to screen

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for novel infections more systematically. But there is no way to sell technologies aimed at viruses that may never go pandemic, and that hampers progress, says Sampath.

A third line of defense would be to proactively develop vaccines and therapeutics. The Coalition for Epidemic Preparedness Innovations (CEPI) was set up in 2017 to fund the development of vaccines for potentially pandemic viruses. But progress has been slow; the only coronavirus vaccine being funded before Covid-19 was for MERS, an existing disease with a potential market. Efforts to set up a similar coalition for antiviral drugs have never gotten off the ground. Covid-19 could inspire more urgent efforts.

Which Viruses?

But what viruses should we invest in?

A logical focus might be on the new infections already attacking humans, which would be discovered through improved surveillance. But some virologists argue we should learn about viruses before they find us, not after. The Global Virome Project (GVP), a nonprofit organization, is trying to raise US\$3.7 billion over the next 10 years to genetically sequence and geographically map the half-million viruses in animals that belong to virus families that can infect humans.

But Adalja and colleagues at the Johns Hopkins Center for Health Security argue that such a survey won't tell us which of the thousands of new viruses discovered are dangerous or likely to emerge. Only tracking disease in humans will do that.

The answer might be a bit of both. Starting in 2013, Peter Daszak, head of the U.S.-based research nonprofit EcoHealth Alliance, and among the scientists backing the GVP, worked with Shi to discover SARS-like coronaviruses in bats, as the GVP advocates. But the team also found which of those viruses could infect people — plus evidence that, near bat caves in China, they already were. One of those viruses eventually caused Covid-19.

The problem is that neither discovery led to an urgent program of anti-coronavirus research and development.

David Morens, senior scientific advisor to Anthony Fauci at the U.S. National Institutes for Allergy and Infectious Disease, suspects we need dedicated institutions whose job it is to survey worrying viral discoveries,

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decide which require a response, and see it gets done. No one is now charged with connecting all those dots.

“We all have a stake in preventing pandemics, and the problems can't be solved by any one country,” he says. “So we should solve them together, as we have nuclear weapons,” where a U.N. agency monitors nuclear industries. But, he says, the WHO doesn't have the resources to monitor global disease. “No one's in charge.”

For example, Wuhan doctors knew last December that the virus spread person-to-person, but Chinese officials claimed to the WHO that it didn't, possibly to avoid panicking people. Earlier transparency might have led to earlier controls and a smaller epidemic.

But the WHO had no right to go into China and verify whether China's reports were true. Treaties for chemical and nuclear weapons permit international inspectors to verify countries' declarations about those things. Diseases pose arguably a worse risk, but under the IHR, they are the sole concern of the country they happen to strike first. If the WHO could inspect and verify countries' declarations about disease — and help countries build their surveillance capability while they're at it — we might be less at the mercy of countries' inclination or ability to report disease.

Preventing the Leap

Ultimately, to prevent pandemics we need to prevent wildlife viruses from leaping from nonhuman animals to people.

Much attention has focused on the wildlife trade, as some early cases of Covid-19 had links to a wet market in Wuhan. Certainly markets pose a risk, says Daszak. But genetic and epidemiological evidence that Covid-19 started on that market is weak. Other dangerous activities have gotten less investigation — for example, the widespread use in China of dried feces from the very bats that carry Covid-like viruses as a traditional eye medicine.

One way to keep humans and bats apart may be to factor the potential costs of pandemics into how we manage land use. The destruction of wildlife habitat, which brings people and wild species into new kinds of contact that can spread viruses, makes stressed, hungry wildlife more likely to spread infection.

The Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) brings together scientists and policy experts to advance conservation and sustainable use of biodiversity. In October IPBES

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estimated that spending US\$40 billion to US\$58 billion per year on disease surveillance, and reducing wildlife trade and risky land use changes, would significantly reduce pandemic risk — a bargain compared with the estimated US\$8– trillion to US\$16 trillion cost of just this pandemic — and that was only until July. Timber companies and the like might be eager to cooperate, says Daszak, a lead scientist on the IPBES report, if they were liable for damages from infections unleashed by their activities.

Replacing Complacency

Meanwhile, the Covid-19 crisis will end. A vaccine might be ready soon. It won't immediately stop all Covid-19 circulating. However, it could be coupled with rapid, frequent, inexpensive tests to see who is carrying the virus, coupled with strict quarantine of infected people and their contacts, to safely re-open businesses, schools and restaurants, says Michael Mina of Harvard University, a leading expert on immune reactions to viruses. The air travel industry is already introducing rapid tests for the virus at some airports in a bid to replace the quarantines some countries now require of new arrivals, which have vastly reduced travel.

But while normal life might one day return, the complacency that led to this pandemic must not, or, disease experts agree, we will certainly have more, and potentially worse pandemics. Covid-19 has revealed the true cost of our destruction of biodiversity. As we have seen, to control outbreaks, countries must start watching more closely for novel infections, sharing that information, and making far better pandemic plans. But they must also start trying to stop novel outbreaks from happening at all, by vastly reducing the destruction of nature that allows animal viruses to jump to us in the first place.

Not only that, but people who do not see our natural planet as worth conserving in its own right may now see another point. Destroying nature leads to deadly, destabilizing, very expensive pandemics. If campaigns using cute pandas can't end the destruction, maybe mounting death tolls — and economic devastation — will.

ensia.com, 8 December 2020

<https://www.ensia.com>

Plastic waste forms huge, deadly masses in camel guts

2020-12-15

Marcus Eriksen was studying plastic pollution in the Arabian Gulf when he met camel expert Ulrich Wernery. "[Ulrich] said, 'You want to see plastic?

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Come with me.' So we went deep into the desert," Eriksen recalls. Before long, they spotted a camel skeleton and began to dig through sand and bones.

"We unearthed this mass of plastic, and I was just appalled. I couldn't believe that — almost did not believe that — a mass as big as a medium-sized suitcase, all plastic bags, could be inside the rib cage of this [camel] carcass," says Eriksen, an environmental scientist at the 5 Gyres Institute, a plastic pollution research and education organization in Santa Monica, Calif.

"We hear about marine mammals, sea lions, whales, turtles and seabirds impacted" by plastic waste, Eriksen says (SN: 6/6/19). But "this is not just an ocean issue. It's a land issue, too. It's everywhere."

About 390,000 dromedary camels (*Camelus dromedarius*) live in the United Arab Emirates. Now in a study in the February 2021 *Journal of Arid Environments*, Eriksen, Wernery and colleagues estimate that plastic kills around 1 percent of these culturally important animals.

Of 30,000 dead camels that Wernery, a veterinary microbiologist at the Central Veterinary Research Laboratory in Dubai, and his team have examined since 2008, 300 had guts packed with plastic ranging from three to 64 kilograms. The researchers dubbed these plastic masses "polybezoars" to distinguish them from naturally occurring hair and plant fiber bezoars.

As dromedaries roam the desert looking for food, they munch on plastic bags and other trash that drift into trees and pile up along roadsides. "From the camel's perspective ... if it's not sand, it's food," Eriksen says.

With a stomach full of plastic, camels don't eat because they don't feel hungry, and they starve to death. Plastic can also leach toxins and introduce bacteria that poison the one-humped mammals, Wernery says.

"If 1 percent mortality due to plastic is verified by future and more detailed studies, then plastic pollution will certainly represent a reason of concern for [camels]," says Luca Nizzetto, an environmental scientist at the Norwegian Institute for Water Research in Oslo, who was not involved with the research. "These types of studies are relevant to raise social awareness about this pollution."

Banning plastic bags and single-use plastics is crucial for protecting camels and other wildlife, Eriksen says. "Plastic bags are escape artists.

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They blow out of garbage cans, out of landfills, out of trucks and out of people's hands. They travel for hundreds of miles."

sciencenews.org, 15 December 2020

<https://www.sciencenews.org>

Chemicals in plastics are a global health threat, says new report

2020-12-16

A new scientific report out Tuesday concludes that plastics and the chemicals they leave behind in the environment are a major threat to human health. It identifies over 140 chemicals readily found in plastic products that can harm our bodies, particularly through interfering with the endocrine system.

The report is the result of a collaboration between the Endocrine Society—one of the largest organizations of scientists who study the parts of the body that produce hormones, called the endocrine system—and the International Pollutants Elimination Network, or IPEN. It was penned by scientists in the U.S. and Sweden and is intended as a review of the research conducted so far on plastics and their potential to cause harm in people and other animals. They looked at hundreds of studies from around the world. All told, the report paints a dire picture.

The main threat from plastics comes from a group of chemicals that mimic hormones or can otherwise interfere with their role in the body. Hormones are naturally produced chemicals that help regulate most every bodily function we have, from metabolism to sleep to fertility.

The report identifies 144 of these endocrine-disrupting chemicals, or EDCs, that are commonly found in everyday plastic products. These chemicals include per- and polyfluoroalkyl substances (PFAS), phthalates, bisphenol A (BPA), and toxic metals like lead and cadmium. Some are intentionally added to plastics to improve things like their durability, while others are byproducts that leach out into the environment after plastic products are disposed of into landfills or the oceans and break down into microplastics.

Higher levels of EDCs in the body have been linked to greater rates of infertility, metabolic disorders like diabetes, and certain cancers among the general population. Other chemicals, like lead, are unsafe even at very low levels of exposure. This threat rises the younger we are, with fetal exposure to EDCs linked to higher rates of childhood autism spectrum

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disorder, attention deficit hyperactivity disorder, and lower birth weight, among other problems. Just this week, a new study found evidence that microplastics can end up in the human placenta, further highlighting the risk for fetal exposure.

"Endocrine-disrupting chemical exposure is not only a global problem today, but it poses a serious threat to future generations," said co-author Pauliina Damdimopoulou, a researcher at the Karolinska Institute in Sweden, in a statement released by the Endocrine Society and IPEN Tuesday. "When a pregnant woman is exposed, EDCs can affect the health of her child and eventual grandchildren. Animal studies show EDCs can cause DNA modifications that have repercussions across multiple generations."

Another major problem is that because plastics are so omnipresent, our exposure to EDCs is nearly universal as well. That means there's no place to hide from them, and it makes it hard to figure out the exact effects of EDCs, since there are no real "control" groups of unexposed people to use for comparison. Still, according to lead author Jodi Flaws, the harm caused by EDCs might be comparable to other common environmental toxins like cigarette smoke. However, as noted before, EDCs are practically everywhere, so they're harder to avoid than pollutants like smoke.

The ubiquitousness of EDCs means that it will take a global effort on the part of countries and plastic-making companies to really change things. So far, that effort has been lacking. Supposedly safer alternatives to BPA used in recent years, for instance, seem to cause similar toxic effects, while so-called biodegradable plastics often have the same chemical additives as conventional plastics. Meanwhile, the overall production of plastic continues to rise, further increasing our exposure to EDCs. Though the authors acknowledge that plastics are still needed in society for the foreseeable future, particularly for things like medical equipment, the situation needs to begin changing now if we ever want to lower our health risk from EDCs.

The plus side is that many of the same steps that would make for less EDCs—like easing our dependence on fossil fuels, the source of most plastic—would also save our climate from continuing to change in dangerous ways. The report also recommends stricter government regulations on the use of EDCs in plastics, including outright bans, incentivizing companies to develop safer alternatives, and improving the plastic recycling process, which can introduce other EDCs like dioxins into the environment.

All told, the report paints a dire picture.

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In a move lauded by the authors, for instance, Switzerland in May became the first country to suggest adding a UV-stabilizer, one class of EDC that hasn't received as much attention as others, to a list of dangerous chemicals maintained by the Stockholm Convention on Persistent Organic Pollutants, a global UN treaty that tries to compel countries to regulate their use.

While there's only so much a person can do about their individual exposure to EDCs, avoiding single-use materials for food and drink containers and not heating plastic containers in the microwave can help.

"It is our collective responsibility to enact public policies to address this clear scientific evidence that EDCs in plastics are hazardous," the report authors wrote. "It is our hope that the science will lead to global policy action to address the hazards that are widespread in plastics that threaten our environment, our health, and our future."

[gizmodo.com](https://www.gizmodo.com), 16 December 2020

<https://www.gizmodo.com>

EU-wide ban would save nature from 500,000 tonnes of microplastics agency

2020-12-09

HELSINKI (Reuters) - Banning the use of microplastics in products such as cosmetics and detergents across the European Union would prevent 500,000 tonnes of microplastics from polluting the environment over 20 years, the EU Chemicals Agency ECHA said on Wednesday.

The tiny bits of plastic that end up in waterways and oceans are causing growing concern among scientists about their effect on marine ecosystems.

In 2019, the Helsinki-based agency proposed that European lawmakers should ban the use of intentionally added microplastics and has now concluded its scientific and technical assessment of the ban's socio-economic impact.

Over 20 years, "the total cost of the restriction to European society is estimated to be 10.8 or 19.1 billion euros, depending how environmental risks from the granular infill material (mainly from shredded car tyres) are addressed," the ECHA said, referring to the soft infill used on artificial turf sports pitches.

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The agency has proposed a microplastics ban on products such as cosmetics, cleaning and laundry products, fertilisers, plant protection products and seed coatings, but adding the largest single source of emissions - turf pitches - to the list implies a significantly higher total cost, it concluded.

Artificial sports pitches release up to 16,000 tonnes of microplastics into nature each year and so the ECHA said their sale should either be banned after a six-year transition period or cheaper measures should be made mandatory to help mitigate the problems, such as fences or brushes.

Campaigners and some EU advisers have criticised the ECHA's proposal for allowing companies to continue to use even smaller nanoplastic particles.

EU member states will eventually vote on the ban that could be adopted as soon as in 2021, the ECHA said.

"When all the transition periods have expired, the emissions would be reduced by more than 90%," it concluded.

[reuters.com](https://www.reuters.com), 9 December 2020

<https://www.reuters.com>

The tiny bits of plastic that end up in waterways and oceans are causing growing concern among scientists about their effect on marine ecosystems.

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The Paris climate pact is 5 years old. Is it working?

2020-12-11

When world leaders celebrated reaching a landmark climate change agreement in Paris in December 2015, the Eiffel Tower and Arc de Triomphe were illuminated with green floodlights and the message “Accord de Paris c’est fait!” (the Paris agreement is done!). Now, five tumultuous years later, a new slogan might be “travail en cours” (work in progress).

That will be the implicit message sent tomorrow when nations gather—virtually—to look back on what the Paris agreement has achieved in its first half-decade and, more importantly, to unveil new pledges to further cut planet-warming emissions. Although analysts say the pact has helped make progress toward its goal of preventing average global temperatures from increasing by 2°C above preindustrial levels, the effort is also shadowed by ample evidence that many countries aren’t living up to the promises they made in 2015. And even if nations had kept those promises, some researchers forecast that global temperatures would rise by 2.6°C by the end of the century, underlining the need for stronger action.

If a grade is awarded to the Paris pact “based on whether we have any prospect of meeting a 2°C target, from that point of view, it’s probably a D or an F,” says Michael Oppenheimer, a climate scientist and policy expert at Princeton University. But at the same time, he says, the pact has made a “real difference” by helping make climate change “a top concern of all countries.”

The Paris agreement is an unusual hybrid of soaring ambitions and few enforcement mechanisms. Every country in the world signed onto a promise to take steps to keep global temperature increases “well below” 2°C by 2100. Doing so would require weaning off fossil fuels for energy and transportation, halting the loss of forests, overhauling food production, and finding ways to suck greenhouse gases out of the atmosphere. Yet to meet the goal, countries were allowed to come up with their own goals and plans for how to accomplish them. Falling short comes with few concrete penalties.

Signs of progress

The idea was to create a dynamic structure that could evolve along with changes in national economies, technology, and political will, said Christiana Figueres, who headed the U.N. office that coordinated talks leading to the Paris accord. That flexibility, she noted, has recently allowed

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a number of nations to strengthen their initial pledges by promising to cut their net climate emissions to zero by 2050. The European Union, Canada, South Korea, Japan, South Africa, and the United Kingdom have all made that pledge. U.S. President-elect Joe Biden endorsed the target and has promised to make addressing climate change a centerpiece of his presidency. Meanwhile, China—the world’s single largest source of emissions—has said it will cut climate pollution faster than initially promised, aiming for carbon neutrality by 2060.

“We are constantly seeing the progress of the implementation of the Paris agreement,” Figueres said at a press conference held earlier this week in advance of Saturday’s summit, which was scheduled to be held in Glasgow, U.K., before the pandemic forced its cancellation. “Not as quickly as we want to, but it is definitely moving forward.”

There are also signs that the temperature spikes predicted for later this century are easing slightly. Before the 2015 Paris summit, global emissions were on course to push temperatures up by 3.5°C by 2100, according to estimates by the Climate Action Tracker, a nonprofit science consortium. Now, that trajectory has flattened to 2.9°C.

The shift is the result of a combination of technological, economic, and political changes, says Bill Hare, a physicist and CEO of Climate Analytics, a nonprofit that is part of the consortium. The cost of renewable energy technologies, such as solar power, has plummeted. Economic growth has slowed. Regulations, particularly in European countries, have begun to take a bite out of emissions. In Europe, emissions fell 23% below 1990 levels by 2018. On Friday, EU leaders agreed to a plan for a 55% reduction by 2030.

Setbacks emerge

Such promising moves, however, have been offset by less encouraging developments over the past 5 years. President Donald Trump, for example, withdrew the United States from the Paris deal with few penalties. (Biden plans to rejoin it.) And many U.S. states that rushed to launch a state-level version of the U.S. targets abandoned by Trump are also falling short, according to a new analysis by the Environmental Defense Fund (EDF). Even when accounting for the economic downturn caused by the COVID-19 pandemic, researchers found that states will likely cut emissions by just 18% below 2005 levels by 2025. In contrast, the United States under former President Barack Obama had promised cuts of between 26% and 28%.

Now, five tumultuous years later, a new slogan might be “travail en cours” (work in progress).

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"I think it's easier to speak rhetorically about the importance of climate change than it is to do the hard work of putting in place the regulatory framework that actually ensure pollution declines," says Pam Kiely, EDF's senior director of regulatory strategy.

Meanwhile, Russia and Brazil, two other countries key to dealing with climate pollution, have largely thumbed their noses at the Paris agreement. In Brazil, under the government of President Jair Bolsonaro, deforestation has soared in the Amazon, releasing vast amounts of carbon that had been stored in trees and underground.

Such developments enabled global emissions of warming gases to continue climbing to a record high in 2019, according to a new U.N. report. This year, the pandemic has triggered a short-term drop in climate pollution as economies faltered and people avoided travel and worked from home. Emissions fell by about 7% this year compared with 2019, according to a new estimate by an international team of scientists in the journal *Earth System Science Data*. But emissions are expected to bounce back as economies revive.

What's next?

The mix of contrasting trends has meant the progress enabled by the Paris agreement has been "very incremental," Hare says. So, to stay below the 2°C warming threshold—or below the 1.5°C limit that vulnerable island nations say is needed to prevent rising seas from swallowing their communities—the countries gathering at Saturday's summit will have to commit to stiffer emissions reductions. "What needs to happen in the next few years," Hare says, "is something much more transformational."

It's not clear, however, that the political will exists. There are signs, for example, that many countries won't be using the emissions reductions caused by the pandemic as an opportunity to give a boost to their climate ambitions. The world's richest countries, the G-20, have earmarked \$12 trillion to address the economic disruption caused by COVID-19, but just one-quarter of the donors are dedicating funds to efforts to reduce carbon emissions, according to a new report from the United Nations Environment Programme. "We've never had \$10 [trillion] to \$20 trillion, which will be spent in the next 24 months, ever before to reboot the world economy," Andrew Steer, president of the World Resources Institute, said at a press conference this week. "If we invest that in yesterday's economy we are basically committing a mortal sin for our grandchildren."

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Submitting nations will also face other financial challenges. Many leading developed nations had announced an initiative to double spending on clean energy R&D by this year, an increase of \$10 billion per year. So far, however, the effort has raised spending just \$4.9 billion. It's also not clear whether the richest countries are making good on a previously promised \$100 billion in annual public and private financing by this year for climate-related work such as renewable energy projects. (Spending had risen to \$79 billion in 2018, the most recent year available, from a previous high of \$62 billion in 2014, according to the Organisation for Economic Co-operation and Development.)

Meanwhile, the clock is ticking. At current rates, according to one project tracking carbon emissions, the world has 7 years before it has exhausted its budget of carbon to keep temperature increases below 1.5°C.

[sciencemag.org](https://www.sciencemag.org), 11 December 2020

<https://www.sciencemag.org>

Longest-exposure photo ever was just discovered. It was made through a beer can

2020-12-15

Eight years and one month ago, a Master of Fine Art student at the University of Hertfordshire fitted a beer can with photographic paper and created a low-tech pinhole camera. She then placed the can on a telescope at the university's Bayfordbury Observatory and eventually forgot about the project.

Now, the resulting photograph has been rediscovered — and it may be the longest-exposure photo ever taken.

"I had tried this technique a couple of times at the Observatory before, but the photographs were often ruined by moisture and the photographic paper curled up," photographer Regina Valkenborgh, now a photography technician at Barnet and Southgate College, said in a statement. "I hadn't intended to capture an exposure for this length of time and to my surprise, it had survived."

The photograph shows the sun's journey through the sky since 2012; 2,953 arcs of light tracing its path as the sun rose and set. Part of the telescope's dome is also visible at the left of the photograph. On the right is a gantry structure designed to straddle the observatory, which was built halfway through the exposure.

"I hadn't intended to capture an exposure for this length of time and to my surprise, it had survived."

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Prior to this photo, the longest-exposure picture was thought to be four years, eight months, taken by German artist Michael Wesely, according to the university. Wesely takes long-exposure photographs of various scenes, such as the renovation of the Museum of Modern Art (MOMA) in New York City.

Valkenborgh's image was rediscovered by the Bayfordbury Observatory's principal technical officer, David Campbell, who found and removed the unassuming beer can from the telescope.

"It was a stroke of luck that the picture was left untouched, to be saved by David after all these years," Valkenborgh said.

[livescience.com](https://www.livescience.com), 15 December 2020

<https://www.livescience.com>

Did the universe's creator hide a message in the cosmos?

2020-12-09

Did the creator of the universe leave a hidden message in the cosmos for intelligent life? If so, scientists have yet to find it.

A search for a message on "the most cosmic of all billboards, the Cosmic Microwave Background (CMB)," has failed, a new study finds. The CMB is the oldest light in the universe, visible across all of space. Its microwaves have been traveling since the first atoms formed out of a haze of protons and electrons that filled the universe soon after the Big Bang. They form a background radiation pattern across the whole sky. Physicists have long studied the CMB looking for features that might offer clues about the structure of the universe. Michael Hippke, a self-described "gentleman scientist" affiliated with the Sonneberg Observatory in Germany, went looking for a sign from a creator in that background radiation. But, either way, he didn't find one.

A beacon across the universe

Leaving aside all the hidden assumptions in the question — that there is a cosmic creator, that a cosmic creator wants people to know about them, that the cosmic creator has an insight into the minds of future intelligent creatures and can therefore predict the future — the CMB would be a good place to hide a message if you were a creator trying to target civilizations at our current level of development, said Avi Loeb, a Harvard

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astrophysicist who wasn't involved in Hippke's work published to the arXiv database on Nov. 29. (The paper has not been peer reviewed.)

"There could be different media on which you'd encode the message," Loeb said. The CMB is a good option because we've been able to detect it since the first good microwave study of the sky in 1964, as opposed to, say, gravitational waves, which require more technical equipment and we only detected in February 2016. "It all depends on what level of intelligence you want to approach. It's almost like writing different sections of a newspaper for different audiences."

Another advantage to hiding a message in the CMB for a would-be cosmic creator is that right now, the CMB is visible from almost any vantage point in space, said Yoni Brande, a University of Kansas astrophysicist who also wasn't involved in this paper. (The exception might be at the center of a very dense cluster of stars or dust.)

"If I was a creator and I wanted to delay the slam-dunk evidence of, here is the message that says 'Hi guys, I created the universe. And you're welcome.' And I wanted to make people work for that a little bit, I'd make it this sort of subtle-yet-universally observable thing," Brande said.

In that case, humanity might have reached that level of subtlety fairly recently.

Hippke wasn't the first researcher to speculate about the presence of a message in the CMB. Steve Hsu of the University of Oregon and Anthony Zee of University of California, Santa Barbara wrote a paper proposing the idea in the journal *Modern Physics Letters A* in 2006. But they had much less CMB data to work with.

(They also wrote in that paper that: "Our work does not support the Intelligent Design movement in any way whatsoever, but asks, and attempts to answer, the entirely scientific question of what the medium and message might be IF there was actually a message.") **PLAY SOUND**

An imperfect messenger

If you were a creator looking for a "cosmic billboard" on which to announce yourself to your subjects, the CMB has disadvantages as well as advantages. Hippke wrote in the study. For instance, the CMB will fade beyond recognition at about 100 billion years after the Big Bang, Brande said. (We're at 13.8 billion right now.) That's well within the period when the universe will still make new stars and when intelligent civilizations

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might develop. It would be a bit odd, Brande said, to write a message to creation but erase it before the emergence of its later denizens.

Perhaps more importantly, the CMB probably doesn't actually look the same from every point in space. Mostly, the microwave radiation is a perfectly random "static" in the sky. But there are slightly cooler spots and warmer spots, which physicists believe are signatures of early irregularities in the universe that later led to the formation of galaxies. And that pattern of cool and warm would likely look different from different points in space.

Hippke got around that by not looking for a message in the image of CMB itself, but in its "power spectrum," a graph of the different energy levels underlying CMB radiation. It's at least possible, Hippke wrote, that the power spectrum would be consistent across the universe (though most researchers think this is unlikely). And even if it weren't, a creator might have set up the CMB to deliver one message to one part of space and a different message to a different part of space.

But there is a bigger issue with using the CMB to send us a message.

"The real problem I have with the microwave background is ... what we see in the sky is a two-dimensional surface surrounding us," Loeb said.

It's a view of that ancient moment in space-time when the universe became clear that is particular to our neighborhood of space. It's the inner surface of a sphere with a 13.8 billion light year radius and Earth at the center. That sphere is composed of all the points in space 13.8 billion light-years from Earth as they looked at the moment after the Big Bang when the universe became transparent. A viewer in another galaxy would see a different 13.8 billion light year radius sphere centered on themselves, composed of what all the points that far away looked like at the same moment in time. The further apart the two viewers are, the more different their views of the CMB would be.

"The problem is, if I move away from Earth, to the center of the Milky Way galaxy or the Coma Cluster [321 million light-years from Earth] or somewhere else a great distance away, then the two-dimensional surface around that point would be a different sphere," Loeb said. "The sphere is always centered around the observer."

That's important, Loeb said, because it means the CMB isn't really a billboard to the cosmos. It's a billboard to our particular location in the cosmos. Sending coherent messages to the whole universe would be like manufacturing untold trillions of billboards, not one big one. It might

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be possible to structure the universe such that there were one or many messages in the CMB power spectrums at different points in space. But that's a different project for the creator to have undertaken than the relatively simple one initially suggested by the paper. (Loeb also noted that there are many expert cosmologists studying the CMB all the time looking for patterns, and it would be surprising if Hippke had found a pattern on a lark where all those scientists had failed.)

It's also the case, Brande said, that there's no particular reason to locate a message in physics as opposed to some other science. Why wouldn't the universe's message be encoded in, say, the parts of the cell, or DNA, or the periodic table?

While he sees the CMB as the best example of a subtle, universal thing, Brande said, "my dad would probably say something different because he's a geologist. Like 'Why not do something with the physical chemistry of how planets are formed? Something you can pick up and look at?' But I do think there's enough variation in basically every other easily-observable thing [besides physics] around us [to rule it out]."

Where to really find a message, if one is out there

Loeb and Brande both said that despite their questions about the idea of the paper, there's nothing wrong with a scientist looking into questions like this. It's an interesting way of framing some basic physical questions, Brande said. And Loeb asked, "Who does it hurt to look?"

No one can speak for the full diversity of religious feeling on any topic, but Avigayil Halpern, a rabbinical student at New York's Hadar Institute, said that whatever the scientific merits of the project, it doesn't work as theology.

"The central problem ... is that it fundamentally misunderstands who or what 'God' is," Halpern said. "The implicit goal ... seems to be to attempt to prove God's existence, but it's a category error to think that scientific evidence has something to say about if God exists."

"It makes no more sense to assert that God can be found in a code written into the cosmic microwave background than to say that morality can be derived from the study of chemistry," she said. "Those looking to find God in the universe would do better to seek out the image of the Divine as reflected in the faces of those around them."

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Religion isn't the only framework for imagining a creator though. Some physicists, Loeb pointed out, imagine a sort of prosaic theology where our universe might be a laboratory experiment in some higher-order universe.

If Loeb were our creator, he said, the sign of his own existence that he would have left us would have been the capacity to create yet another universe within our own.

Right now, that's impossible, he said. But one day, perhaps when the ingredients that made our universe are better understood, researchers will develop another universe in a laboratory, Loeb speculated. If that happens, he said, it would make sense to understand it as a sort of message from a higher-order creator: Just like you have the ability to create universes, so too was your universe created.

Hippke, for his part, didn't find an intelligible message in the cosmos. But he was able to convert the CMB power spectrum into a binary code — which is basic enough that it would likely be recognizable to most intelligent civilizations, Brande said:

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11101011101110101011111110101011110000001011010010110100101
001011101110011111010110011011001110100001011000011110000110
001110010110100010100010101101001010000111110001110011111011
11000100010011000111001011011100100101000101001110001001010
01010000111011001010100110101100101100010001101100100100111
01011011001010100110010110010010111101010001111111010011011
000101111010101001001110011011010101101000011000010110101110
011001110001010010011100111111010100011010000000011010110010
001011010100000111100000010110101000001111000
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"We may conclude that there is no obvious message on the CMB sky," Hippke wrote. "Yet, it remains unclear whether there is (was) a Creator, whether we live in a simulation, or whether the message is printed correctly in the previous section, but we fail to understand it."

Originally published on Live Science.

[livescience.com](https://www.livescience.com), 9

<https://www.livescience.com>

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How did this rare pink manta get its color?

2020-02-11

Photographer Kristian Laine was freediving recently off the southernmost island of Australia's Great Barrier Reef when a bright pink manta ray glided by. He thought for sure that his camera was malfunctioning.

"I had no idea there were pink mantas in the world, so I was confused and thought my strobes were broken or doing something weird," says Laine, whose photographs posted on Instagram this week have gone viral. Laine later realized he'd spotted an 11-foot male reef manta ray named after Inspector Clouseau, the bumbling detective of the Pink Panther movies. The fish, who cruises the waters around Lady Elliot Island, is the only known pink manta ray in the world.

First spotted in 2015, Inspector Clouseau has been seen fewer than 10 times since. "I feel humbled and extremely lucky," says Laine, who photographed him amid a group of seven other males, all of them vying for a female. (Read how manta rays form close friendships, shattering misconceptions.)

Scientists with the Australian research group Project Manta, who study the rosy ray, have confirmed its color to be real. At first, they theorized Inspector Clouseau's color was the result of a skin infection or diet, similar to how pink flamingos get their color from eating tiny crustaceans. But in 2016, Project Manta researcher Amelia Armstrong took a small skin biopsy from the famous animal, and their resulting analyses ruled out diet and infection as the cause.

Now, Project Manta's leading theory is that the manta has a genetic mutation in its expression of melanin, or pigment, says Asia Armstrong, a research assistant for the group.

And the ray is not just a cool-looking animal—it could contribute to science, she adds by email. "Understanding the origin of this genetic mutation may help inform us" about how color evolved in mantas, she says.

Tickled pink

Solomon David, an aquatic ecologist at Louisiana's Nicholls State University, suspects the mutation is a condition called erythrism, which causes an animal's skin pigmentation to be reddish, or in some cases, pink. Other more well-known genetic mutations to an animal's pigment can make them melanistic (black) or albino (white).

The fish, who cruises the waters around Lady Elliot Island, is the only known pink manta ray in the world.

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"Having seen other pigmentation-related mutations in fishes, it's not completely unexpected that this exists, but it's really cool to see regardless," Solomon says by email. (Go inside the underwater world of manta rays with a National Geographic photographer.) Guy Stevens, CEO and co-founder of the U.K.-based Manta Trust, agrees that erythrism is the most plausible explanation.

Reef mantas typically come in three color patterns: All-black, all-white, or black-and-white. The latter, which is most common, features a pattern called countershading, in which the fish has a black back and a white belly. When viewed from above, their dark backs blend in with the darker water below, and when viewed from below, their light bellies blend into the sunlit surface—a configuration generally thought to offer protection from predators, such as sharks.

Even so, Stevens thinks the manta's atypical color shouldn't impact its survival or vulnerability to predation. That's mostly because of the reef manta's massive size; an adult can easily weigh more than a ton. (Learn why manta rays swim in mesmerizing circles.)

"They are big when they are born, and they grow quite quickly in their first few years to make them large enough that only the biggest of marine predators prey on them."

"It just goes to show—nature will always surprise you," he adds. "Now the search is on for a blue manta."

[nationalgeographic.com](https://www.nationalgeographic.com), 11 February 2020

<https://www.nationalgeographic.com>

Dogs will never speak human. Here's why

2020-12-09

You probably think your dog is the smartest (and cutest!) when they learn to sit or give a paw. But most dogs can pick up only a limited number of words in their lives, and a new study may help explain why.

The study found that dogs' brains cannot distinguish words that differ by a single speech sound, such as "dig" versus "dog," or "sit" versus "set." This makes dogs similar to human infants, who also can't distinguish between words with similar sounds. But around age 14 to 20 months, babies typically start to learn that every sound in a word matters (i.e. that "dog" and "dig" are different words), and this allows their vocabulary to soar, the authors said.

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It appears that dogs never grasp these distinctions. "Dogs might not attend to all details of speech sound when they listen to words," study senior author Attila Andics, of the Department of Ethology at Eötvös Loránd University in Hungary, said in a statement. "Further research could reveal whether this could be a reason that incapacitates dogs from acquiring a sizable vocabulary."

PLAY SOUND

For the study, published Tuesday (Dec. 8) in the journal *Royal Society Open Science*, the researchers monitored the brain waves of 17 very good dogs using a technique called electroencephalography (EEG). The study is one of the first to use EEG on awake dogs that didn't have any specific training. The dogs visited the lab with their owners, and once the dogs got used to the new environment, they sat down on a mattress with their owners, and the researchers attached electrodes to the dogs' heads with tape.

Then, the dogs listened to pre-recorded words that they knew (e.g. "sit"), as well as nonsense words that sounded similar (e.g. "sut") and nonsense words that sounded very different (e.g. "bep").

The dogs' brains could quickly discriminate the words that they knew from the nonsense words that sounded very different ("sit" vs. "bep"). But their brains seemed to make no distinction between the words they knew and the nonsense words that differed by only a single speech sound ("sit" vs. "sut"). Researchers have seen a similar pattern in infants younger than 14 months.

It's not that the dogs can't hear the different sounds — studies have found that dogs can distinguish individual speech sounds (such as "d," "o" and "g"). But they may have "attentional and processing biases" that prevent them from attending to all the sounds in a word, they said.

Future studies with a large number of participants and more trials of words are needed to confirm the findings, they said.

Originally published on Live Science.

[livescience.com](https://www.livescience.com), 9 December 2020

<https://www.livescience.com>

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You can now get Scotch whisky KitKats but only in Japan

2020-12-14

(CNN) — Nestlé has launched an elaborate new line of KitKats in Japan, using chocolate aged for six months in whisky barrels in Scotland.

The gourmet bars are available only for the winter season in the country, and use cacao nibs shipped over from Islay -- home to a number of ancient distilleries.

The company says the new bar is “a bitter chocolate for adults that lets consumers enjoy a hint of refined whisky aroma and taste.”

“During the 180-day period, whisky barrels are manually rotated at a pace of once a week and this puts all of the cacao nibs in the barrel into contact with the whisky barrel’s interior,” the company said.

The bars are only available online in whisky-loving Japan and from KitKat’s speciality Chocolatory shops, located in a handful of Japanese cities, at a price of 300 yen (\$2.90).

The chocolate was aged under the supervision of Japanese chef Yasumasa Takagi, the company said.

Production on some of Scotland’s world-renowned whisky islands has been affected by the coronavirus pandemic, with travel to the locations being sealed off and bars and restaurants across the UK closed in response to the virus.

In 2019, the country exported 1.3 billion bottles to 175 markets around the world, bringing in £4.9 billion (\$6.5 billion) to its economy.

Ardbeg, Lagavulin and Laphroaig are all produced on Islay, with production of each whisky lined up on a narrow two-mile stretch of coastal road on Islay’s southern shore.

But the entire island was sealed off during the British lockdown earlier this year; the only ferries that arrived were delivering supplies, and the only people allowed off-island were those with medical emergencies.

edition.cnn.com, 14 December 2020

<https://www.edition.cnn.com>

The company says the new bar is “a bitter chocolate for adults that lets consumers enjoy a hint of refined whisky aroma and taste.”

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Protein found in fingertip ‘capsules’ may be critical to our sense of touch

2020-12-11

Can you tell the difference between high- and low-thread-count sheets just by touching them? Thank usherin, a protein found in a mysterious structure in your fingertips. Usherin also helps us see and hear, suggesting a deep molecular connection among our most important senses.

“The work is surprising,” says Ellen Lumpkin, a neuroscientist at the University of California (UC), Berkeley, who was not involved in the study. The study, she says, points to a single protein being used over and over again in distinct ways to help us monitor the outside world.

Scientists already had some hints that usherin is important for our sense of touch. A mutation in the gene that codes for it, USH2A, causes Usher syndrome—a rare, inherited disease that leads to blindness, deafness, and an inability to feel faint vibrations in the fingertips.

To further explore usherin’s role in touch, researchers recruited 13 patients with a form of Usher syndrome that specifically affects touch. The team—led by Gary Lewin, a neuroscientist at the Max Delbrück Center for Molecular Medicine—measured how well each person sensed pain, temperature changes, and tiny vibrations at 10 and 125 hertz (Hz), mimicking the sensation of moving a fingertip across a rough surface. The scientists then compared the patients’ results against those of 65 healthy volunteers.

People with Usher syndrome did just as well as their counterparts at sensing temperature changes and mild pain, the team found. But they were four times less likely to pick up on the 125-Hz vibrations and 1.5 times less likely to detect the 10-Hz vibrations.

To find out why, the researchers replicated the experiment using mice with or without the USH2A gene. As with their human equivalents, rodents in both groups were fine at detecting temperature changes and pain. But mice with USH2A were better at detecting both degrees of vibrations than those without it, the team reports this week in *Nature Neuroscience*.

The study also unveiled a surprising source for usherin. The protein is typically present in nerve cells responsible for vision and hearing. But in mice and humans, the scientists found it in the “Meissner corpuscle,” a microscopic, oval-shaped capsule that surrounds nerve cells in fingers.

But they were four times less likely to pick up on the 125-Hz vibrations and 1.5 times less likely to detect the 10-Hz vibrations.

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The find adds to an emerging area of research: exploring how molecules outside neurons, once thought to merely support or protect nerve cells, shape our sense of touch, says Theanne Griffith, a neuroscientist at UC Davis who was not involved with the work. Until about 20 years ago, she says, researchers thought these neurons were operating alone to pass on sensory signals to the brain. "It's amazing that they were able to show these results."

Lewin says he and his team plan to determine exactly how USH2A is working to help us detect vibrations, noting that further work with both the gene and protein could lead to a better understanding of how we gauge and control our grip strength. "We now have evidence that something being made in the Meissner corpuscle is necessary," he says, "but there are likely many more elements at play."

sciencemag.org, 11 December 2020

<https://www.sciencemag.org>

How to recycle an airport

2020-12-04

BERLIN — It turns out old airports offer some handy solutions to pressing challenges facing fast-growing cities.

Take Berlin, now home to four mothballed airfields owing to its history as a divided city and the recent — mightily delayed — opening of the new Berlin Brandenburg Airport in November. Those former sites include Tempelhof, now a park, and Tegel, soon to be redeveloped, with both offering a broad canvas for urban renewal schemes.

Berlin could be followed by other cities — there are some 193 airports at risk of closure out of a total 740 across Europe due to the pandemic's catastrophic impact on the travel industry, according to industry lobby ACI Europe.

While those airports are fighting to survive, for Berlin, the derelict terminals are a planner's dream come true.

"It's a once in a lifetime opportunity," said Philipp Bouteiller, who's in charge of redeveloping Tegel, located just a 20-minute drive from the Bundestag.

The Tegel site is a tenth the size of Manhattan and has long been earmarked for redevelopment. In future it will be home to a so-called

For example, the redevelopment plan will make Tegel a "sponge city" that retains rainwater rather than allowing it to drain away.

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Urban Tech Republic, which will place a university and start ups in the old hexagonal terminal building, which dates from the 1970s in the old French zone of occupation. Out across the runway, a new residential development with more than 5,000 units will be the world's largest neighborhood built from wood.

That will help to relieve a pressing housing shortage in the German capital, although the first flats won't be ready until the late 2020s.

"To receive five square kilometers in these times when urbanization is one of the biggest challenges is an absolute gift, and one that other metropolises are envious about," Bouteiller said.

During the near decade-long delay in Tegel's closure, due to a series of planning problems with Berlin Brandenburg, discussion has intensified over the need to create climate-friendly living and working environments.

"When we began to start to think about sustainable technologies back then ... people looked at me in bewilderment," Bouteiller said of his planning for post-plane Tegel back in 2012. "Now, it's a ... part of the mainstream."

While it will take up to three more decades to fully develop Tegel, the site offers a chance to roll out green urban design solutions at scale. For example, the redevelopment plan will make Tegel a "sponge city" that retains rainwater rather than allowing it to drain away. Cars will be discouraged, and the goal is to make the site more biodiverse than it was as an airport, Bouteiller said.

Such measures build on work already done at two smaller former aviation hubs in the city. At Gatow, the former British sector airport in the far west of Berlin, 950 families have moved in around the old airport (which is now a museum) although work on a new nature park is delayed. In the southeast of the city, part of the 26-hectare site of Berlin's old Johannisthal airfield, where early aviation pioneers tested their planes, has been turned into a nature reserve.

Tempelhof utopia

Just 5 kilometers south of the Bundestag, another former airport offers a glimpse of a different vision. Tempelhof, designated as an airfield in the 1920s and expanded under the Nazis before being taken over by the U.S. military during the Cold War, is now one of the largest inner-city parks in the world at 300 hectares.

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On an average sunny day, as many as 90,000 people visit the park, with kitesurfing allowed on the old landing strip. After its closure as an inner-city airport in 2008, a 2014 referendum forced the government to maintain Tempelhof as a public space and killed plans to allow private investors to develop housing on the site.

That's paying off during the pandemic. "In 2014, we saved the field. In 2020, the field saved us," said Mareike Witt from the citizens' initiative 100% Tempelhofer Feld.

The field's management — which includes seven elected citizens — aims to use the site for the broader good of the city. Housing for refugees has been developed, as well as small garden allotments and sport facilities, while parts of the park are used for animal grazing in summer.

In the next few months, part of Tempelhof's massive crumbling terminal building will also be used for a coronavirus vaccination program, as will Tegel's recently closed terminal. But while Tegel already has a redevelopment masterplan that aims to suck in private investment, Tempelhof's building complex is largely empty and in need of urgent renovation.

More than 80 leasers currently use a fraction of the 300,000 square meters of floor space inside the old Tempelhof complex. They include the city police, a university and Berlin's traffic control center, said Pascal Thirion, who helps manage the sprawling complex for the city authorities.

"It's clear that Tempelhof is such a unique space of historical and emotional importance to Berlin that it's not something the city will ever be able to give away for commercial use," said Thirion.

Still, settling on a vision for how the building can be used for the broader public good has been tough.

"I think the biggest challenge at the moment is that of course the citizens have great expectations of what this building could achieve," said Regula Lüscher, the city's state secretary for urban development and housing. "We are faced with the challenge of having to renovate this building step-by-step over a long period of time."

Lüscher estimates it will cost as much as €800 million to renovate just the old office blocs inside Tempelhof, a curving terminal building running 1.2 kilometers in length. Getting it fully modernized will take 15 years, she said.

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"That is the challenge: On the one hand, to raise the large funds — and, in parallel, to let the population participate in this development," she said.

While the 2014 referendum blocked developers, the pressure isn't over. There are calls to hold another vote.

"Many people argue that the field is huge, so that giving away a third of the area can't do harm," said Monika Dierenfeld, who sits on the Tempelhof coordination board. "This is complete deception; species protection is only possible because the field is so large. We host 40 percent of all Berlin skylarks on the field, they breed here."

"The pressure [by investors] is permanent, but our city community is watching out," said Dierenfeld.

politico.eu, 4 December 2020

<https://www.politico.eu>

How non-native plants are contributing to a global insect decline

2020-12-08

For years, Doug Tallamy sounded the alarm about the grave threat that plants introduced from abroad pose to native insects. By transforming native plant communities into so-called novel landscapes increasingly dominated by exotic species on which many insects cannot feed, the University of Delaware entomologist speculated, they imperil not only insects but also the birds and other animals that depend on insects for survival.

Not everyone has greeted the thesis with open arms. The effect of introduced plants on native biodiversity has been one of the most contentious issues in ecology, compared to gun control, abortion, and other "hot-button issues in contemporary American culture" by Peter Del Tredici, senior research scientist at Harvard's Arnold Arboretum. "Over the past few decades," 19 leading ecologists, including Del Tredici, wrote in a 2011 commentary in the journal *Nature*, "'non-native' species have been vilified for driving beloved 'native' species to extinction and generally polluting 'natural' environments... 'Nativeness' is not a sign of evolutionary fitness or of a species having positive effects."

Dozens of recent studies, however, have provided evidence that supports Tallamy's hotly disputed hypothesis. In a paper published online on November 18 in the journal *Ecological Entomology*, Tallamy and two

'Nativeness' is not a sign of evolutionary fitness or of a species having positive effects.'

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co-authors review the research buttressing the proposition that the widespread displacement of native plant communities by non-native plants in agriculture, agroforestry, and horticulture is a key cause of insect declines.

The issue of non-native plants has become newly urgent as the scope of the “insect apocalypse” has become clear. In the past few years, insect declines have been documented around the globe, including western and northern Europe, North America, neotropical countries such as Costa Rica and Puerto Rico, and even the High Arctic. In a comprehensive review of 73 historical reports published in *Biological Conservation*, scientists found that in terrestrial ecosystems, Lepidoptera (butterflies and moths), Hymenoptera (bees and their close relatives), and Coleoptera (beetles), as well as four major aquatic insect groups such as Odonata (dragonflies and damselflies), have suffered dramatic declines. What’s more, it’s not just specialist species with restricted ecological requirements, like dependence on a small number of plants, that have slumped but many common and generalist species as well. A blockbuster 2017 study that revealed a shocking 76 percent decline in the biomass of flying insects over 27 years at protected areas in Germany catapulted the plight of insects into the public consciousness.

According to researchers, the global insect demise began at the dawn of the 20th century, accelerated during the 1950s and 1960s, and reached alarming proportions globally during the past two decades. Reports of an ongoing “bird armageddon” that mirrors the insect apocalypse suggest that insectivorous birds have been collateral damage in the collapse of insect populations worldwide.

Scientists say that insects have been clobbered by an array of continuing threats, from habitat destruction, deforestation, climate change, and light pollution to the rise of industrial agriculture. A widely publicized study published last year in *PLOS ONE* calculates that U.S. agriculture is 48 times more toxic to insects than it was 25 years ago, with neonicotinoid pesticides accounting for 92 percent of the lethal escalation; the study notes that “this increase in toxicity loading is consistent with the reduction in beneficial insect and insectivorous bird populations observed in recent years.” Yet one threat that has attracted little notice, and that more than two dozen international experts failed to mention in their recommendations for solutions to the insect crisis, is the replacement of native plants with non-native vegetation under way around the world.

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Tallamy’s paper aims to rectify the oversight. University of Connecticut entomologist David Wagner, who peer-reviewed the paper, called it a “much needed contribution” to the insect conservation literature. He added that it “does an especially laudable job of exposing the weak footing of many arguments that some have used to claim that non-native plants are not a threat to biodiversity, which I regard as nonsense.”

Mark Davis, an ecologist at Macalester College, has a different view. He points out that even Tallamy and his co-authors concede that they can only extrapolate the impact of non-native plants on insect populations from short-term studies performed at local scales because longer-term, landscape-scale studies have not yet been done. “In other words,” says Davis, “there is as yet no evidence that non-native plants reduce insect abundance over the general landscape.”

Tallamy’s early hunch that non-native plants have helped decimate insect populations was based on decades of research showing that many insects, especially the phytophagous or plant-eating species that account for most insect diversity, depend on a limited number of plants for survival. Since the 1960s, scientists have attributed this so-called host plant specialization to several factors, including the need for feeding insects to develop ways to get around plant defenses, like the production of chemical compounds that would be fatal to other species. As a result, the diet of most insects is restricted to a single plant family, and the closer species are to the tropics, the more constrained their menus are likely to be. More than 90 percent of the insect herbivores in the rainforests of Papua New Guinea, for example, can utilize only plants in a single genus, or a closely related group of species.

The diet restrictions of butterflies and moths have been studied more than those of other insect groups whose populations are plummeting. Five years ago when scientists looked at the diet breadth of plant-eating insects around the world, they found that 69 percent of caterpillar species can develop on just one plant family. Given such restricted diets, Tallamy and his co-authors write, it stands to reason that “the displacement of native plants by non-native species may have profound effects on phytophagous insect populations everywhere.”

In fact, research has shown repeatedly that when native host plants dwindle or disappear from an area, the populations of insect herbivores shrink and become less diverse. An analysis of 76 studies of caterpillar health on native and introduced plants found that with few exceptions caterpillars were larger and more likely to survive when reared on their

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native host plants. And in plant communities invaded by non-native species, the study found, the abundance and diversity of butterflies and moths were significantly reduced.

There have, however, been exceptions. In a small percentage of cases, insect herbivores have adopted introduced plants as food sources, especially if they belong to the same genus or family as their native hosts. In the most celebrated example, 34 percent of California butterfly species were found to feed or lay their eggs on non-native plants.

Because not every study has demonstrated negative effects, the long-running controversy over whether introduced plants are harmful to native insects continues. Ecologist Richard Hobbs, a senior research fellow at the University of Western Australia's School of Biological Sciences, says that "the assumption that species cannot adapt to new resources is being increasingly questioned." He notes that "studies indicate that non-native species can have positive, neutral, or negative impacts, and it is not as simple as just assuming that non-native species are just plain bad."

According to Tallamy, however, the positive cases are uncommon, and "you have to look at the negative as well as the positive effects." He points to kudzu, a rampant invader of the eastern U.S. that has been found to support the silver-spotted skipper, a native butterfly. This has led some people to conclude that invasive non-native plants are not all bad. "With a kudzu invasion you may gain the silver-spotted skipper," Tallamy responds, "but you lose literally thousands of species" that depend on the native plants the kudzu replaced.

Even among those who consider non-native plants a significant problem, there is some difference of opinion about the degree of threat that they pose. University of Connecticut's Wagner, who has described the plight of insects as "death by a thousand cuts," says "there's no question that invasive species and the ornamentals we plant in our yards are taking a toll on insects." Although they're "super important stressors," in Wagner's words, the truly destructive "cuts" are agricultural intensification, deforestation, and land use change. "Those are ones that are just wicked bad," he adds, "and are making it tough for species to continue to live with humans on this planet."

Tallamy says that in 2001, when he began to focus on this subject, "there was a whole lot in the literature on the problems caused by invasive species but wrecking the food web wasn't one of them." When he realized how large an area has been transformed by non-native plants, it struck him that this was a major issue. Nearly half of the planet's land is now in

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some form of agriculture. According to the World Bank, almost 45 percent of the land in the lower 48 U.S. states is devoted to production agriculture, and this figure soars when the area occupied by rangeland and tree farms is factored in. According to the UN Food and Agriculture Organization, 44 percent of the world's planted forests include non-native tree species; many have escaped from cultivation and now dominate nearby native forests. Tallamy and his co-authors also call attention to the fact that due in large part to the strong preference for exotic plants in landscaping, urban areas are rife with introduced species, and it's estimated that these quickly growing areas could cover as much as 20 percent of the earth's habitable land by 2030.

Horticulture has been one of the primary proliferators of invasive non-native plants in natural and human-dominated landscapes alike. Studies show that 50 to 70 percent of invasive and naturalized species arrived in their new lands via the horticulture trade. And Tallamy points out that even if these ornamental plants never become invasive, they are still replacing the native vegetation that is critical for the survival of most insects.

In the words of a groundbreaking 2018 Proceedings of the National Academy of Sciences paper co-authored by Tallamy, "the widespread preference for non-native plants in the horticultural industry has globally transformed millions of acres from potential habitat into 'food deserts' for native insects, with the unintentional consequence of reducing the abundance and distribution of birds as well." The paper was the first to provide data demonstrating that the decline of insects has cascading effects higher up the food chain.

For three years, lead author Desirée Narango, a postdoctoral fellow at the University of Massachusetts, Amherst, and a team of field assistants measured what happens to breeding Carolina chickadees and the caterpillars that are essential food for their chicks in the suburbs of Washington, D.C. Among their findings is that parent birds foraged for food on native plants 86 percent of the time. Yards dominated by introduced plants produced 75 percent less caterpillar biomass than primarily native landscapes and were 60 percent less likely to have breeding chickadees at all. Nests that chickadees did build in yards with many non-native plants contained 1.5 fewer eggs than nests on properties dominated by natives.

The chickadees were able to achieve the so-called replacement rate — that is, produce enough chicks each year to replace adults that succumb

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to old age and predators — only in yards with less than 30 percent introduced plant biomass; unfortunately for the birds, Narango and her co-authors found that, on average, 56 percent of the plants in the Washington, D.C. suburbs are not native. They point out that if a common “urban-adapted” bird like the Carolina chickadee is limited by the relative lack of food in a typical suburban landscape, it may be an even bigger problem for birds with more specialized diets. What’s more, some 96 percent of North America’s terrestrial birds rear their young on insects rather than seeds or berries, so when insects decline, they do too.

For these reasons, Tallamy has proposed a domestic version of Harvard biologist E.O. Wilson’s Half Earth Project. If American homeowners converted half of their lawn to productive native plant communities, he says, they would create a “Homegrown National Park” larger than the Everglades, Yellowstone, Yosemite, Grand Teton, Canyonlands, Mount Rainier, North Cascades, Badlands, Olympic, Sequoia, Grand Canyon, Denali, and Great Smoky Mountains National Parks combined.

At the conclusion of their new paper, Tallamy and his co-authors concede that critical gaps in our knowledge remain. But they conclude that at this point enough studies have been completed and enough evidence gathered that, in Tallamy’s words, “we can now definitively answer the question, ‘Are alien plants bad?’ In terms of supporting insects, the preponderance of the evidence says yes.”

e360.yale.edu, 8 December 2020

<https://www.e360.yale.edu>

As 2020 comes to an end, here’s what we still don’t know about COVID-19

2020-12-09

More than 68 million infected with the novel coronavirus and more than 1.5 million dead. 2020 has been a year defined by global sickness and loss.

In the face of this extraordinary threat, it’s easy to forget how much we have accomplished. Doctors, nurses and staff in hospitals around the world have learned how to better care for those sick with COVID-19. Researchers have uncovered secrets of a virus that, not so long ago, was wholly unknown.

Accelerated efforts to create vaccines succeeded beyond even the most optimistic predictions, with the United Kingdom granting emergency use

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of a vaccine on December 2 and the United States poised to follow suit before the end of the year.

Meanwhile, public health officials have fought to inform the public about how to reduce the risk of infection amid an onslaught of false reports about cures and treatments, and denials about the pandemic’s severity. Millions of people have donned masks and dramatically reshaped their daily lives to help fight the virus.

In early January, we had no tests for detecting the virus, no treatments, no vaccines. And though we’re not where we want to be, we’ve made progress on all those fronts. But we still have so much to learn. Here are pressing questions that scientists seek to answer. — Emily DeMarco

Why do some people get sick while others don’t?

A person’s age and preexisting medical conditions are risk factors for more severe disease, and men appear to be at higher risk than women (SN: 4/23/20). But scientists don’t have many answers to explain the wide variety of experiences people have with SARS-CoV-2, the coronavirus that causes COVID-19. Many people have no symptoms. Some struggle to breathe, suffer strokes, or progress to organ failure and death.

People who develop severe disease do have something in common: “a very severe inflammatory response,” says cancer immunologist Miriam Merad of the Ichan School of Medicine at Mount Sinai in New York City. The body’s own immune response can get out of whack and inflict inflammatory damage in a misguided attempt to make things right (SN: 8/29/20, p. 8).

Scientists have begun to pick out immune system players that seem to gum up the works during a severe bout of COVID-19. For example, a problem can arise with type 1 interferons, proteins that kick off the initial immune response to an intruder and activate production of pathogen-destroying antibodies. Patients with severe COVID-19 can have a weak interferon response; in some patients, genetic errors can interfere with the production of interferons, in others, the immune system incapacitates the proteins (SN: 9/25/20).

Meanwhile, some severely sick people produce an excess of other components of the body’s early immune response. In nearly 1,500 people hospitalized with COVID-19, Merad and colleagues measured four immune proteins that contribute to inflammation. High levels of two of the proteins, interleukin-6 and TNF alpha, predicted that a patient would go

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on to have severe illness and possibly die, even after accounting for age, sex and underlying medical conditions, the researchers reported in August in *Nature Medicine*.

It may be that people with no or mild symptoms have some degree of preexisting immunity. Some people who haven't been exposed to SARS-CoV-2 have white blood cells called T cells that nonetheless recognize the virus. This appears to be due to past colds from common coronaviruses, researchers reported in October in *Science*. They speculated that this preexisting T cell immunity may contribute to differences in COVID-19 disease severity. — Aimee Cunningham

What are the long-term health consequences of an infection?

This question could take years to resolve.

For now, we know that for some people, the symptoms and suffering from COVID-19 can go on for months after the initial infection (SN: 7/2/20). There isn't an agreed-upon definition for what some call "post-COVID syndrome" or "long COVID," but symptoms tend to include fatigue, shortness of breath, brain fog and heart abnormalities. And these problems aren't necessarily tied to a more severe initial illness.

It's not yet clear how widespread the syndrome is or what to do about it. But studies are beginning to offer clues as to how common persistent illness is. Of 143 patients in Italy who had been hospitalized with COVID-19, 32 percent had one or two symptoms and 55 percent had three or more symptoms an average of two months after first feeling sick, researchers reported in August in *JAMA*. And in a survey of 274 symptomatic adults who had a positive test for SARS-CoV-2 but weren't hospitalized, 35 percent were not back to their normal state of health two to three weeks after testing, according to a July study in *Morbidity and Mortality Weekly Report*.

One of the largest surveys so far comes from the COVID Symptom Study, in which people logged their symptoms into an app. Of 4,182 users with COVID-19, 13.3 percent had symptoms lasting more than four weeks, 4.5 percent had symptoms for more than eight weeks and 2.3 percent topped 12 weeks. The risk of persistent symptoms rose with age, researchers reported in October in a preliminary study posted at [medRxiv.org](https://medrxiv.org).

To learn about the long-term physical and mental health effects of COVID-19, the U.S. National Institutes of Health plans to follow for months to years people who have been infected. And a trial by Steven Deeks, an

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internal medicine physician at the University of California, San Francisco School of Medicine, and colleagues will assess the role of inflammation in persistent health effects.

Long-term studies of entire communities will be especially important to learn how common persistent symptoms are, how long they last and why they're happening, Deeks says. "Right now, we have just a whole long list of questions," he says. "It's going to take a lot to figure this out." — Aimee Cunningham

How long might immunity last?

There are signs that the immune system can learn how to deal with the virus, bestowing at least temporary immunity. Most people appear to make immune proteins that stop SARS-CoV-2 in its tracks, called neutralizing antibodies, and also T cells that help coordinate the immune response or kill infected cells, says epidemiologist Aubree Gordon of the University of Michigan in Ann Arbor. Those antibodies and T cells can stick around in the body for at least six months, if not longer, studies suggest. "So that's promising," Gordon says.

But scientists don't know how long a person will be protected from a future bout with the virus. "There's just been a limited time for people to study this," she says.

Still, SARS-CoV-2 is not the only coronavirus that infects people. For instance, four others that cause the common cold circulate around the globe. "We can get some evidence from what goes on with some of the human endemic coronaviruses," says immunologist Brianne Barker of Drew University in Madison, N.J. For those viruses, protection lasts about a year. People can get infected with the same virus over and over again once their immunity wears off, though the severity of a second infection varies. The duration of immunity after an infection with the coronaviruses that cause SARS and MERS is unknown.

To date, there have been a few documented reinfections with SARS-CoV-2, suggesting that, for some, immunity doesn't last very long. Efforts — including a study Gordon is working on — are under way to figure out how common reinfection really is and whether subsequent infections are any different from the initial one. — Erin Garcia de Jesus

What can we expect from the treatments and vaccines being developed?

Because of crucial advances in 2020, "we know more about the virus and some of the complications it causes and how to prevent and predict

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and treat those complications,” says Amesh Adalja, an infectious disease physician at Johns Hopkins Center for Health Security.

Doctors have learned tricks that help people breathe easier, such as putting hospitalized COVID-19 patients on their stomachs. And two drugs — the antiviral remdesivir and the steroid dexamethasone — have shown promise against the virus (SN: 6/16/20). The U.S. Food and Drug Administration approved remdesivir for use in hospitalized COVID-19 patients ages 12 and older in October because some studies showed that it can shorten hospital stays. But the drug, which is the only FDA-approved drug for COVID-19, didn't reduce the chance of dying or going on a ventilator in a large study by the World Health Organization (SN: 10/16/20).

In November, the FDA gave a cancer drug called baricitinib emergency use authorization. In combination with remdesivir, the drug shaved an extra day off hospital stays compared with remdesivir alone in a large clinical trial. But many doctors aren't convinced of baricitinib's effectiveness.

Ideally, doctors could treat people before they are sick enough to need the hospital. Some drugs are in early stage clinical trials to determine if they can help people early in an infection (SN: 9/26/20, p. 8). Some antibodies taken from COVID-19 survivors and lab-made antibodies are also being put to the test (SN: 9/22/20). Lab-made antibodies from Eli Lilly and Company and Regeneron were given emergency use authorization in November for treating people newly diagnosed with COVID-19, making the therapies the first available to people who aren't ill enough to go to the hospital. (Regeneron Pharmaceuticals is a major donor to the Society for Science & the Public, which publishes Science News.)

Vaccines are being developed on a fast track. Russia was the first country to announce it had a vaccine for the public, though scientists question its efficacy (SN: 8/11/20). China has also given the nod for emergency use of some vaccines for the military (SN: 8/1/20, p. 6) and general public, although those vaccines are still in testing too. The United Arab Emirates authorized two vaccines made in China for use by its citizens.

Both Pfizer and Moderna announced in November that their mRNA-based vaccines were about 95 percent effective at preventing illness (SN: 11/16/20; SN: 11/18/20). On December 2, the United Kingdom OK'd Pfizer's vaccine for emergency use, making the vaccine the first to get the nod after thorough testing. AstraZeneca and the University of Oxford reported that their vaccine prevents illness too, and may cut down on transmission of the virus (SN: 11/23/20).

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Over 200 other vaccines are in development worldwide, says Esther Krofah, executive director of FasterCures, part of the Milken Institute think tank. But getting doses of a vaccine, at least initially, “will not be as straightforward as calling up your local CVS,” she says.

In the United States, 21 million health care workers and about 3 million people living in long-term care facilities are expected to be first in line for the vaccines (SN: 12/1/20). Children may be among the last to be immunized. That's because vaccines haven't been tested in kids under 12, and children are less likely to die or develop severe disease than adults.

Bottom line: A COVID-19 vaccine may not be widely available in the United States until late spring or summer 2021.

Even when a vaccine is approved for broad use and there's a large enough supply, “the bigger challenge will come in distributing vaccines widely,” says Julie Swann, a health systems engineer at North Carolina State University in Raleigh. Pfizer's vaccine, for instance, has to be kept frozen at supercold temperatures. So distributors must either be able to give out all of their doses within a couple of days after receiving a shipment, or have access to special freezers or dry ice to keep the vaccines cold enough. Big cities may have more access to those measures than rural areas.

Many of the vaccines in testing require two doses. Keeping track of who has gotten which vaccine and when it's time for a booster, and whether booster shots are available, could also be challenging, Swann says. — Tina Hesman Saey

Will the pandemic end in 2021?

“I don't think anyone can say with clarity what the end of the pandemic might look like,” says Michael Osterholm, an epidemiologist at the University of Minnesota in Minneapolis. If a vaccine can confer long-lasting immunity, on the order of years to decades, widespread community transmission around the globe could cease, he says.

But “a vaccine is nothing until it becomes a vaccination in somebody's arm,” Osterholm says. And those arms must be willing. Vaccine development has progressed at a record pace, but some experts worry that speed, and the politicization of certain drugs, have seeded distrust (SN: 8/1/20, p. 6). “Acceptance is going to be a huge issue,” he says.

Of course, many countries managed to slow the virus' spread without a vaccine. In the United States, “we don't have to wait to get this under control,” says public health researcher Megan Ranney of Brown University

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in Providence, R.I. “We already know that basic, multimodal public health interventions work.”

Such interventions include widespread and easily accessible testing that spurs contact tracing and case isolation, as well as consistent public health messaging around the importance of wearing masks, social distancing and avoiding crowded indoor spaces.

Thus far in the United States, these basic public health interventions have been patchy and inadequate on a national scale (SN: 7/1/20). That’s allowed the “first wave” of infections to slosh around the country, growing in size to about 200,000 new cases each day in early December. Whether this dire trend worsens in the early months of 2021 depends in large part on federal action, both Osterholm and Ranney say.

“We need a national plan, and we don’t have a national plan,” Osterholm says. That may change with the election of Joe Biden, who campaigned on creating a coronavirus national plan. Osterholm is part of the president-elect’s Transition COVID-19 Advisory Board, which has begun planning a new federal response.

Broadly, that plan includes clear and consistent public health messaging, a well-funded national testing strategy, support for states to boost contact tracing, supplying personal protective equipment to essential workers and mask mandates. “If we have all those things in place, the coming year could be somewhat similar to where we’ll be with widespread vaccination,” Ranney says. People could go about most normal activities with a little extra caution, wearing masks and avoiding crowds indoors.

Still, measures like universal mask wearing, social distancing and contact tracing only work if people abide by them. As the pandemic wears on, experts worry that complacency and fatigue could further fracture an already uneven response to the disease.

If the United States “continues on the path we’re on now, we’re going to continue to see increasing numbers of people hospitalized and dead, continue to go through this seesaw of full lockdown then full reopening, confusing messages, unmitigated anxiety and fear and a worsening economy,” Ranney says. — Jonathan Lambert

Once the pandemic ends, will the virus still circulate?

When the pandemic eventually fizzles out, the coronavirus itself will probably stick around for a while, experts say. How long, however,

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depends on how well our immune system and available vaccines protect us from reinfection.

So far, it’s impossible to say how frequently reinfections with SARS-CoV-2 happen based on the small number of these cases identified. But if reinfections become common in the face of waning immunity, then the virus is likely here to stay.

For example, if immunity lasts around 40 weeks, as it does for some cold-causing coronaviruses, then there may be yearly outbreaks of COVID-19, researchers reported in May in *Science*. If the immune system’s memory of the virus lasts slightly longer, say two years, then there may be biannual outbreaks. Permanent immunity could mean the virus may disappear entirely, though that possibility is unlikely since respiratory viruses like influenza and viruses that cause colds rarely lead to this sort of long-lasting immunity.

Adding an effective vaccine to the mix would help build — and maintain — immunity among people to control potential future outbreaks. And if a vaccine is highly effective and enough people take it plus any boosters or follow-up vaccinations as needed, that could help prevent the virus from spreading at all. But those are big ifs.

Because SARS-CoV-2 can be spread by people without symptoms, some experts do not anticipate the virus will go away any time soon, unlike the coronavirus that caused SARS. That virus stopped circulating among people a little more than a year after it appeared, in part because it wasn’t spread by people with no symptoms. That allowed public health experts to more easily isolate sick patients and quarantine their contacts to prevent the virus’ spread. It’s estimated that around 30 percent of people infected with SARS-CoV-2 don’t show symptoms, making such total containment much harder.

“From everything we’re seeing so far,” says Barker, the Drew University immunologist, “this virus may become endemic and may be with us for a long time.”

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