CHEMWATCH

Bulletin Board

Contents

OCT. 22, 2021

(click on page numbers for links)

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CHEMWATCH

Bulletin Board

Contents

OCT. 22, 2021

CHEMWATCH

Bulletin Board

Contents

OCT. 22, 2021

ASIA PACIFIC

Jakarta's air quality five times worse than WHO limit, says expert

2021-10-11

Sustainable Nature Foundation (ASRI) volunteer and health consultant Alvi Muldani on Thursday said Jakarta's air quality was considered poor as the city's average 2.5 particulate matter concentration reached 26.9 ug/m3, which is five times worse than the latest limit set by the World Health Organization (WHO) on September 22.

In a virtual discussion on the lawsuit on air quality in Central Jakarta's district court, Alvi said the PM 2.5 ambient air quality standard was currently limited to 15 micrograms per cubic meter (daily) and 5.0 annually.

The new standard is far stricter compared to the previous limit as the older regulation is considered unable to prevent seven million of the world's population from early deaths caused by air pollution.

"Meanwhile in Jakarta, it is nearly six times higher than the WHO standard. This limits the average age to 55 years," she said on Thursday.

Read More

Tempo.co, 11 October 2021

https://en.tempo.co/read/1515115/jakartas-air-quality-five-times-worse-than-who-limit-says-expert

New Australian vaping research finds 'suite of chemicals' in liquids used in vapes, some at 'dangerously high' levels

2021-10-11

They are flavoured, colourful and popular with teenagers, but new Australian research is discovering mounting evidence that vapes are also unsafe to use.

Curtin University respiratory physiologist Alexander Larcombe studied 65 common liquids used in vapes from local suppliers that are available in Australia.

CHEMWATCH
Bulletin Board
Regulatory Update
OCT. 22, 2021

Dr Larcombe said the results showed that many vapes contained carcinogenic and other harmful ingredients.

The study is the extension of a 2019 study published by the same researchers that looked at 10 vape ingredients. It is the most comprehensive study of products available in Australia to date.

It is estimated that more than 200,000 Australians use vapes, however, those using them with nicotine must have a prescription from a doctor.

Until recently, nicotine-free flavours were far more easily available online and from tobacconists.

The Therapeutic Goods Administration has recently cracked down on imports but can only regulate those with nicotine and imports of officially banned flavours, and there are far fewer regulations around the manufacture and supply of flavours alone within Australia.

Read More~sABC News, 11 October 2021

https://www.abc.net.au/news/2021-10-11/chemicals-found-in-vaping-liquids/100525148

APVMA Special Gazette, 11 October 2021

2021-10-11

11 October 2021

- PDF (527.5 KB) | DOCX (120.47 KB)

Contents

- Notice under section 34AB of the Agricultural and Veterinary Chemicals Code: Molinate reconsideration – proposed decision on reconsideration – 1
- Attachment A: Active constituent approval(s), product registration(s) and approved label(s) placed under reconsideration – 3
- Attachment B: Draft statement of reasons – 4
- Attachment C: Sample label – 25

Content last updated:

11 October 2021

Content last reviewed:

"Meanwhile in Jakarta, it is nearly six times higher than the WHO standard. This limits the average age to 55 years," she said on Thursday.

undefined.

11 October 2021

APVMA, 11 October 2021

https://apvma.gov.au/node/92496

AMERICA

Landmark California law bans 'forever chemicals' in products for infants, children

2021-10-05

Today, in a major victory for consumers, Gov. Gavin Newsom signed legislation to protect infants and children from the toxic "forever chemicals" known as PFAS by banning the compounds in cribs, playpens and many other products. The ban takes effect on July 1, 2023.

Authored by Assemblymember Laura Friedman (D-Glendale), the law bans the use of PFAS in a wide range of "juvenile" products, as defined in the law.

"As a mother, it's hard for me to think of a greater priority than the safety and well-being of my child," said Friedman. "PFAS have been linked to serious health problems, including hormone disruption, kidney and liver damage, thyroid disease and immune system disruption.

"This new law ends the use of PFAS in products meant for our children," she said.

PFAS are a class of thousands of chemicals linked to increased risk of cancer, harm to fetal development and reduced vaccine effectiveness. They are known as forever chemicals because they do not break down in the environment and build up in our blood and organs.

"This law puts California in the lead for protecting children's health," said Bill Allayaud, EWG's director of California government affairs. "We applaud Gov. Newsom for giving parents confidence that the products they buy for their children are free from toxic PFAS.

"It's heartening that for this legislation, the chemical industry joined consumer advocates to create a reasonable solution, as public awareness increases of the health risks posed by PFAS exposure," he said.

"PFAS have been linked to serious health problems, including hormone disruption, kidney and liver damage, thyroid disease and immune system disruption.

CHEMWATCH
Bulletin Board
Regulatory Update
OCT. 22, 2021

Read More

EWG, 5 October 2021

https://yubanet.com/california/landmark-california-law-bans-forever-chemicals-in-products-for-infants-children/

EPA receives TSCA Section 21 petitions regarding chemical mixtures in cigarette and cosmetics

2021-10-05

On August 2, 2021, the U.S. Environmental Protection Agency (EPA) received a petition under Section 21 of the Toxic Substances Control Act (TSCA) seeking a rule requiring cigarette manufacturers to eliminate the hazardous chemicals used and to develop new product designs that eliminate or reduce the cigarette butt disposal risks to the environment. Filed by William David Bush, the petition states that the more than 4,000 chemicals in cigarette smoke come from chemicals within the soil, the paper surrounding the tobacco column, and the manufacturing process, while others are deliberately added. According to the petition, cigarette butts endanger the health of the environment, comprising 30-40 percent of items collected in annual coastal/urban cleanups. Organic compounds "seep from cigarette butts into aquatic ecosystems, becoming acutely toxic to fish and microorganisms." The petitioner asks EPA to:

- Determine that the chemical mixtures contained within cigarettes present an unreasonable risk of injury to health and the environment;
- Order by rule that cigarette manufacturers eliminate the hazardous chemicals used in a mixture with tobacco, including but not limited to the toxic substance inclusions resulting from tobacco growing or handling techniques;
- Order by rule that cigarette manufacturers develop new product designs that eliminate or reduce the cigarette butt disposal risks to the environment.

EPA acknowledged receipt of Bush's petition on September 9, 2021, stating that it will grant or deny the petition by **October 31, 2021**.

EPA received a second TSCA Section 21 petition from Bush on August 16, 2021, seeking a determination that the chemical mixtures contained within cosmetics present an unreasonable risk of injury to public health and the environment. According to the petition, since 2009, almost 600 cosmetics manufacturers have reported using 88 chemicals in more than 73,000 products that have been linked to cancer, birth defects, or

Organic compounds "seep from cigarette butts into aquatic ecosystems, becoming acutely toxic to fish and microorganisms."

reproductive harm. The petition states that these toxic chemicals have been banned by the European Union (EU) "and many other nations." The petition notes that Congress has not given the Food and Drug Administration (FDA) the authority to regulate the chronic risks posed by chemicals and contaminants in cosmetics and that FDA does not have the power to suspend registration or order recalls when products pose a risk of serious adverse health consequences or death. The petition asks that EPA order by rule that cosmetic manufacturers eliminate hazardous chemicals used in mixtures, stating that examples include formaldehyde, paraformaldehyde, methylene glycol, quaternium 15, mercury, dibutyl and diethylhexyl phthalates, isobutyl and isopropyl parabens, long-chain per- and polyfluoroalkyl substances (PFAS), and m- and o-phenylenediamine.

Read More

TSCA Blog, 5 October 2021

http://www.tscablog.com/entry/epa-receives-tsca-section-21-petitions-regarding-chemical-mixtures-in-cigar

California sets nation's strictest rules on recycling labels

2021-10-06

Californians will have a better idea of what's headed for landfills instead of recycling centers under one of several related bills that Gov. Gavin Newsom signed into law Tuesday. It sets the nation's strictest standards for which items can display the "chasing arrows" recycling symbol, advocates say. Consumers assume that the symbol showing three circular arrows means that items should go into curbside recycling bins, California's Statewide Commission on Recycling Markets and Curbside Recycling said earlier this year. It recommended that the symbol "be reserved for materials which are accepted in curbside bins and do not cause contamination." "It's dishonest, it's not fair to companies that have invested in actually making their products recyclable, and it's not fair to consumers who pay more for something that they think will be better for the environment," said Californians Against Waste Director of Advocacy Nick Lapis.

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The Sacramento Bee, 6 October 2021

https://www.sacbee.com/news/business/article254790712.html?utm_source=ActiveCampaign&utm_medium=email&utm_content=Top+news%3A&utm_campaign=ATF+Daily

It sets the nation's strictest standards for which items can display the "chasing arrows" recycling symbol, advocates say.

CHEMWATCH
Bulletin Board
Regulatory Update
OCT. 22, 2021

EPA may require companies to know all the chemicals in products they make or sell

2021-10-04

In a dramatic announcement last week, EPA suggested that if companies import, manufacture, or process a finished good for commercial sale, and that product is not a pesticide, not a firearm, not a tobacco product, and not a food, food additive, drug, cosmetic, or device, they will need to know all chemicals contained in those products. We explain more about this below.

EPA has traditionally declined to extend most of its chemical regulations to finished goods, which are known as "articles" under the Toxic Substances Control Act (TSCA), on the grounds it would be enormously difficult for importers of complex consumer products to determine the chemical identity of each chemical substance in these products. Industry stakeholders have generally supported this approach and have long taken the position that supply chains are too complex to expect finished product manufacturers to be aware of all chemicals in those products.

But Michal Freedhoff, head of the EPA chemicals program, signaled last week that EPA may be shifting course to a new approach for articles. In a bold keynote address at the annual meeting of the Product Stewardship Society, Freedhoff noted that EPA unquestionably has the authority under TSCA to regulate chemicals in manufactured goods and finished products—even if it has not often exercised that authority in the past. She said, "It's simply not tenable for industry to complain about a rule regulating articles because they don't know what's in them." Freedhoff further emphasized that "companies are already required to know what is in their products in order to comply with European Union regulations, which require reporting for products which contain chemicals identified as a "substance of very high concern."

While Freedhoff did not announce any new regulatory actions, this potential new direction for EPA has important—and very serious—implications for nearly every company involved in manufacturing, importing, distributing, or selling finished good

Read More

National Law Review, 4 October 2021

https://www.natlawreview.com/article/epa-may-require-companies-to-know-all-chemicals-products-they-make-or-sell

She said, "It's simply not tenable for industry to complain about a rule regulating articles because they don't know what's in them."

EUROPE

European Commission kicks off review of cosmetic products Regulation

2021-10-06

Inception impact assessment open for comments until 1 November

The European Commission has published the inception impact assessment (IIA) that marks the reopening of the EU cosmetic products Regulation and outlines a raft of potential changes to the law.

The revision sets out to extend the Regulation's scope to address environmental endpoints for the first time, as part of the actions planned under the chemicals strategy for sustainability.

According to the IIA the law, which currently only covers human health endpoints, should ensure that cosmetics do not contain chemicals that are persistent and bioaccumulative in the environment.

The Commission has previously suggested this could set a precedent for including further environmental endpoints in the future, depending on subsequent changes to the CLP Regulation.

The IIA further floats a ban on endocrine disrupting (EDCs), immunotoxic and neurotoxic chemicals, and those toxic to specific organs.

A full impact assessment of the revision will analyse various options for revising the scope of the Regulation, the IIA says, such as:

- extending existing provisions that restrict carcinogenic, mutagenic, reprotoxic (CMR) substances to further hazard classes;
- bringing the Regulation in line with the essential use concept currently being developed under the chemicals strategy; and
- introducing provisions to take account of combination effects.

It also mentions reviewing the definition of a nanomaterial under the cosmetic products Regulation. This could mean aligning it with the new or revised horizontal definition, which the Commission is currently reviewing.

And the EU executive will consider changing the way in which product information, such as on chemical hazards, is provided on cosmetic products. Options include "simplifying certain information" or providing it through digital means – an ongoing discussion that extends beyond cosmetics.

The revision sets out to extend the Regulation's scope to address environmental endpoints for the first time, as part of the actions planned under the chemicals strategy for sustainability.

CHEMWATCH
Bulletin Board
Regulatory Update
OCT. 22, 2021

Read More

Chemical Watch, 6 October 2021

https://chemicalwatch.com/347138/european-commission-kicks-off-review-of-cosmetic-products-regulation

The official controls (plant protection products) regulations (OCR) 2020: guidance and notification form

2021-10-07

DEADLINE PASSED: Businesses must register their use of PPPs

The deadline for registration under OCR was 22 September.

Businesses are still able to register and must do so immediately. This is a legal obligation under regulation 5 of the OCR.

If you are a business that imports, manufactures, processes, distributes or sells professional plant protection products (PPPs), their ingredients or adjuvants in Great Britain, then you must register your company details, product types, and storage capacity using this form on GOV.UK.

There is guidance on GOV.UK explaining how to use the form and who needs to register.

Businesses that place only amateur products on the market or that only use professional PPPs should not register now, but will need to follow a similar process in the future. More information will follow.

The EU Official Controls Regulation (OCR) aims to improve feed and food safety, animal health and welfare and plant health by applying official controls throughout the agri-food supply chain.

The Official Controls (Plant Protection Products) Regulations 2020 apply the OCR to PPPs in Great Britain. They introduce a new requirement for operators throughout the PPP supply chain to notify their competent authority. In England this is the Secretary of State. In Wales and Scotland this is the Welsh and Scottish Ministers.

Read more in this policy statement.

HSE, 7 October 2021

guidance on GOV.UK

Businesses are still able to register and must do so immediately. This is a legal obligation under regulation 5 of the OCR.

On EU Commission's menu for agri in 2022: pesticides, carbon removal, packaging

2021-10-07

The sustainable use of pesticides and a carbon removal certification scheme will be placed front and centre of the European Commission's agricultural priorities next year, according to a leaked draft version of its 2022 work programme seen by EURACTIV.

The programme, dated 27 September, sets out the list of actions the Commission will prioritise over the coming twelve months.

According to the draft document, a key focus is the overhaul of the sustainable use of pesticides directive.

The directive, adopted in 2009, aims to reduce the risks and the impacts of pesticide use on human health and the environment but has been criticised for its poor implementation in the majority of member states.

As outlined in the Commission's flagship food policy, the Farm to Fork strategy, the Commission aims to revise the directive to bring it in line with the objectives of the European Green Deal in a way that helps meet the target of slashing the use and risk of chemical pesticides in half.

The adoption of the revision was originally earmarked for March of next year but, according to the leaked programme, this will now take place in May 2022.

This will follow the publication of a roadmap and the launch of public consultation before November 2021.

The overhaul of the pesticide directive will be included in the framework of a Zero Pollution Package together with the revision of the EU's air quality legislation.

The draft work programme highlights that this is currently "impossible to say" whether this policy initiative will result in a heavier burden on stakeholders given that policy options have not yet been decided on.

However, it concludes that overall, the Commission expects "an increase in the administrative costs."

"Administrative costs and other costs for the different policy options will be assessed for different stakeholders, including farmers and other economic operators," the programme reads.

The programme, dated 27 September, sets out the list of actions the Commission will prioritise over the coming twelve months.

CHEMWATCH
Bulletin Board
Regulatory Update
OCT. 22, 2021

Ways to minimise costs will be explored, the document promises, offering the example of digitalisation.

"Trade-offs between administrative burden for operators and positive health and environmental benefits exist and will be taken into account in the analysis," it states.

Read More

Eurativ, 7 October 2021

https://www.euractiv.com/section/agriculture-food/news/on-eu-commissions-menu-for-agri-in-2022-pesticides-carbon-removal-packaging/

ECHA posts new set of Q&As for downstream users of nanoforms

2021-10-09

The European Chemicals Agency (ECHA) has posted a new set of questions and answers (Q&A) for downstream users of nanoforms. The new Q&As, posted under Section I, include:

- What are my obligations as a downstream user purchasing, modifying or creating nanoforms?
- How do I know when I have created a new nanoform from a supplied substance?
- How do I know whether the nanoform I have created is covered by my supplier if I received [a safety data sheet (SDS)] with an exposure scenario attached?
- How do I know whether the nanoform I have created is covered by my supplier if: i) I did not receive an SDS or ii) I received an SDS but it does not contain exposure scenarios?
- How to check if my use and the conditions of use are covered by the exposure scenario received?
- What do I need to do if my nanoform/uses are not covered by my supplier?
- What should the downstream user chemical safety report contain?
- How do I report to ECHA that I have performed a downstream user chemical safety report (or I am relying on an exemption)?

Read More

Bergeson & Campbell, 9 October 2021

https://nanotech.lawbc.com/2021/10/echa-posts-new-set-of-qas-for-downstream-users-of-nanoforms/

The EU chemicals strategy for sustainability – one year on

2021-10-07

We are facing a chemical pollution crisis: a cocktail of synthetic chemicals in hundreds of everyday products is putting human health and wildlife at risk.

While the EU's chemical legislation REACH is world-leading, it has been too slow in identifying and regulating the most hazardous chemicals. There

The European Chemicals Agency (ECHA) has posted a new set of questions and answers (Q&A) for downstream users of nanoforms.

CHEMWATCH
Bulletin Board
REACH Update
OCT. 22, 2021

are also gaps in the way that the EU regulates chemicals in some product areas, such as food packaging, and EU laws do not properly address the reality that we are constantly exposed to mixtures of chemicals, not just one chemical at a time.

The EU's Green Deal, launched in December 2019, set out to achieve a toxic-free environment, with the Chemicals Strategy for Sustainability (CSS), presented on 14th October 2020, providing a detailed strategy for implementing this vision. The CSS promises to remove endocrine disrupting and other hazardous chemicals from everyday products, such as toys and food contact materials, and put forward 56 actions to achieve a non-toxic environment. The EU Environment Commissioner Virginijus Sinkevicius has committed to '*make pollution a thing of the past*'.

CHEM Trust's priorities

CHEM Trust were very supportive of the proposals made in the Chemicals Strategy for Sustainability, and over the last year we have been involved in many processes to help move this strategy forward.

We are calling for a ban of the most hazardous chemicals in consumer products by 2030 and therefore our key priorities include:

(i) Accelerating identification and control of endocrine disrupting chemicals and those substances that stick around in the environment – those that are persistent, mobile and toxic or very persistent and very mobile, like the PFAS 'forever chemicals'.

(ii) **adding in a** Mixtures Assessment Factor in EU risk assessments to reflect the reality that we are all exposed to mixtures of chemicals, not single substances

(iii) **widening the range of uses where the most hazardous chemicals are not permitted to be present**, including in food contact materials and other consumer products

(iv) **implementing the 'grouping approach',** addressing chemicals in groups rather than one at a time in order to speed up controls and prevent regrettable substitution with chemicals with similar hazard properties.

Read More

Chemtrust, 7 October 2021

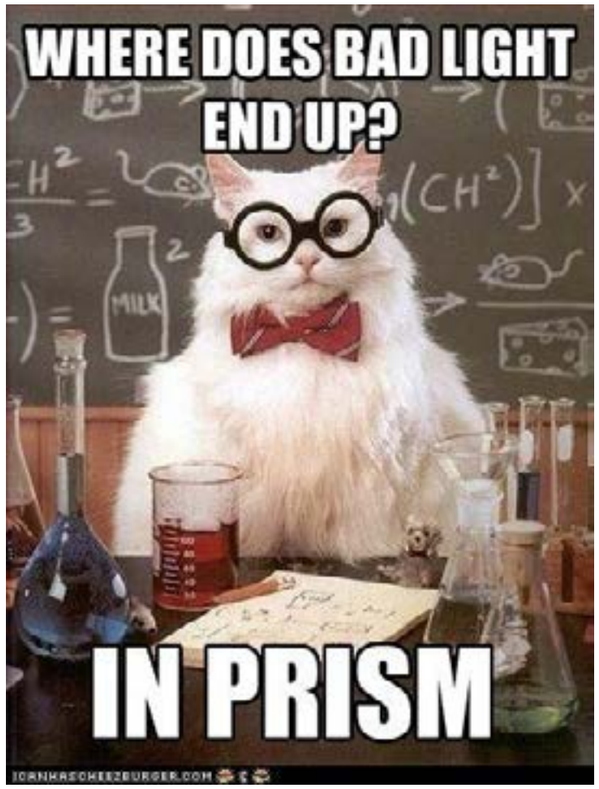
https://chemtrust.org/css-one-year-on/

Janet's Corner

OCT. 22, 2021

Prism

2021-10-22



https://www.siliconrepublic.com/science/science-week-puns-chemistry-jokes-memes

Hazard Alert

OCT. 22, 2021

Phenol

2021-10-22

Phenol, also known as carbolic acid and phenic acid, is an organic compound with the chemical formula C_6H_5OH. [1] Pure phenol consists of white or clear acicular crystals. At 41 degrees Celsius, phenol congeals into a solid that can be liquefied by mixing a very small amount of water (2 parts water: 23 parts phenol). On exposure to air and light, phenol assumes a pinkish or reddish discoloration; this discoloration is accelerated by the presence of alkalinity or impurities. Phenol has a characteristic sweet, medicinal, or tar-like odour. [2] It is mildly acidic, but requires careful handling due to its propensity to cause burns. Phenol was first extracted from coal tar, but today is produced on a large scale (about 7 billion kg/year) using a series of industrial processes starting with crude oil. [1]

Phenol, also known as carbolic acid and phenic acid, is an organic compound with the chemical formula C6H5OH.

USES [3]

Phenol is used as a general disinfectant, as a reagent in chemical analysis and for the manufacture of artificial resins, medical and industrial organic compounds and dyes. It is also used in the manufacture of fertilisers, explosives, paints and paint removers, drugs, pharmaceuticals, textiles and coke. It is produced in large volume, mostly as an intermediate in the production of other chemicals. The largest single use of phenol is as an intermediate in the production of phenolic resins, which are low-cost, versatile, thermoset resins used in the plywood adhesive, construction, automotive, and appliance industries. It is also used as an intermediate in the production of caprolactam, which is used to make nylon and other synthetic fibres, and bisphenol A, which is used to make epoxy and other resins.

SOURCES OF EMISSION AND ROUTES OF EXPOSURE

Sources of Emission [3]

- Industry sources: Phenol is a common component of oil refinery wastes. It is also produced in the conversion of coal into gaseous or liquid fuels and in the production of metallurgical coke from coal. It may enter the environment from oil refinery discharges, coal conversion plants, municipal waste treatment plant discharges, or spills.
- Diffuse sources: Released as a vapour from natural or human made sources contaminated by or containing phenol.

- Natural sources: Phenol is found naturally in animal wastes and decomposing organic material.
- Consumer products: Agricultural chemicals, disinfectants (non-agricultural), general antibacterials and antiseptics, household hard surface cleaners (liquid), lubricating oils, automotive chemicals, paint and varnish removers, pharmaceutical preparations, synthetic resin and rubber adhesives, wood office work surfaces (modular systems).

Routes of Exposure [2]

Exposure to phenol can occur via the following routes:

- inhalation,
- ingestion,
- eye or skin contact, and
- absorption through the skin

HEALTH EFFECTS [4]

Acute Effects

Inhalation and dermal exposure to phenol is highly irritating to the skin, eyes, and mucous membranes in humans. Symptoms of acute toxicity in humans include irregular breathing, muscle weakness and tremors, loss of coordination, convulsions, coma, and respiratory arrest at lethal doses. Acute animal tests in rats, mice, and rabbits have shown phenol to have high acute toxicity from oral exposure.

Chronic Effects

Anorexia, progressive weight loss, diarrhoea, vertigo, salivation, and a dark coloration of the urine have been reported in chronically exposed humans. Gastrointestinal irritation and blood and liver effects have also been reported. In one study, muscle pain, weakness, enlarged liver and elevated levels of liver enzymes were found in an individual after inhalation and dermal exposure to phenol and a few other chemicals. Application of phenol to the skin results in dermal inflammation and necrosis. Cardiac arrhythmias have also been reported in humans exposed to high concentrations of phenol. Chronic inhalation exposure of animals to phenol has shown central nervous systems (CNS), kidney, liver, respiratory, and cardiovascular effects. The Reference Dose (RfD) for phenol is 0.6 milligrams per kilogram body weight per day (mg/kg/d) based on reduced foetal body weights in rats. EPA has established a provisional Reference

CHEMWATCH
Bulletin Board
Hazard Alert
OCT. 22, 2021

Concentration (RfC) for phenol of 0.006 milligrams per cubic metre (mg/m^3) based on no effects in rats, mice, or monkeys.

Reproductive/ Developmental Effects

No studies were located concerning the developmental or reproductive effects of phenol in humans. Animal studies have reported reduced foetal body weights, growth retardation, and abnormal development in the offspring of animals exposed to phenol by the oral route. Decreased maternal weight gain and increased maternal mortality were also observed.

Cancer Risk

Small, non-significant excesses in certain types of cancers were reported in occupationally exposed workers; however, these effects were not clearly related to phenol exposure. Animal studies have not seen tumours resulting from oral exposure to phenol, while dermal studies have reported that phenol applied to the skin may be a tumour promoter and/or a weak skin carcinogen in mice. EPA has classified phenol as a Group D, not classifiable as to human carcinogenicity, based on a lack of data concerning carcinogenic effects in humans and animals.

SAFETY [5]

First Aid Measures

- Eye Contact: Check for and remove any contact lenses. In case of contact, immediately flush eyes with plenty of water for at least 15 minutes. Cold water may be used. Get medical attention immediately.
- Skin Contact: In case of contact, immediately flush skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Cover the irritated skin with an emollient. Cold water may be used. Wash clothing before reuse. Thoroughly clean shoes before reuse. Get medical attention immediately.
- Serious Skin Contact: Wash with a disinfectant soap and cover the contaminated skin with an anti-bacterial cream. Seek immediate medical attention.
- Inhalation: If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical attention immediately.
- Serious Inhalation: Evacuate the victim to a safe area as soon as possible. Loosen tight clothing such as a collar, tie, belt or waistband. If

breathing is difficult, administer oxygen. If the victim is not breathing, perform mouth-to-mouth resuscitation. Seek medical attention.

- Ingestion: If swallowed, do not induce vomiting unless directed to do so by medical personnel. Never give anything by mouth to an unconscious person. Loosen tight clothing such as a collar, tie, belt or waistband. Get medical attention immediately.

Fire Hazard Data

Phenol may be combustible at high temperature. It is flammable in the presence of open flames and sparks, of heat. Non-flammable in presence of shocks, of oxidising materials, of reducing materials, of combustible materials, of organic materials, of metals, of acids, of alkalis. A dry chemical powder should be used to extinguish small fires. Foe large fire, use water spray, fog or foam. Do not use water jet.

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 work-station location.

Personal Protection

The following personal protective equipment is recommended when handling phenol:

- Face shield
- Full suit
- Vapour respirator (be sure to use an approved/certified respirator or equivalent)
- Gloves
- Boots

Personal Protection in Case of a Large Spill:

- Splash goggles
- Full suit
- Vapour respirator
- Boots
- Gloves

CHEMWATCH
Bulletin Board
Hazard Alert
OCT. 22, 2021

- A self-contained breathing apparatus should be used to avoid inhalation of the product.
- Note: Suggested protective clothing might not be sufficient; consult a specialist BEFORE handling this product.

REGULATION [2,3,6]

United States

- OSHA: The current Occupational Safety and Health Administration permissible exposure limit (PEL) for phenol is 5 ppm (19 milligrams per cubic metre (mg/m^3) as an 8-hour time-weighted average (TWA) concentration. In addition, the OSHA PEL bears a "Skin" notation, which indicates that the cutaneous route of exposure (including mucous membranes and eyes) contributes to overall exposure [29 CFR 1910.1000, Table Z-1].
- NIOSH: The National Institute for Occupational Safety and Health has established a recommended exposure limit (REL) for phenol of 5 ppm (19 mg/m^3) as a TWA for up to a 10-hour workday and a 40-hour workweek and a short-term exposure limit (STEL) of 15.6 ppm (60 mg/m^3) for periods not to exceed 15 minutes. NIOSH also assigns a "Skin" notation to phenol [NIOSH 1992].
- ACGIH: The American Conference of Governmental Industrial Hygienists has assigned phenol a threshold limit value (TLV) of 5 ppm (19 mg/m^3) as a TWA for a normal 8-hour workday and a 40-hour workweek. The ACGIH also assigns a "Skin" notation to phenol [ACGIH 1994, p. 29].
- EPA: The Environmental Protection Agency has determined that exposure to phenol in drinking water at a concentration of 6 milligrams per litre (mg/L) for up to 10 days is not expected to cause any adverse effects in a child. A lifetime exposure to 2 mg/L phenol in drinking water is not expected to cause any adverse effects.
- FDA: The Food & Drugs Administration has determined that the phenol concentration in bottled drinking water should not exceed 0.001 mg/L.

Australia

- Safe Work Australia has established a maximum 8 hour time weighted average (TWA) of 1 ppm (4 mg/m3)

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4. http://www.epa.gov/ttn/atw/hlthef/phenol.html
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CHEMWATCH
Bulletin Board
Gossip
OCT. 22, 2021

Chemicals used in packaging may play role in 100,000 US deaths a year – study

2021-10-15

The group of chemicals called phthalates, also known as plasticizers, may contribute to the early deaths of 91,000 to 107,000 older adults in the US each year, according to a new study.

Adults between 55 and 64 with the highest concentrations of phthalates in their urine were more likely to die of any cause, especially heart disease, than adults with lesser exposure, according to the study published on Tuesday in the peer-reviewed journal Environmental Pollution.

The study also estimated that this loss of life could cost the US between $40bn and $47bn each year.

"Until now, we have understood that the chemicals connect to heart disease, and heart disease in turn is a leading cause of death, but we had not yet tied the chemicals themselves to death," the study's lead author, Dr Leonardo Trasande, said in a release.

In the US, three types of phthalates have been restricted or banned in toys, but are less restricted in cosmetics and food packaging materials. Researchers said the study "focuses substantial urgency" in putting further limits on phthalates in food packaging materials and other consumer goods.

Phthalates, a group of chemicals most commonly used to make plastic harder to break, can interfere with the function of hormones, and researchers plan to examine what role the chemical plays in hormone regulation and inflammation in the body.

The study included more than 5,300 adults who between 2001 and 2010 participated in the US National Health and Nutrition Examination Survey, which collects health information from people during in-person interviews across the US.

The survey results included in this study were from adults who had also provided urine samples that were measured for phthalate metabolites.

Trasande, the study's lead author, is director of the Center for the Investigation of Environmental Hazards at New York University's Grossman School of Medicine and wrote Sicker Fatter Poorer, a book about the threat of hormone-disrupting chemicals.

The study also estimated that this loss of life could cost the US between $40bn and $47bn each year.

He cautioned that the biological connection between phthalates and early deaths has not been established, so the study does not prove phthalates were the direct cause of these early deaths.

"Our research suggests that the toll of this chemical on society is much greater than we first thought," said Trasande. "The evidence is undeniably clear that limiting exposure to toxic phthalates can help safeguard Americans' physical and financial wellbeing."

theguardian.com, 15 October 2021

https://www.theguardian.com

E-waste surges in 2021 as world sends goldmine to landfill

2021-10-14

The amount of electronic waste created globally has again increased this year, with the majority of it unlikely to be recycled.

Key points:

- E-waste is expected to hit over 70 million tonnes per year by 2030
- Only 17.4 per cent of e-waste is effectively recycled
- Australia has to move to a circular economy to reach net-zero emissions, experts say

Perhaps in part because of COVID-19 and increased reliance on technology for home offices and entertainment, the amount of dumped e-waste is expected to total 57.4 million tonnes in 2021, according to the Waste Electrical and Electronic Equipment (WEEE) Forum.

That's an additional 2 million tonnes on last year and roughly equal to the weight of the Great Wall of China, the group said (though estimates of the weight of the Great Wall of China vary).

Despite the e-waste containing anything from gold and silver to valuable glass and rare earth elements, only about 17.4 per cent will be effectively recycled, based on 2019 figures.

That's in contrast to the public perception that 40-50 per cent of waste is recycled, according to the WEEE Forum.

Today is International E-Waste Day: an annual event created by the WEEE Forum to draw attention to the growing problem of electronic waste.

"In Europe, one out of seven electricals in the household is sitting in drawers because they are not used or not functioning.

CHEMWATCH
Bulletin Board
Gossip
OCT. 22, 2021

The group are using this year's event to push for the recycling of household e-waste, much of which is sitting unused in drawers and cupboards.

"We hope to raise awareness among citizens of the importance of returning electricals that are no longer functioning or are unused," WEEE Forum director-general Pascal Leroy said.

"In Europe, one out of seven electricals in the household is sitting in drawers because they are not used or not functioning.

"In France, 5 kilograms of [electrical] products per person are non-functional [while] 17kg are rarely used."

Making recycling options easy for people to access is one key to increasing the proportion of recycled e-waste, Mr Leroy said.

"Convenience is important, i.e. making it easy for citizens to return their electricals to shops or civic amenity sites."

But while the WEEE Forum's focus this year is on recycling, and recycling is an important part of diverting waste from landfill, experts say individual consumers shouldn't shoulder the responsibility for what is largely a systemic failing with systemic solutions.

Why do we have so much waste?

Currently we have a linear approach to manufacturing, ownership and disposal.

In other words, a company makes a product, and once we buy it, sole responsibility for that product (besides manufacturing faults), is handed to us. At its end of life, its disposal is the individual consumers' responsibility.

In the best case, the product is recycled, but more often than not it's sent to landfill.

But this model, which puts indefinite pressure on Earth's finite resources, is fundamentally unsustainable, according to Lisa McLean, chief executive officer of non-profit research and advocacy group NSW Circular.

Instead, we have to transition to a circular economy, she says. Under the circular model, manufacturers still have responsibility for the end-of-life handling of the products they profit from.

When a product — whether that be a kettle, a washing machine or even the clothes we wear — stops working or is worn out, it's returned to the manufacturer.

The manufacturer, with the right incentives, is then tasked with either repairing the item, repurposing its working parts, or as a last resort, recycling the components for reuse.

Considering a tonne of mobile phones contains more gold than an average tonne of gold ore, this last option isn't necessarily bad.

As for materials that aren't recyclable, we have to transition to products that don't use those materials, Ms McLean said.

"We need to say goodbye to products that can't be recycled. Certain plastics and other products that can't be recycled, they have to be designed out," she said.

Although there are already systemic changes taking place in parts of Europe toward a circular economy, industrial design expert Miles Park from UNSW says our e-waste problem is about to get much bigger if we don't move faster.

"A whole lot of new products are hitting waste streams in huge numbers — right now batteries and then in about 10 years [early] generation solar panels will be coming to their end of life," Dr Park said.

"[And] now we've got microchips and antennae in everything from our toothbrushes to our cars."

At the present rate of increase, the UN predicts global e-waste will hit 74 million tonnes per year by 2030.

Climate change the catalyst for a circular revolution

Short of conquering and mining other planets, Earth will run out of useful resources if we continue using them faster than they can be replenished.

So although it sounds like a radical shift in the way we do things, moving to a circular economy is a matter of when, not if.

There needs to be a "carrot and stick" approach by legislators and policymakers to help manufacturers drive the transition, according to Dr Park.

CHEMWATCH
Bulletin Board
Gossip
OCT. 22, 2021

Right now, technology manufacturers are locked in a race to create new and innovative products, which quickly make superseded models obsolete.

Instead, there needs to be the right market incentives to develop products that last, or that are easily updated.

One piece of the puzzle is for manufacturers to bear the responsibility for a product's end of life.

"From a product design point of view, there are well-understood approaches, but they're not widely applied," Dr Park said.

"First and foremost, if it lasts longer, you're going to displace increased demand for stuff.

"Throw into that you've got upgrade-ability, and instead of ownership, you've got shared schemes – car-share schemes for instance.

"You've got to create a landscape where businesses can flourish and take back [their products] in this whole ecosystem of a circular economy."

Climate change and Australia's need to move to net-zero emissions means the time to shift to a circular economy is now, according to Ms McLean.

While transitioning to renewable energies and transport are needed to cut down Australia's emissions, that still leaves a lot of emissions in manufacturing, mining and waste disposal, she said.

"It still leaves around 45 per cent of emissions that are embedded in products and are embedded in waste," Ms McLean said.

abc.net.au, 14 October 2021

https://www.abc.net.au

Scientists just broke the record for the coldest temperature ever recorded in a lab

2021-10-15

Scientists just broke the record for the coldest temperature ever measured in a lab: They achieved the bone-chilling temperature of 38 trillionths of a degree above -273.15 Celsius by dropping magnetized gas 393 feet (120 meters) down a tower.

The team of German researchers was investigating the quantum properties of a so-called fifth state of matter: Bose-Einstein condensate

Scientists have even developed a special scale for extremely cold temperatures, called the Kelvin scale, where zero Kelvin corresponds to absolute zero.PLAY SOUND

(BEC), a derivative of gas that exists only under ultra-cold conditions. While in the BEC phase, matter itself begins to behave like one large atom, making it an especially appealing subject for quantum physicists who are interested in the mechanics of subatomic particles.

Temperature is a measure of molecular vibration — the more a collection of molecules moves, the higher the collective temperature. Absolute zero, then, is the point at which all molecular motion stops — minus 459.67 degrees Fahrenheit, or minus 273.15 degrees C. Scientists have even developed a special scale for extremely cold temperatures, called the Kelvin scale, where zero Kelvin corresponds to absolute zero.PLAY SOUND

Near absolute zero, some weird things start to happen. For example, light becomes a liquid that can literally be poured into a container, according to research published in 2017 in the journal Nature Physics. Supercooled helium stops experiencing friction at very low temperatures, according to a study published in 2017 in the journal Nature Communications. And in NASA's Cold Atom Lab, researchers have even witnessed atoms existing in two places at once.

In this record-breaking experiment, scientists trapped a cloud of around 100,000 gaseous rubidium atoms in a magnetic field inside a vacuum chamber. Then, they cooled the chamber way down, to around 2 billionths of a degree Celsius above absolute zero, which would have been a world record in itself, according to NewAtlas.

But this wasn't quite frigid enough for the researchers, who wanted to push the limits of physics; to get even colder, they needed to mimic deep-space conditions. So the team took their setup to the European Space Agency's Bremen drop tower, a microgravity research center at the University of Bremen in Germany. By dropping the vacuum chamber into a free fall while switching the magnetic field on and off rapidly, allowing the BEC to float uninhibited by gravity, they slowed the rubidium atoms' molecular motion to almost nothing. The resulting BEC stayed at 38 picokelvins - 38 trillionths of a Kelvin - for about 2 seconds, setting "an absolute minus record", the team reported Aug. 30 in the journal Physical Review Letters. The previous record of 36 millionths of a Kelvin, was achieved by scientists at the National Institute of Standards and Technology (NIST) in Boulder, Colorado with specialized lasers.

The coldest known natural place in the universe is the Boomerang Nebula, which lies in the Centaurus constellation, about 5,000 light years from Earth. Its average temperature is -272 C (about 1 Kelvin) according to the European Space Agency.]

CHEMWATCH
Bulletin Board
Gossip
OCT. 22, 2021

The researchers of the new study said in a statement that, theoretically, they could sustain this temperature for as long as 17 seconds under truly weightless conditions, like in space. Ultra cold temperatures may one day help scientists build better quantum computers, according to researchers at MIT.

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Earth could be alien to humans by 2500

2021-10-14

Unless CO2 emissions drop significantly, global warming will make the Amazon barren, the American Midwest tropical, and India too hot to live in by 2500, according to a team of scientists.

"We need to envision the Earth our children and grandchildren may face, and what we can do now to make it just and livable for them," says Christopher Lyon, a postdoctoral researcher under the supervision of professor Elena Bennett at McGill University. "If we fail to meet the Paris Agreement goals, and emissions keep rising, many places in the world will dramatically change."

The scientists ran global climate model projections based on time dependent projections of atmospheric greenhouse gas concentrations for low, medium, and high mitigation scenarios up to the year 2500. Their findings, published in Global Change Biology, reveal an Earth that is alien to humans.

Under low and medium mitigation scenarios—which do not meet the Paris Agreement goal to limit global warming to well below 2 degrees Celsius—vegetation and the best crop-growing areas may move toward the poles. The area suitable for some crops would also shrink. Places with long histories of cultural and ecosystem richness, like the Amazon Basin, may become barren.

They also found that heat stress may reach fatal levels for humans in tropical regions that are highly populated. Even under high-mitigation scenarios, the team found that the sea level keeps rising due to expanding and mixing water in warming oceans.

"If we fail to meet the Paris Agreement goals, and emissions keep rising, many places in the world will dramatically change."

"These projections point to the potential magnitude of climate upheaval on longer time scales and fall within the range of assessments made by others," says Lyon.

Although many reports based on scientific research talk about the long-term impacts of climate change—such as rising levels of greenhouse gases, temperatures, and sea levels—most of them don't look beyond the 2100 horizon. To fully grasp and plan for climate impacts under any scenario, researchers and policymakers must look well beyond the 2100 benchmark, says the team.

"The Paris Agreement, the United Nations, and the Intergovernmental Panel on Climate Change's scientific assessment reports, all show us what we need to do before 2100 to meet our goals, and what could happen if we don't," says Lyon. "But this benchmark, which has been used for over 30 years, is short-sighted because people born now will only be in their 70s by 2100."

Climate projections and the policies that depend on them, shouldn't stop at 2100 because they cannot fully grasp the potential long-term scope of climate impacts, the scientists conclude.

Source: McGill University

futurity.org, 14 October 2021

https://www.futurity.org

Astronomers find Jupiter-like planet orbiting white dwarf star, in potential glimpse at our Solar System's future

2021-10-14

A gas giant planet circling the remnants of a dead star has given astronomers a glimpse of what our Solar System might look like billions of years down the track.

Key points:

- Astronomers have found the first planet-star pair that looks like how our Solar System is predicted to end
- In about 5 billion years, the Sun will swell up and swallow the inner planets

"It was a very serendipitous discovery," Dr Blackman said.

CHEMWATCH
Bulletin Board
Gossip
OCT. 22, 2021

- The finding shows Jupiter could survive the Sun's evolution into a red giant star

The detection is the first to spot a Jupiter-like planet orbiting a white dwarf at a distance we might expect when a star runs out of fuel and dies.

An international team of astronomers, including Joshua Blackman at the University of Tasmania, report their celestial revelation in the journal Nature today.

"It was a very serendipitous discovery," Dr Blackman said.

"This system is kind of a window into the possible future of the Solar System."

Jonti Horner, an astronomer at the University of Southern Queensland who was not involved in the study, agreed.

"It's showing us that when the Sun goes through this process, the giant planets are likely far enough away that they would survive."

What's in store for the Sun?

Astronomers don't know for certain how the Sun will behave over the next 10 billion years or so, but they have a pretty good idea.

And it's a fate destined for the vast majority of stars in our galaxy, the Milky Way.

Right now, the Sun, which is a pretty typical "main sequence" star, is 4.6 billion years old. The heat and light it emits is produced as it fuses hydrogen into heavier elements.

But eventually, in around 5 to 6 billion years, its hydrogen inventory will run out.

The Sun's core will contract and collapse, and its outer layers will puff up as it evolves into a red giant, Dr Blackman said.

The surface of the swollen Sun will slowly but inexorably start encroaching on the Solar System.

And it's bad news for Earth.

"It will engulf the inner planets, so Mercury and Venus, even Earth, will likely be destroyed," Dr Blackman said.

"But Mars and the gas giants further out will survive. That's the general predicted model of what's going to happen."

After another few hundred million years or so, the Sun will shrug its fluffy envelope into space, leaving behind a dead, dense core — a white dwarf.

But planets tipped to ride out the Sun's red giant phase may still be there with it. They just won't be as close.

As its mass will be less than its hydrogen-burning heyday, the white dwarf's gravitational pull won't be as strong, and any planets still remaining will be orbiting further out than before.

And this is what Dr Blackman and his colleagues found happening in another solar system for the first time.

EOver around 150 million years, a star similar to the Sun evolved into a white dwarf.

How to see 'dark' objects in space

Many distant stars can't be "seen" using traditional telescopes, so they and other dim objects are detected using a technique called gravitational microlensing.

It's based on the idea that the gravitational field of an object — such as a white dwarf — distorts the light shining from a star behind it, like a lens.

If the stars literally align with Earth, astronomers see the light from the furthest star intensify and smear into a curve, called an Einstein ring, as it bends around the white dwarf.

As the stars move out of alignment, the Einstein ring fades.

The white dwarf and its gas giant, which sit around 6,500 light-years away, were first spied this way in 2010 by the telescope at New Zealand's Mount John Observatory, but it would be years before astronomers worked out exactly what they'd found.

By the time Dr Blackman joined the project in 2016, more telescopes had observed the lensing event, including the much larger and more powerful Keck Telescope on Mauna Kea in Hawaii.

"We were expecting the star to be like our Sun, a main sequence star, which is what we typically see," he said.

CHEMWATCH
Bulletin Board
Gossip
OCT. 22, 2021

"So when we didn't see that, we spent a long time trying to figure out what we did wrong ... before we could quite confidently say it was a white dwarf, about half the mass of the Sun."

They also saw "bumps" in the Einstein ring of curved light, he added — signs of a planet lapping the white dwarf, closer than Jupiter does the Sun today, but within the expected distance of a gas giant that survived its star's death.

A different class of exoplanet

Gravitational microlensing hasn't found nearly as many exoplanets as other detection methods, purely because it relies on the chance alignment of stars.

Astronomers don't know when those events will transpire, so they point telescopes into space and wait for it to happen.

But gravitational microlensing can pick up exoplanets that other methods can't, Professor Horner says.

The transit method, where telescopes pick up momentary but regular dips in a star's luminosity as an orbiting planet blocks the light, is good at finding bright stars with big planets orbiting very close.

The radial velocity method is also biased towards big planets circling near their star, because it detects the ever-so-slight wobble of a star caused by a planet's gravitational tug.

Gravitational microlensing can pick up dead stars that emit little light, and have planets sitting further out.

"Think of it like a census, and you're trying to understand the breadth of humanity," Professor Horner said.

"The transit method is really good at finding children who are at nursery, the radial velocity method's good at finding children at primary school.

"And this is a method that lets you find retirees."

More telescopes, more observations

It's not the first time a Jupiter-like planet has been spotted orbiting a white dwarf. A handful have been found, such as this one reported last year, Dr Blackman said.

"But none of those resemble what we expect to happen.

"Most are very close to their host star, like a Jupiter-mass planet 10 times closer than Mercury, whereas our planet is in alignment with the traditional expectation of what's going to happen in the Solar System."

More Jupiter-like planets will be found whizzing around the dead, dim remnants of their star in the coming decades, he added.

The upcoming Roman Space Telescope, earmarked for launch in the mid-to-late-2020s, will hunt for exoplanets using gravitational microlensing.

The Hubble Space Telescope and soon-to-be-launched James Webb Space Telescope could be enlisted to help too, Dr Blackman said.

"They can see much deeper into the sky, and we're hoping we can get a direct detection of the white dwarf in the future."

abc.net.au, 14 October 2021
https://www.abc.net.au

Yellow warblers remembers warning calls 1 day later, suggesting long-term memory

2021-10-15

Across North America, hundreds of bird species waste time and energy raising chicks that aren't their own. They're the victims of a "brood parasite" called the cowbird, which adds its own egg to their clutch, tricking another species into raising its offspring. One target, the yellow warbler, has a special call to warn egg-warming females when cowbirds are casing the area. Now, researchers have found the females act on that warning 1 day later—suggesting their long-term memories might be much better than thought.

"It's a very sophisticated and subtle behavioral response," says Erick Greene, a behavioral ecologist at the University of Montana, Missoula, who was not involved in the study. "Am I surprised? I guess I'm more in awe. It's pretty dang cool."

Birds have been dazzling scientists with their intellects for decades. Western scrub jays, for instance, can remember where they've stored food for the winter—and can even keep track of when it will spoil. There's evidence that other birds might have a similarly impressive ability to remember certain meaningful calls.

"Am I surprised? I guess I'm more in awe. It's pretty dang cool."

CHEMWATCH
Bulletin Board
Gossip
OCT. 22, 2021

"Animals are smart in the context in which they need to be smart," says Mark Hauber, an animal behavior researcher at the University of Illinois, Urbana-Champaign (UIUC), and the Institute of Advanced Studies in Berlin, who co-authored the new study. He wanted to see whether yellow warblers had the capacity to remember their own important warning call known as a seet.

The birds make the staccato sound of this call only when a cowbird is near. When yellow warbler females hear it, they go back to their nests and sit tight. (It could just as well be called a "seat" call.) But it's been unclear whether they still remember the warning in the morning.

So a UIUC team found 27 yellow warbler nests near campus and exposed females to either silence, or one of two sounds: a recording of a seet call or a recording of a generic warning—used for predators or competition—called a chip for 10 minutes. The next morning, the researchers observed the birds for 80 minutes: 20 minutes before sunrise and 60 minutes after, when the cowbirds are at their most active.

"These birds are really hard to see when there's hardly any light out," says Shelby Lawson, a behavioral ecologist at UIUC who led the study. "You basically stare at your binoculars for a solid hour because you don't want to miss anything." To be safe, the researchers also placed temperature sensors in the nests to detect when a bird was present.

They found the warblers left their nests less often after hearing a seet call than if they had heard no warning, the team reported last month in Biology Letters. The chip call didn't seem to have any impact on how often they left the nest. "Sixteen hours after the experiment, the birds are still behaving as if there's a cowbird threat," Hauber says. "It allows us to think that these kinds of signals carry long-term meaning."

Of more than 200 species targeted by cowbirds, yellow warblers are the only so far known to have developed a warning call tailored to cowbirds. This research shows the warblers can take it a step further, Hauber says, storing the knowledge passed on by the call using something resembling the scrub jays' impressive long-term memory.

Lawson hopes to follow up by scanning the birds' brains while playing various calls, to better understand how the information is processed. Does the same part of the brain light up when the birds hear the call of a cowbird as when they hear a seet call, for instance?

"These are animals that have the stepping stones of language," Lawson says. "That must require some kind of higher order stuff going on in the brain, but right now we don't know what's going on in there at all."

science.org, 15 October 2021

https://www.science.org

Polar bears could vanish by the end of the century, scientists predict

2021-10-15

Arctic sea ice has been steadily decreasing since the beginning of satellite records in 1979, but a new study comes with a chilling (or perhaps, warming) prediction: By the end of this century, Arctic sea ice may disappear during the summer, which could drive polar bears and other ice-dependent species to extinction.

The "Last Ice Area" is a region containing the oldest, thickest Arctic ice. It spans an area of more than 380,000 square miles (1 million square kilometers) from the western coast of the Canadian Arctic Archipelago to Greenland's northern coast. When scientists named the 13-foot-thick (4 meters) ice region, they thought it would last for decades.

But now, under both the most optimistic and pessimistic scenarios for warming linked to climate change, the sea ice will dramatically thin by 2050. The most optimistic scenario, in which carbon emissions are immediately and drastically curbed to prevent the worst warming, could result in a limited portion of the ice surviving in the region. In the most pessimistic scenario, in which emissions continue at their current rate of increase, the summer ice — and the polar bears and seals that live on it — could disappear by 2100, researchers reported in a new study.

"Unfortunately, this is a massive experiment we're doing," study co-author Robert Newton, a senior research scientist at Columbia University's Lamont-Doherty Earth Observatory, said in a statement. "If the year-round ice goes away, entire ice-dependent ecosystems will collapse, and something new will begin."

Arctic sea-ice cover grows and shrinks each year, reaching its minimum extent at the end of the summer melt season in September before rebounding in the fall and winter to reach its maximum extent in March. But as carbon dioxide and other greenhouse gases increasingly contribute to the warming of the atmosphere, the span of the sea ice has yo-yoed

The "Last Ice Area" is a region containing the oldest, thickest Arctic ice.

CHEMWATCH
Bulletin Board
Gossip
OCT. 22, 2021

between ever shrinking bounds — with the past 15 years bringing the lowest 15 sea-ice extents in the satellite record, according to the National Snow and Ice Data Center (NSIDC).

Worse still, the NSIDC reports that the amount of older, thicker Arctic ice that has survived at least one melt season is at a record low, around a quarter of the total recorded by the first satellite surveys 40 years ago.

A more dramatic decrease in ice coverage could have a crippling effect on the lives of the animals that dwell on, or under, the shifting ice network, including photosynthetic algae, tiny crustaceans, fish, seals, narwhals, bowhead whales and polar bears.

"Ringed seals and polar bears, for example, have relied on their dens in the ridged and corrugated sea-ice surface to stay approximately in one place," the researchers wrote.

Because they are specialized predators, polar bears (Ursus maritimus) would be especially vulnerable to extinction if the ice were to disappear. Adapted to lurk atop sea ice, the Arctic bears hunt by snatching unfortunate seals that come to the surface to breathe. Polar bears have jaws adapted for consuming soft blubber and meat; and though the bears have been seen shifting their diet to seabird eggs and caribou while on land, a 2015 study published in the journal Frontiers in Ecology and the Environment found that the calories they gain from these sources do not balance out those the bears burn from foraging for these animals, Live Science previously reported.

This rapid habitat shift could cause polar bears to become extinct or lead to more extensive interbreeding with grizzly bears (Ursus arctos horribilis), whose ranges are expanding northward as the climate warms, Live Science previously reported. This process could eventually replace polar bears with hybrid "pizzly" bears. Nonetheless, in the more pessimistic, increasing-emission scenario, the researchers expect the summer ice and the ice-dependent ecosystem to disappear.

"This is not to say it will be a barren, lifeless environment," Newton said. "New things will emerge, but it may take some time for new creatures to invade." The researchers suggested that fish and photosynthetic algae may make their way northward from the North Atlantic, although they are uncertain if the new habitat would be stable enough to support those organisms year-round, especially during the long, sunless Arctic winter.

Even a partially melted Arctic could also create a positive feedback loop: The water's surface is darker and more efficient at absorbing sunlight, meaning the melt would accelerate the overall rate of warming, in a vicious cycle.

On Aug. 9, a landmark report from the U.N.'s Intergovernmental Panel on Climate Change (IPCC) issued a stark warning that Earth is expected to reach a critical threshold: a global temperature increase of 1.5 degrees Celsius (2.7 degrees Fahrenheit) due to climate change within the next 20 years. A draft third section of the IPCC report leaked to the Spanish publication CTXT warned that global greenhouse gas emissions must peak in the next four years if global heating is to remain within 1.5 C.

The researchers published their findings Sept. 2 in the journal Earth's Future.

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https://www.livescience.com

Toxic algae blooms are multiplying. The government has no plan to help.

2021-10-14

Most of the air we breathe comes from algae and other aquatic organisms that have been photosynthesizing sunlight into oxygen for a billion years. But not all algae are life-giving. Blue-green algae contain a powerful class of toxins called cyanotoxins. When these algae form blooms — rapid accumulations of algae in fresh or marine water — they can damage ecosystems and cause vomiting, fever, headache, neurological problems, and even death in humans and animals.

These poisonous organisms have been cropping up a lot lately. Beaver Lake in Asheville, North Carolina, was closed last week after local officials found toxic algae in the water. Three dogs died from playing on a beach suspected to be contaminated with toxic algae on the Columbia River in Washington state last month. In California, the Bureau of Land Management closed a 28-mile stretch along the Merced River after water samples south of where a family of hikers mysteriously died in August showed high levels of toxic algae. These types of incidents are not rare. A new study from the Centers for Disease Control and Prevention estimates

A new study from the Centers for Disease Control and Prevention estimates that toxic algae sent more than 300 Americans to the emergency room between 2017 and 2019.

CHEMWATCH
Bulletin Board
Gossip
OCT. 22, 2021

that toxic algae sent more than 300 Americans to the emergency room between 2017 and 2019.

But despite the dangers of algae-related poisoning and the harmful and costly impacts of blooms on ecosystems, the federal government doesn't have a cohesive strategy for dealing with freshwater harmful algal blooms, or HABs. That's the conclusion of a new watchdog report from the U.S. Environmental Protection Agency's Office of Inspector General. "The EPA does not have an agency-wide strategy for addressing harmful algal blooms," the report says, "despite Congress appointing the EPA administrator as the leader for federal actions focused on reducing, mitigating, and controlling freshwater HABs." The report recommends that the EPA needs to focus on developing a national program to "forecast, monitor, and respond" to these blooms; establish new water safety criteria for algae-causing chemicals in lakes, rivers, and streams; and take a closer look at whether water with algae in it is safe to drink.

Algal blooms are sparked by nutrients, an umbrella term for the chemical elements phosphorus and nitrogen, which are often used by farmers to fertilize their fields. Nutrients can also come from other sources, like chemically treated water from wastewater plants and water from storm drains containing a cocktail of urban pollution. Atmospheric pollution from fossil fuel plants and cars can seed algal blooms, too.

Climate change also fuels blooms, albeit more indirectly. Research shows that algae thrive in bodies of water warmed by climate change. And erratic weather like intense tropical storms and extreme rainfall, byproducts of a warming planet, serve as catalysts for new blooms by helping nutrients leach into bodies of water and moving algae around. Blue-green algae, also known as cyanobacteria, particularly like it when heavy rain is followed by a big drought — a pattern that's becoming more common with climate change — because the rain pushes algae downstream into new areas and then drought forces that water and the algae in it to stagnate, which then allows the algae to proliferate unchecked. "It's the perfect storm scenario for cyanobacteria," Hans Paerl, a professor of marine and environmental sciences at University of Carolina, Chapel Hill, told Grist.

As the risk of harmful blooms grows, the EPA has been more or less asleep at the wheel, according to the watchdog report. According to the report, the agency has been chipping away at the HABs problem little by little, by investigating localized blooms in individual states and collecting water data from the public to be used for better monitoring, among other small-

scale initiatives. But the EPA has not invested in expanding these efforts into a national algae monitoring network. The report notes that the EPA has also not exercised its full authority to regulate HABs under the Clean Water and Safe Drinking Water acts.

In 2015, Congress put the EPA in charge of developing informational drinking water health advisories for cyanotoxins. Exposure to even low doses of the toxins over a long period of time can encourage liver tumors and other disease. But the report notes that the agency still hasn't developed those advisories. Experts say the EPA should go a step further and set maximum contaminant limits, a legal threshold on the amount of a substance that is allowed in public water systems under the Safe Drinking Water Act, for cyanotoxins, which would require states to meet those standards for their drinking water supplies. Only two states, Oregon and Ohio, have forged ahead without the EPA and regulated cyanotoxins in drinking water. Until the EPA releases a set of federal standards, most states won't monitor their drinking water supplies for these toxins. "If you think about how people respond to regulations in general, they typically step up to the plate to meet what regulations are on the books," Christine Kirchoff, associate professor of water policy and management at the University of Connecticut, told Grist. "And there aren't regulations for cyanotoxins except in those two states."

In the EPA's defense, there isn't a ton of research on the public health effects of algal contaminants in drinking water. It's difficult for the EPA to amass enough evidence to determine which thresholds of algae in drinking water are safe or not safe.

In response to the inspector general report, EPA officials said they plan to "explore the potential for new or revised numeric nutrient criteria" — in plain English, standards for nutrients in waterways like lakes and rivers — by the end of 2022. But the inspector general said that wasn't good enough and that the EPA should make a more concrete plan. Outside experts agree with that.

"Even though the EPA's HABs program is getting better and more involved, it's still not up to the scale of the problem," Donald Anderson, a biologist at the Woods Hole Oceanographic Institution, told Grist. He wants the EPA to work with the National Atmospheric and Oceanic Administration, which is the agency in charge of monitoring HABs in marine environments, so that the programs can inform one another. And he thinks that Congress needs to not just authorize the EPA to lead the nation's response to HABs, but also ensure that the agency is getting enough money, or congressional

CHEMWATCH
Bulletin Board
Gossip
OCT. 22, 2021

appropriations, to sufficiently address the problem. "There really isn't a recurrent funding program in the EPA on multiple areas of HAB research," he said. "It's a little more piecemeal, hit and miss."

Paerl said the EPA could be more aggressive about collecting and disseminating data on HABs. "The role the EPA really needs to play is to bank the data, so to speak, and then from that develop strategies that can be used across the U.S.," he said. Some of the areas that are prone to blooms, like agricultural watersheds, stretch across multiple states, which means that effectively addressing those blooms will require an interstate response.

The EPA can draw inspiration for its HABs program from the few states that have put successful strategies in place already. In Ohio, for example, state legislators passed a bill preventing farmers from applying fertilizer to saturated ground or if the forecast says the chance of 1 inch of rain over the next 12 hours is greater than 50 percent. A regulation like that on a much wider scale could help stem the flow of nutrients into waterways. "What we need to do is known, it's just sort of getting the regulatory push to do it," Kirchoff said.

grist.org, 14 October 2021

https://www.grist.org

Rare conjoined turtles hatched in Massachusetts

2021-10-14

Conjoined turtles with two heads and a single body have hatched at a Massachusetts wildlife center. Against all odds, the fused siblings are thriving.

Against all odds, the fused siblings are thriving.

The baby turtles, diamondback terrapins (Malaclemys terrapin), are "very alert" and "active," according to a recent Facebook post from the New England Wildlife Center's Cape Cod branch. "Animals with this rare condition don't always survive very long or live a good quality of life, but these two have given us reason to be optimistic."

Genetic or environmental factors that influence the embryos as they develop can cause the condition known as bicephaly, or having two heads. Living animals with bicephaly are extremely rare because many don't survive, Live Science previously reported. Some other examples include a two-headed viper discovered in Virginia, a two-headed deer found dead in Minnesota and a two-headed porpoise taken out of the North Sea.

PLAY SOUND

The baby turtles hatched in a protected nesting site in Barnstable, Massachusetts. The wildlife center has been taking care of them for a little over two weeks, and the turtles continue to be "bright and active," according to the Facebook post.

The wildlife center has used X-rays to learn more about how the turtles navigate the world. It seems that they have two spines that merge further down the body and that each turtle has control of three legs.

In the first couple of days after hatching, the turtles got their nutrition from the same yolk salk. By giving the turtles a white powder that can be visualized on X-rays of the gastrointestinal (GI) tract, the researchers found that each turtle has a separate GI tract. One of the GI tracts seems a bit more developed, but both turtles are eating and digesting food.

A deep-water swim test showed that the two siblings can coordinate swimming to the surface to breathe. The two are eating, swimming and gaining weight. "It is impossible to get inside the heads of these two, but it appears that they work together to navigate their environment," according to the post.

The researchers hope to get the turtles a CT scan once they're a bit older to learn more about the internal organs and structures they share. "There is still so much to learn about them," the wildlife center wrote in the post.

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https://www.livescience.com

EPA eyes broader oversight of cancer-causing gas

2021-10-13

EPA is set to ramp up scrutiny of facilities that do not currently report releases of a toxic gas as the Biden administration beefs up its environmental justice agenda.

The agency said in a statement today that 31 facilities are receiving letters notifying them of the potential for reporting requirements related to their use of ethylene oxide, which is used in medical sterilization practices as well as in agriculture and other sectors.

Some facilities will also receive notifications pertaining to releases of ethylene glycol, which is produced using ethylene oxide, meaning they can occur together.

CHEMWATCH
Bulletin Board
Gossip
OCT. 22, 2021

Sites receiving the letters, EPA said, are likely to exceed a 10,000-pounds-per-year threshold under the Toxics Release Inventory for chemicals not covered by manufacturing or processing efforts. Some facilities will also receive notifications pertaining to releases of ethylene glycol, which is produced using ethylene oxide, meaning they can occur together.

"EPA is committed to taking action to protect people from exposure to EtO, especially children, workers and residents in underserved and overburdened communities," EPA Assistant Administrator for the Office of Chemical Safety and Pollution Prevention Michal Freedhoff said in a statement.

Freedhoff added that the move "will help inform EPA's future actions and ensure that communities have access to the best information available so they can take necessary action."

TRI is a resource meant to help stakeholders gather information about industrial and federal facilities, including affected communities that may be exposed to contamination. President Biden's EPA has focused on the inventory as a useful tool that can help bolster environmental justice goals in particular, given the disproportionate number of low-income communities and people of color living near relevant facilities.

In April, EPA Administrator Michael Regan said the agency would expand chemical reporting requirements under TRI "to protect the health of every individual, including people of color and low-income communities that are often located near these facilities but have been left out of the conversation for too long." EPA emphasized both per- and polyfluoroalkyl substances (PFAS) and ethylene oxide in its announcement (Greenwire, April 30).

But even prior to that announcement, ethylene oxide had been a source of contention for some time. The compound is a carcinogen posing severe long-term health risks for exposed communities. Industry members, however, maintain that ethylene oxide serves a critical public health role and that science does not justify a severe crackdown.

The notice from EPA gave the facilities a month to respond to the agency with relevant information to help reach a final decision on reporting requirements. EPA said that the move marks "the first stage of an ongoing effort to broaden TRI reporting requirements for contract sterilizers" and that it will continue to monitor additional facilities that could be added to the list.

Trump-era hangover

Ethylene oxide is a particularly sore subject for some critics after an April report from EPA's inspector general.

The watchdog office found that top leaders in EPA's air office under former President Trump blocked releases of data that showed possible risks from ethylene oxide to residents of the Chicago area. Those actions were not illegal, the Office of Inspector General concluded, but they flew in the face of EPA's mission and hindered public health protections (E&E News PM, April 15).

At the heart of the drama are former agency air chief Bill Wehrum and his deputy, Clint Woods. Wehrum overrode a recommendation from a regional EPA official on releasing air monitoring data showing high ethylene oxide levels near a Chicago-area Sterigenics medical sterilization plant. That official worried the emissions would spark "another public health emergency like the Flint, Michigan drinking water crisis."

Wehrum, who had served in private industry and has since returned, quit EPA in 2019. Ethylene oxide has remained an ongoing fight for industry members in the time since, with companies that sterilize medical equipment ramping up lobbying late last year (Greenwire, Dec. 11, 2020).

Major players like the American Chemistry Council have also had an active role in the debate, pointing to an analysis from the Texas Commission on Environmental Quality finding ethylene oxide is less hazardous than EPA had previously determined. Texas is home to a number of ethylene oxide-emitting facilities. Under Trump, EPA indicated it might consider TCEQ's findings, sparking concern from groups that worried the agency would release a more benign risk assessment for the chemical.

In June, Regan said the agency would reconsider ethylene oxide's cancer risks, granting an ACC petition over its 2016 Integrated Risk Information System assessment carrying a bleak outlook for the chemical's health implications. ACC praised that move at the time, as did advocacy groups that said revisiting the determination could allow for a stronger crackdown (E&E News PM, June 22).

The Biden approach

Environmental groups have long argued that communities are left uninformed about exposure risks from pollutants. EPA has sought to bridge that gap with a series of public virtual meetings aimed at

CHEMWATCH
Bulletin Board
Gossip
OCT. 22, 2021

connecting with residents in Texas and Louisiana, both home to significant industry activity.

The agency kicked off those sessions in August, focusing on a total of seven communities across both states (E&E News PM, Aug. 10). While outcry over ethylene oxide has been widespread in states like Illinois, rural communities in the South have been less aware. An initial session catered to residents of Longview, Texas, where an Eastman Chemical Co. facility released around 4 tons of ethylene oxide in 2019, per TRI data.

Those sessions have faced some criticism over allowing industry members to participate and at times offer information counter to scientific findings. And EPA has faced additional pushback over its TRI emphasis from critics who say the system contains loopholes that allow industry to shirk reporting requirements (E&E News PM, Aug. 2).

Meanwhile, Joe Goffman, EPA's acting air chief, has been engaged in a back-and-forth with EPA's inspector general, who has been critical of the agency's pace on air pollution cleanup plan approvals (Greenwire, Aug. 9).

Inspector General Sean O'Donnell has urged new reviews of ethylene oxide and another pollutant, chloroprene. But Goffman has resisted that push — leading O'Donnell to recommend a formal dispute resolution process to work through the standoff.

Goffman has separately asserted that the agency is unlikely to back down on the 2016 findings on ethylene oxide's risk to the public.

"We stand firmly behind the ethylene oxide IRIS value," Goffman said in August.

eenews.net, 13 October 2021

https://www.eenews.net

Cannabidiol: What is CBD, how does it work, and what are the risks?

2021-10-17

Cannabidiol, also known as CBD, appears to be having a real moment in the sun.

Last year, Australia's drug regulator approved low-dose CBD products to be sold over the counter in pharmacies.

You may have also heard celebrities, influencers and podcast presenters touting the many benefits of taking a regular dose of the medicinal cannabis concoction, from treating anxiety and insomnia to general pain relief.

Take their word for it, and you might think CBD has replaced the apple a day that keeps the doctor away.

But let's separate fact from fiction. What's the evidence that CBD oil works, what can it be used for — and when should you steer clear?

How do cannabinoids work?

CBD sits in a class of molecules called cannabinoids.

The ABCs of CBD

- The cannabis plant (Cannabis satvia) produces hundreds of different compounds in its leaves and flowers
- One group of cannabis compounds are cannabinoids. More than 100 different cannabinoids have been found in cannabis so far, including tetrahydrocannabinol, or THC, the chemical that gets you high
- Cannabidiol, also known as CBD, is another cannabinoid. It doesn't get you high, but has anti-psychotic and anti-inflammatory effects.

Depending on the cannabinoid, they can make us hungry, sleepy, forgetful or euphoric (or any combination of these and more).

Cannabinoids do this by activating specific biological sensors on our cells called receptors, which, in turn, change how the cell behaves and the chemicals it releases.

But as to the nitty-gritty of how this system works?

Take their word for it, and you might think CBD has replaced the apple a day that keeps the doctor away.

CHEMWATCH
Bulletin Board
Curiosities
OCT. 22, 2021

"The honest answer is we don't really know how all the cannabinoids exert their activity," said Jennifer Martin, director of the Australian Centre for Cannabinoid Clinical and Research Excellence.

Part of the issue is cannabinoid receptors are on cells all through our body, and they can do different things in different places at different doses.

What's more, some cannabinoids can also act on non-cannabinoid receptors, such as opioid receptors.

"'Promiscuous' is the pharmacological term," Professor Martin said.

"Usually when we're trying to get a drug registered or design a clinical trial, we're looking at one symptom, one disease, one chemical.

"Here we have [cannabinoid] drugs that work on multiple receptors and have multiple effects.

"I think that makes them fascinating, but also makes it complicated from a clinical use perspective."

What about CBD specifically?

Claims for CBD's benefits can be broadly split into two, although they are connected: general pain relief and more specific neurological effects.

CBD may alleviate some of the distress experienced in chronic pain, although exactly how it does this isn't clear.

For acute pain, such as arthritis and nerve pain, relief from symptoms is thought to be predominantly due to CBD's anti-inflammatory actions.

It does this by engaging cannabinoid receptors on immune cells, such as macrophages.

Macrophages act like your immune system's clean-up crew, engulfing and digesting anything nasty they encounter along the way.

They also secrete chemicals called cytokines. Immune cells use these to communicate with each other, but they also cause inflammation.

"Based on animal work in the bone marrow, CBD is likely to have effects on cells of the immune system such as macrophages to reduce the release of pro-inflammatory cytokines, which cause pain," Professor Martin said.

As for the highest concentration of cannabinoid receptors in the human body, that's in our brain.

CBD's purported effects there — such as calming us down and helping us nod off at night — are all controlled by evolutionarily ancient brain systems that regulate vital functions such as appetite, emotion, fear and sleep.

Indeed, cannabinoid receptors aren't only found in humans. All animals — even down to invertebrates such as insects and leeches — have them.

Like other cannbinoids, CBD modulates how our brain cells behave by controlling the release of chemicals called neurotransmitters, said Anand Gururajan, a neuropharmacologist at the University of Sydney's Lambert Initiative for Cannabinoid Therapeutics.

And — being a promiscuous molecule — CBD doesn't just work its magic on cannabinoid receptors. It can activate others, such as serotonin receptors.

Low levels of brain serotonin, a neurotransmitter, are involved in depression and anxiety.

In some people, and at high enough doses, CBD seems to help the brain use serotonin more effectively.

What's the evidence for low-dose CBD?

There are a number of clinical trials currently running in Australia looking into the effect of CBD on conditions as varied as insomnia, Tourette's syndrome and a transplant condition called graft-versus-host disease.

But the levels of CBD administered in clinical trials are far larger than the maximum dose recently approved by the Therapeutic Goods Administration (TGA) for over-the-counter products, Professor Martin said.

Any CBD products that do go on sale in Australian pharmacies will be low dose, only around 150 milligrams per day.

"The problem is it's probably too low to be effective for most symptoms and diseases," Professor Martin said.

"To get a therapeutic benefit, particularly for seizures or acute pain, it appears you probably need to take around 10 to 20 milligrams per kilogram, so roughly a gram of cannabidiol per day."

But, she added, your risk of side effects runs much higher at those doses.

Who should be cautious about using CBD?

CHEMWATCH
Bulletin Board
Curiosities
OCT. 22, 2021

In short, anyone taking any medication should be careful.

That's because it slows the liver's processes that break down some drugs in your bloodstream, meaning they can stay floating around in your blood at higher levels for longer.

"Maybe by taking a low dose [of CBD], people are also getting higher levels of their other pain or depression medicines," Professor Martin said.

To get therapeutic benefit from a drug, levels need to fall in a Goldilocks zone of sorts — not too low that it doesn't do anything, and not so high that you start to see side effects.

If a medication is allowed to hang around at high levels in your body for longer, that increases your risk of side effects, Dr Gururajan said.

"That's why you have to be really, really careful, especially if you're taking other medications.

"CBD tends to push everything higher. So that can be a bad thing."

Plus there are plenty of gaps in the research, he added.

"We don't know what long-term effects are for cannabidiol.

"And if you have someone who's pregnant and needs to be on cannabidiol, does that have an effect on the baby? We don't know."

So is CBD available in Australia now?

It is, but it's not freely accessible.

There are two cannabis-based prescription-only medicines currently on the Australian Register of Therapeutic Goods (ARTG).

In September last year, the TGA approved a cannabidiol-based medicine that can be prescribed to treat rare, but incredibly severe, drug-resistant forms of epilepsy that start in childhood.

The other has been around for a while — it was given the green light by the TGA in 2012 — and it contains CBD and another cannabinoid, THC. It's prescribed as a muscle relaxant for people with multiple sclerosis.

Prescription-only cannabis-derived medicines are classified as Schedule 8, or "controlled drugs". Drugs in this group include opioids such as morphine, methadone and oxycodone.

As well as the two cannabinoid medicines on the Australian Register of Therapeutic Goods, there are also at least 100 different unregistered cannabis products.

These products can be capsules or oils containing THC or CBD, or dried flowers, which authorised doctors can prescribe.

In 2015, cannabidiol was included as Schedule 4, prescription-only medicine if it contained at least 98 per cent cannabidiol.

This means no more than 2 per cent of the medicine can be another cannabinoid, such as THC, or other ingredients.

In December, the TGA revised that to Schedule 3, or available over the counter.

People tend to take CBD for its therapeutic effects or as a general "wellness" supplement, Rhys Cohen, a consultant and journalist who sits on the Lambert Initiative's external advisory board, said.

"It's like a sexier fish oil."

But regardless of your reasons for taking CBD, the TGA's decision doesn't mean you can pop out to your local pharmacy and pick up some up right this minute.

That's because any CBD products sold at a pharmacy must first be put on the Australian Register of Therapeutic Goods as a Schedule 3 drug — and none so far have passed muster.

"The TGA has said anyone who proves their CBD product is effective for an appropriate indication, up to this specific dose [of 150 milligrams per day], may be allowed to sell it over the counter," Mr Cohen said.

And it's jumping through the efficacy hoop that will be the tricky part.

With little current evidence that low-dose CBD has much medical benefit, he added, it may be years before the first CBD products appear on your pharmacist's shelves.

What about the stuff online?

CBD has been available without a prescription in the UK and some US states for a few years now.

But buying CBD online from overseas isn't just illegal, it's also risky.

The problem, Dr Gururajan says, is quality control — or lack thereof.

CHEMWATCH
Bulletin Board
Curiosities
OCT. 22, 2021

While any CBD products sold in chemists in Australia will be subject to TGA regulations, oils and capsules bought online could contain anything.

"A lot of cannabidiol that's available for public consumption right now is cannabidiol mixed with a bunch of other stuff from cannabis. It's not pharmaceutical-grade cannabidiol," Dr Gururajan said.

"So you don't know exactly what you're getting, and you don't know the actual compound that's giving you relief."

Given these unknowns, as well as cannabidiol's ability to slow your liver's ability to metabolise other drugs, anyone considering taking CBD should speak to a medical professional first, no matter the claims you see pushed by influencers.

"I certainly wouldn't recommend people refer to or look at social media for guidance," Dr Gururajan said.

"It's best to have these conversations with people like your GP or your specialist."

abc.net.au, 17 October 2021

https://www.abc.net.au

Study shows how to boost muscle regeneration and rebuild tissue

2021-10-19

One of the many effects of aging is loss of muscle mass, which contributes to disability in older people. To counter this loss, scientists at the Salk Institute are studying ways to accelerate the regeneration of muscle tissue, using a combination of molecular compounds that are commonly used in stem-cell research.

In a study, in Nature Communications, the investigators showed that using these compounds increased the regeneration of muscle cells in mice by activating the precursors of muscle cells, called myogenic progenitors. Although more work is needed before this approach can be applied in humans, the research provides insight into the underlying mechanisms related to muscle regeneration and growth and could one day help athletes as well as aging adults regenerate tissue more effectively.

"Loss of these progenitors has been connected to age-related muscle degeneration," says Salk Professor Juan Carlos Izpisua Belmonte, the

"Our study uncovers specific factors that are able to accelerate muscle regeneration, as well as revealing the mechanism by which this occurred."

paper's senior author. "Our study uncovers specific factors that are able to accelerate muscle regeneration, as well as revealing the mechanism by which this occurred."

The compounds used in the study are often called Yamanaka factors after the Japanese scientist who discovered them. Yamanaka factors are a combination of proteins (called transcription factors) that control how DNA is copied for translation into other proteins. In lab research, they are used to convert specialized cells, like skin cells, into more stem-cell-like cells that are pluripotent, which means they have the ability to become many different types of cells.

"Our laboratory previously showed that these factors can rejuvenate cells and promote tissue regeneration in live animals," says first author Chao Wang, a postdoctoral fellow in the Izpisua Belmonte lab. "But how this happens was not previously known."

Muscle regeneration is mediated by muscle stem cells, also called satellite cells. Satellite cells are located in a niche between a layer of connective tissue (basal lamina) and muscle fibers (myofibers). In this study, the team used two different mouse models to pinpoint the muscle stem-cell-specific or niche-specific changes following addition of Yamanaka factors. They focused on younger mice to study the effects of the factors independent of age.

In the myofiber-specific model, they found that adding the Yamanaka factors accelerated muscle regeneration in mice by reducing the levels of a protein called Wnt4 in the niche, which in turn activated the satellite cells. By contrast, in the satellite-cell-specific model, Yamanaka factors did not activate satellite cells and did not improve muscle regeneration, suggesting that Wnt4 plays a vital role in muscle regeneration.

According to Izpisua Belmonte, who holds the Roger Guillemin Chair, the observations from this study could eventually lead to new treatments by targeting Wnt4.

"Our laboratory has recently developed novel gene-editing technologies that could be used to accelerate muscle recovery after injury and improve muscle function," he says. "We could potentially use this technology to either directly reduce Wnt4 levels in skeletal muscle or to block the communication between Wnt4 and muscle stem cells."

The investigators are also studying other ways to rejuvenate cells, including using mRNA and genetic engineering. These techniques

CHEMWATCH
Bulletin Board
Curiosities
OCT. 22, 2021

could eventually lead to new approaches to boost tissue and organ regeneration.

Other authors included: Ruben Rabadan Ros, Paloma Martinez Redondo, Zaijun Ma, Lei Shi, Yuan Xue, Isabel Guillen-Guillen, Ling Huang, Tomoaki Hishida, Hsin-Kai Liao, Concepcion Rodriguez Esteban, and Pradeep Reddy of Salk; Estrella Nunez Delicado of Universidad Catolica San Antonio de Murcia in Spain; and Pedro Guillen Garcia of Clinica CEMTRO in Spain.

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https://www.thebrighterside.news

Thousands of California worms wriggles into super blobs

2021-10-15

It wriggles. It squirms. It moves like some sort of multi-tentacled horror from the black lagoon. It's … a blob of blackworms. And just in time for Halloween!

California blackworms (Lumbriculus variegatus) are a species of unassuming aquatic worm that typically grow no more than about 1.5 inches (4 centimeters) long. But when threatened by environmental stressors — such as drought — these worms braid themselves together into masses to preserve moisture and protect one another. That's creepy enough, but these masses can also move in a form of what researchers call "emergent locomotion." No one's in charge, but the worm blobs can still steer themselves to more comfortable environments simply by dint of each worm's interactions with their nearest neighbors.

Now, researchers have figured out that the worms pull this off with a carefully calibrated mix of wiggliness and clinginess.

"We found there is a very fine balance required," said Chantal Nguyen, a postdoctoral researcher at the BioFrontiers Institute of the University of Colorado Boulder.

The results could be used to develop soft, swarm-like robotics with many small, simple parts that work together.PLAY SOUND

That's creepy enough, but these masses can also move in a form of what research-ers call "emergent locomotion.

Blob of worms

Lots of different kinds of worms cluster together for safety when their environment becomes hostile (take a peek at any composting blog for more on earthworm "balling"). But few are documented to move as one when they're in these clusters. California blackworms can mass together by the thousands, though, and the resulting blobs seem to have a mind of their own, according to research published in February in the journal Proceedings of the National Academy of Sciences. That research found that blobs of blackworms essentially act like a non-Newtonian fluid, or a fluid that changes thickness depending on the amount of stress it's under. (The classic kitchen concoction of this fluid involves a mixture of cornstarch and water, which feels solid if you squeeze it suddenly and liquid if you run a finger through it slowly.) In other words, a whole bunch of worms clinging tightly to each other act a bit like a solid, but if they loosen up a bit, they're kind of like a liquid.

Nguyen joined the Georgia Tech researchers Yasemin Ozkan-Aydin and M. Saad Bhamla, who led that study, in order to model the movement of these worm blobs.

"It looks really cool to see just this giant blob of these worms kind of sliding around," Nguyen said. She had been working on modeling collective systems, so the opportunity to apply that work to the worms seemed intriguing.

First, the research team conducted experiments on individual worms to see how they moved in different water temperatures. This was to gather real-world worm movement data into their eventual computer model. In water of 86 degrees Fahrenheit (30 degrees C) or lower, the worms were prone to explore. They typically set out in a straight line until they hit the wall of the dish they were in, and then nosed around the edge. Above 86 F, the worms coiled up and moved about very little. Temperatures of over 93.2 F (34 C) proved dangerous — and eventually fatal — to the living worms.

Next, the researchers studied how real worm blobs reacted in different temperatures. At low temperatures of 50 F (10 C) and lower, the worms clung to each other in a tight mass. At 77 F (25 C), they relaxed a bit into a loose mass, but stayed together. At high temperatures near the edge of survivability, they quickly disentangled into individual coils.

Model worms

CHEMWATCH
Bulletin Board
Curiosities
OCT. 22, 2021

The researchers then used these behaviors to create a computer model of worms that could bend, self-propel and interact with one another. The model was in two-dimensions, not three, so it wasn't precisely representative of blackworm blobs, Nguyen said; — in deep enough water, the blobs can be spherical. But the researchers were able to find that a mixture of self-propelled wriggling and wormy clinginess was able to reproduce the kind of motion seen in real worm blobs. The researchers created a temperature gradient in their virtual worm world so that one side of the model worm-blob enclosure was cooler than the other. They first simulated a single worm and found that the automatic movements of the worm in different temperatures led to the worm "finding" the cool side: In cooler waters, the worms straightened out and crawled forward, creating a sort of feedback loop such that the cooler the enclosure was, the more the worm could direct its movement straight ahead.

The researchers then simulated a worm blob. They found that the blobs, too, tended to move to cooler waters. But to do so, they had to wiggle just enough to move without breaking apart their congregation.

"Only for a very fine balance between the active forces and the attraction between worms were we able to see the worm blob move as a collective from the hot to the cold," Nguyen said.

The next step is to make the model 3D, Nguyen said, and then to start developing robots based on the worms' weird movements. The robotics field has a lot of interest in swarm robots, which are simple individual robots that interact with one another to complete more complex tasks than they could do on their own. There is also a lot of interest in soft robots inspired by nature. Thanks to their pliability and flexibility, soft robotics are promising technology for biomedicine, Nguyen said. The worm blobs combine both swarm robotics and soft robotics, she said.

"A lot of current swarm robotic systems consist of rigid elements," she said, "and thus soft swarm robotics is very much an open field of research."

The findings appeared Sept. 30 in the journal Frontiers in Physics.

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Earth is reflecting less light. It's not clear if that's a trend.

2021-10-14

The amount of sunlight that Earth reflects back into space — measured by the dim glow seen on the dark portions of a crescent moon's face — has decreased measurably in recent years. Whether the decline in earthshine is a short-term blip or yet another ominous sign for Earth's climate is up in the air, scientists suggest.

Our planet, on average, typically reflects about 30 percent of the sunlight that shines on it. But a new analysis bolsters previous studies suggesting that Earth's reflectance has been declining in recent years, says Philip Goode, an astrophysicist at Big Bear Solar Observatory in California. From 1998 to 2017, Earth's reflectance declined about 0.5 percent, the team reported in the Sept. 8 Geophysical Research Letters.

Using ground-based instruments at Big Bear, Goode and his colleagues measured earthshine — the light that reflects off our planet, to the moon and then back to Earth — from 1998 to 2017. Because earthshine is most easily gauged when the moon is a slim crescent and the weather is clear, the team collected a mere 801 data points during those 20 years, Goode and his colleagues report.

Much of the decrease in reflectance occurred during the last three years of the two-decade period the team studied, Goode says. Previous analyses of satellite data, he and his colleagues note, hint that the drop in reflectance stems from warmer temperatures along the Pacific coasts of North and South America, which in turn reduced low-altitude cloud cover and exposed the underlying, much darker and less reflective seas.

"Whether or not this is a long-term trend [in Earth's reflectance] is yet to be seen," says Edward Schwieterman, a planetary scientist at University of California, Riverside, who was not involved in the new analysis. "This strengthens the argument for collecting more data," he says.

Decreased cloudiness over the eastern Pacific isn't the only thing trimming Earth's reflectance, or albedo, says Shiv Priyam Raghuraman, an atmospheric scientist at Princeton University. Many studies point to a long-term decline in sea ice (especially in the Arctic), ice on land, and tiny pollutants called aerosols — all of which scatter sunlight back into space to cool Earth.

Whether the decline in earthshine is a short-term blip or yet another ominous sign for Earth's climate is up in the air, scientists suggest.

CHEMWATCH
Bulletin Board
Curiosities
OCT. 22, 2021

With ice cover declining, Earth is absorbing more radiation. The extra radiation absorbed by Earth in recent decades goes toward warming the oceans and melting more ice, which can contribute to even more warming via a vicious feedback loop, says Schwieterman.

Altogether, Goode and his colleagues estimate, the decline in Earth's reflectance from 1998 to 2017 means that each square meter of our planet's surface is absorbing, on average, an extra 0.5 watts of energy. For comparison, the researchers note in their study, planet-warming greenhouse gases and other human activity over the same period boosted energy input to Earth's surface by an estimated 0.6 watts of energy per square meter. That means the decline in Earth's reflectance has, over that 20-year period, almost doubled the warming effect our planet experienced.

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Raptors rather than rodenticide

2021-10-12

Laura Echávez is perched precariously atop a 16-foot ladder next to a slender pole that is supporting a wooden box the size of a carry-on suitcase. She thrusts her hand inside the box, wriggling fingers through owl pellets, feathers, and fragments of eggshells heaped inches thick. A white fluff-ball of a barn owl chick tries to grab her gloved hand while its mother and siblings hiss a staticky barrage of white noise. When Echávez ventures a peek inside, she is hit by a salvo of bones and dried owl poo from defensive birds. And the smell? "Like cat urine," Echávez says.

Her plunge into the dim domain of this barn owl family is hands-on science. Echávez, Samantha Chavez, and Jaime Carlino, all graduate students at Humboldt State University, are spending morning after morning monitoring barn owl nest boxes scattered throughout the sun-drenched vineyards of Napa Valley. The data they are collecting will not only deepen our understanding of how these birds, in their role as natural predators of rodents, contribute to reducing the environmental footprint of the $9.4 billion industry that has made Napa Valley an internationally known wine region. It will also help determine how vineyard nest boxes are affecting barn owls.

"It's not just a pest control service, like a transactional thing," says Matt Johnson, a Humboldt State wildlife professor who is supervising the multiyear research program.

"It's not just a pest control service, like a transactional thing," says Matt Johnson, a Humboldt State wildlife professor who is supervising the multiyear research program.

Rodent pests have been a problem for crop-growers since Neolithic farmers pioneered planting wheat, millet, and spelt, and humans have been teaming up with raptors to hunt small prey for thousands of years. More recently, the "if you build it, they will come" idea has persuaded Malaysians to erect barn owl nest boxes on palm oil plantations, Kenyan maize farmers to install nest boxes and raptor perches, and Israelies to put 1,500 nest boxes in agricultural fields as part of a national program. Over the last two decades, farmers throughout the United States have increasingly turned to raptors to reduce the rodents that damage their crops.

Managing pests is a primary challenge facing California's vintners. Winegrape growers in Napa Valley launched their own raptor pest control efforts in the 1980s, when decades of using commercial fertilizer and a nothing-but-grapes monoculture began catching up with them: having long touted the particular taste of their wines and their unique connection to the land, vintners were realizing their beloved terroir had acquired a toxic taint. Replacing pesticides with barn owls for rodent control was one of several innovations that marked a new appetite for more environmentally sustainable production. Many growers have also begun planting perennial grasses between rows; some are experimenting with reduced or no tilling and no water.

Today, owl boxes rise out of row after row of vineyards like skinny sentinels protecting precious purple gems. In a survey of 75 California vintners, four-fifths say they use the boxes and are convinced that owls help to control rodents, Johnson says. He wanted to know how and how much, so he launched a series of scientific studies in 2015 to determine where owls hunt in vineyard areas, how many rodents they remove, and whether they are actually reducing pesticide use.

Echávez, Chavez, and Carlino are the most recent cohort to monitor as many as 280 nest boxes at the edges of 65 vineyards owned or managed by 15 different groups. At the end of each month, the researchers and volunteers look inside each box via GoPro cameras atop extendable poles. The adult owls will be weighed, measured, photographed, and banded.

"The funnest part is taking their photo" and seeing the variation in plumage, says Carlino.

CHEMWATCH
Bulletin Board
Curiosities
OCT. 22, 2021

Barn owls, the researchers have learned, are not exactly finicky, but they have decided tastes: wooden boxes placed at least three meters high facing away from the sun. They also strongly prefer some uncultivated grassland and avoid nest boxes near forests, according to published studies.

And they eat rodents — voraciously. During the four-month nesting season, when the Napa barn owls spend roughly one-third of their time hunting in the vineyards, a single family gobbles up about 1,000 rodents. Another study estimated a family eats an average of 3,400 annually. At that rate, a farmer with 20 nest boxes can expect barn owls to remove about 70,000 rodents from the vineyard and surrounding landscape. Gophers, mice, and voles are their main prey. Johnson's team found preliminary evidence that owls reduce the gopher but not the mouse population. The data so far are inconclusive for voles.

That still leaves the question of whether barn owls actually affect the amount of pesticides winegrape growers use to reduce the damage done by rodents gnawing on vineyard roots and vines. "It's really the bottom line," Johnson says.

In the past, many California vintners have relied heavily on rodenticides that kill animals by inhibiting clotting and coagulation, ultimately leading to uncontrolled internal bleeding. Under a law that went into effect January 2021, the California Department of Pesticide Regulation severely limits rodenticide use, placing a statewide moratorium on use of the super-toxic poisons that kill birds and other wildlife up the food chain along with their intended targets.

Most of the farmers included in Johnson's research project no longer use rodenticides. Among Napa Valley growers there is clear awareness of the risks and consequently very limited use of high-risk rodenticides, says Anna Brittain, executive director of Napa Green, a nonprofit that facilitates sustainability and climate action certification for wineries and vineyards in Napa County. Of the county's 40,000 acres of vineyards, about 3,800 acres are organic, a certification that prohibits using synthetic chemicals.

A trend toward chemical-free farming statewide is reflected in the threefold increase of organic winegrape acreage since 2005. Napa County represents 18 percent of the total. But while the number of California's organic vineyard acres has doubled in just the last decade, it remains a mere 3.5 percent of the land in the state planted with winegrapes. And even organic certification does not mean the growers do not use some rodenticides. The January bill includes a loophole that exempts all

agricultural users, says Lisa Owens Viani, co-founder and executive director of Raptors Are the Solution (RATS), a San Francisco–area nonprofit that won a David versus Goliath battle through the rodenticide moratorium.

Scientists do not know "for sure" whether owls are reducing pesticide use, Johnson says. A 2019 survey of winegrape growers throughout California found that about 80 percent used barn owl nest boxes, 50 percent used kill traps for rodents, and 21 percent used rodenticides. Farmers with barn owl nest boxes reported using rodenticides at a lower rate than those who did not use barn owl boxes.

"Whether the use of barn owl boxes caused that reduction in rodenticides is, of course, not proven. Nonetheless, this result is encouraging," Johnson says.

Elsewhere, owls and other raptors have confirmed their value as pest controllers. Tasked with protecting its county's 47 miles of dirt levees and 56 dams from burrowing rodents, the Ventura County Watershed Protection Department tested replacing anticoagulant rodenticides with raptors. That strategy proved so successful that the department has stopped using these poisons altogether. Fourteen experimental perches attracting hawks, owls, and other raptors have expanded to 293, says David Torfeh, an environmental scientist with the department. He estimates the cost savings at around $218,600 per channel mile over 30 years. Other studies have documented the cost of barn owl predation at 26 cents per rodent versus trapping at $8.11 per rodent.

Johnson has been wondering how harnessing raptors for pest control affects the birds themselves. Napa's barn owl nest boxes offer an opportunity to demonstrate that people and nature depend on each other—"that there's an essential reciprocal relationship," he says.

His research suggests that rodenticides do not deter owls from occupying nest boxes. That means owls are not avoiding areas with some rodenticide use, so they could be subjected to sublethal effects. A UC Davis team studying such raptors on farms found a relatively low exposure rate in barn owls; the poisons only last in the blood for a couple of weeks, however, so actual exposure could be higher than measured. It's unclear whether the finding is a result of limited interaction between raptors and rodents that have ingested rodenticides or simply of low rodenticide use in the raptors' foraging areas, says Breanna Martinico, a graduate researcher with the project. Over 20 percent of the juvenile red-tailed hawks the team studied in wintertime had been exposed to one or several rodenticide

CHEMWATCH
Bulletin Board
Curiosities
OCT. 22, 2021

compounds. Understanding exposure levels is important because it can affect the health and behavior of these raptors, Martinico says.

Most farmers feel a strong connection to the land and want to do things that improve it. "If putting up owl boxes can help these birds, and if the barn owls are helping control rodents, well that's even better," Johnson says.

It's unlikely that barn owls nesting in vineyard boxes will be the silver bullet that completely eliminates rodenticides in Napa Valley, but the data Echávez, Chavez, and Carlino are gathering is pinpointing just how barn owls are contributing. And it's driving a better understanding of the benefits to birds, making the wine we drink—red or white—just a little greener.

If you've seen just one owl, it's likely to be a common barn owl (Tyto alba). Impossibly cute, with a white heart-shaped face and dark, deep-set eyes, this mid-size owl is the most widely distributed species of owl in the world and one of the most widespread of all species of birds.

Barn owls are the undisputed grand champions of gopher gobbling. A single family in a California vineyard eats 3,400 rodents in a year, most of them voles, mice, and pocket gophers. Imagine the consumption worldwide, when you consider that barn owls are found on every continent except Antarctica. Then there's the mound of pellets at the base of nest boxes—the Tootsie Roll–size wads of fur and bone owls cough up after a hearty rodent meal.

Credit their anatomy for their prowess as hunters. Barn owl eyes are directed in front of the head, giving them depth of focus. The owls' sensitive hearing is enhanced by facial feathers, which form a concave ruff that acts as a reflector, directing sound into the ears. As with other owls, their wing feather design allows the movement of air through them to be silent.

"So armed, it's little wonder that the Barn Owl has been so successful," writes Paul Ehrlich, co-author of The Birder's Handbook.

That success has benefited farmers around the world, who have had a big impact on where these owls hunt. "You can literally put a barn owl nest box in the exact location where you think you have a problem with the small mammals, and voilà! The owls will start using that area," says John C. Robinson, a Bay Area–based ornithologist.

The barn owl's common name reflects this species' willingness to perform ecosystem services for humans. It has also prompted a facetious trope: "Imagine how excited Barn Owls were when humans invented barns." In fact, barn owls have been around for millions of years, barns a mere several thousand. These birds were known in ancient Hebrew as tinshemet, which isonomatopoeic for their heavy breathing and hooting. Their pre-human nest sites include tree holes, caves, and dirt banks.

Another survival mechanism: Barn owls can't count, so when John Comisky, with Napa Wildlife Rescue, finds a chick out of a nest box, he can return it to a family with chicks of a comparable age and the parents will accept it. You could call barn owls mathematically illiterate. Or you could credit them with an open-minded hospitality that sustains their species.

Few birds more powerfully evoke a longing to fly than red-tailed hawks (Buteo jamaicensis). Soaring above open fields, turning in slow, easy circles on broad, rounded wings, these birds are one of the largest many of us will see in North America. Along with the majesty of their effortless orbits, the redtail can kite, holding still against the wind on wings that span four feet.

That's part of what makes these birds such prodigious hunters. They fly high, using eyes as much as eight times more powerful than humans' to spot their quarry. They depend on gophers, voles, mice, and the occasional rabbit for the bulk of their diet. A study in Ventura County found that red-tailed hawks are the most common predators of the rodents burrowing into the dams and levees that protect public safety.

Despite an imposing hooked beak, it is talons that are redtails' primary weapon. They grab their prey with their feet, extending long legs to protect their head and body while piercing their victim with long, penetrating claws. Once the prey is dead, the first part of it down the hawk's hatch is the head. When prey is abundant, the hawks will sometimes eat only the heads, Robinson says.

For all their fierce predation, red-tailed hawks engage in a spectacular courtship ritual that begins with wide, elegant circles. Then the male dives steeply before shooting skyward at an angle nearly as sharp. After a few swoops, the male will fly down to the female, extend his legs, and quickly touch her. Occasionally, the pair will hold talons and fly in fast circles toward the ground before parting.

Let's be clear: Western bluebirds (Sialia mexicana) do not eat gophers. Not even voles or mice. But bluebirds will eat grasshoppers and caterpillars;

CHEMWATCH
Bulletin Board
Curiosities
OCT. 22, 2021

beetles, bugs, and ants; wasps, flies, termites, and scale insects. They catch them on the ground or in the air, on leaves and on stems.

Bluebirds are among the scores of birds that serve farmers as pest eradicators while satisfying their own needs. The overwhelming majority of songbirds are beneficial to agriculture during nesting season because they feed pest insects to their voracious nestlings, writes Jo Ann Baumgartner, executive director of the Wild Farm Alliance, in a guide to pest-controlling birds for farmers. Like raptors, which farmers have employed for millennia as ecosystem supporters, insect-eating birds can help reduce the need for chemical pesticides.

Scientists have found that adding nest boxes to vineyards almost quadrupled the abundance of insect-eating avian species. The density of Western bluebirds alone increased tenfold where boxes were added, and the species richness of avian insectivores increased by over 50 percent. A 2011 study found 2.4 times more beet armyworms removed in vineyards with bluebird nest boxes than in those without. The rate of larval removal averaged 3.5 times greater with occupied boxes than unoccupied.

How do we know this is bluebirds at work? "We collect bird poop and scan it to see what they're eating," Julie A. Jedlicka, author of the study, published in the scientific journal PLOS ONE, told SF Gate.

This species is declining, and scientists think they know why. Western bluebirds nest in tree cavities, relying on woodpeckers and other species with better-equipped bills to do the drilling for them. Logging and conversion of forests to other uses have diminished their habitat. So have vineyards, where expansion has contributed to the conversion of over a million acres of California oak woodlands and savannas. Audubon's climate model forecasts a 64 percent loss of current winter range by 2080.

Western bluebirds weigh less than an ounce, but their power as ecosystem supporters packs a wallop. And their happiness quotient? Incalculable.

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Their life is unlike any other known jaguar population's existence in the world.

Huge numbers of fish-eating jaguars prowl Brazil's wetlands

2021-10-13

In a tract of central Brazilian wetlands, jaguars spend their days wading through chest-deep waters searching for fish. When not hunting, the big cats playfully grapple with each other back on land. Their life is unlike any other known jaguar population's existence in the world.

New findings reveal a degree of flexibility in diet and lifestyle previously unseen among jaguars. The discovery may provide key context on the cats' role in food webs, helping scientists better understand the effect of environmental changes on the species, researchers report October 6 in Ecology.

Jaguars (Panthera onca), which are usually territorial loners that hunt on land, live in a wide array of habitats, ranging from North American deserts to grasslands and tropical rainforests in Central and South America. The cats are also found in the Pantanal, an immense tropical wetland — the largest of its kind in the world — that sprawls over parts of Brazil, Bolivia and Paraguay.

Ecologists Manoel dos Santos-Filho of the Universidade do Estado de Mato Grosso in Cáceres, Brazil, and Carlos Peres of the University of East Anglia in Norwich, England, knew of rumors of large numbers of jaguars sighted near Brazil's Taiamã Ecological Station. That large ecological reserve is located in the remote, northern reaches of the Pantanal.

After relaying these anecdotes to Taal Levi, a wildlife ecologist at Oregon State University in Corvallis, the researchers started a project to better understand the jaguars' biology and population status in the protected area.

Taiamã is seasonally flooded, with no roads or trails, so the team had to access the reserve by boat, setting up motion-activated cameras along waterways to gather data on jaguar numbers. The area's abundance of jaguars, however, was obvious immediately.

"You set your foot out of the boat, and there's a jaguar footprint there already," says Charlotte Eriksson, a wildlife scientist also at Oregon State University. "There are scratches on trees. There are jaguar scats. There's just an unbelievable presence of this apex predator wherever you go, which is something I've never experienced anywhere before."

CHEMWATCH
Bulletin Board
Curiosities
OCT. 22, 2021

The team deployed 59 cameras, which operated from 2014 to 2018, and collected more than 1,500 videos of jaguars. The researchers also captured 13 jaguars and fitted them with GPS or radio-tracking collars to gain insight into the animals' population density, movements and social interactions.

Based on their data, Eriksson and colleagues estimate that the Taiamã Ecological Station hosts the highest density of jaguars ever recorded: 12.4 animals per 100 square kilometers, nearly triple some of the next highest estimates elsewhere. Jaguars were also the most common mammal spotted on the cameras.

Video footage showed jaguars carrying off large fish. When the team analyzed 138 scat samples, the researchers found 46 percent had fish remains in them and 55 percent contained aquatic reptiles, such as caiman or turtles. Just 11 percent contained mammal remains.

In Brazil's Taiamã Ecological Station, jaguars (Panthera onca) were filmed fishing together in flooded wetlands, carrying off freshly caught fish and playing with each other on land. Elsewhere, the big cats are thought to be territorial loners that hunt mainly on land.

Jaguars are well-documented in taking on challenging prey, including underwater fare (SN: 7/15/16). Eriksson and her team think that the Taiamã felines have not only the most fish-dependent diet among jaguars, but also among all big cats. There are tigers in Bangladesh that live in flooded mangrove forests and sometimes eat fish, but those cats still primarily eat land-based food, the researchers say.

The cameras and tracking collars also showed that the Taiamã jaguars were spending a lot of time near each other, sometimes traveling, fishing and playing together. This is all exceptionally odd behavior for jaguars, at least based on what scientists know about the cats elsewhere in the world.

In terms of social behavior, "what we knew of jaguars from before this study is basically that they are solitary, and they meet up to mate. And that's about it," Eriksson says, noting anecdotes of the cats sharing prey carcasses as rare counterexamples.

The profusion of aquatic prey in the flooded preserve — protected from human encroachment — may be responsible for the jaguars' superlative density and their rich social lives. It's possible there's so much food available, Eriksson says, that there is "no real need to fight over it."

Another idea is that aquatic prey concentrated along the river margins are accessible in only certain areas, Levi says. This may encourage jaguar territories to dissolve, since obtaining access to multiple fishing spots requires getting along with other jaguars. Other animals behave in similar ways. Brown bears, for example, congregate in great numbers to feed at salmon spawning grounds, despite the bears' typically solitary nature, Levi says.

The abundance of jaguars and their social behavior is not surprising, given the available food resources, says Todd Fuller, a conservation biologist at the University of Massachusetts Amherst. Still, he finds the new information exciting.

Fuller, who was not involved with the research, says the study helps bring researchers' understanding of jaguars' ecology and conservation closer to what's known about most other large cat species, and "that is a very good thing."

Jaguars in the Pantanal face many threats and are declining within Brazil, Eriksson says, suffering from drought, fire and agricultural expansion. Evaluating how jaguars might respond to such changes is paramount. In 2020, half of the study area burned, so Eriksson is currently assessing the impact of the fires on the jaguars and their periodically submerged home.

She also wants to investigate how the Taiamã jaguars' taste for fish is affecting how often the animals eat land-living prey and what strategies the cats use to catch fish.

"We think we know a lot about these charismatic, large predators," she says, "but there are still things to learn."

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What happened when the dinosaur-killing asteroid slammed into Earth?

2021-10-17

Hidden below the waters of the Gulf of Mexico, the Chicxulub crater marks the impact site of an asteroid that struck Earth 66 million years ago. The most consequential outcome of this cataclysmic event was the fifth mass extinction, which wiped out about 80% of all animal species, including the nonavian dinosaurs.

By studying the geology both at Chicxulub and worldwide, scientists have pieced together what happened that terrible day and the years following it. PLAY SOUND

CHEMWATCH
Bulletin Board
Curiosities
OCT. 22, 2021

But what really happened when the asteroid collided with Earth?

By studying the geology both at Chicxulub and worldwide, scientists have pieced together what happened that terrible day and the years following it. PLAY SOUND

Even before the asteroid hit, it was primed for decimation, colliding with Earth at the most destructive angle, according to a 2020 study published in Nature Communications. The asteroid was about 7.5 miles (12 kilometers) in diameter and was traveling about 27,000 mph (43,000 km/h) when it created a 124-mile-wide (200 km) scar on the planet's surface, said Sean Gulick, a research professor at the University of Texas Institute for Geophysics, who led the study. More importantly, the asteroid struck the planet at about 60 degrees above the horizon. This angle was particularly destructive because it allowed the asteroid's impact to eject a large amount of dust and aerosols into the atmosphere.

Gulick pointed to his colleague's evidence in the region to support the simulations for the angled hit, including the asymmetrical structure of the crater, the position of upwarped (bent upward) mantle rocks, the unique sediment sequences in cores gathered from the region and, in particular, the absence of a distinct type of rock, called evaporites, in the cores, like halite and gypsum.

Gulick's team estimated that the impact would have vaporized the evaporite rocks, sending 325 gigatons of sulfur in the form of sulfur aerosols, as well as 435 gigatons of carbon dioxide, into the atmosphere.

The material thrown into the atmosphere consisted largely of pulverized rock and droplets of sulfuric acid, which came from sulfate-rich marine rocks, known as anhydrite, that vaporized during the asteroid strike, according to a 2014 study published in the journal Nature Geoscience. This cloud of microscopic material created a shroud around the planet, reducing incoming solar heat and light. The resulting long-term cooling drastically altered the planet's climate. A 2016 study in the journal Geophysical Research Letters found that the average temperature in the tropics plummeted from 81 degrees Fahrenheit (27 degrees Celsius) to 41 F (5 C). As incoming sunlight dimmed, photosynthesis waned and the base of the food chain on land and in the ocean collapsed, bringing down the dinosaurs and many other animals.

Meanwhile, the airborne sulfuric acid led to lethal acid rain that rained for days following the impact, killing countless marine animals living in the upper parts of oceans, as well as in lakes and rivers, the 2014 study found.

The impact also triggered massive tsunamis, shallow water waves that propagated through Earth's oceans. The wave initially reached nearly 1 mile (1.5 km) high and traveled 89 mph (143 km/h), and other waves reached massive heights, including up to 46 feet (15 m) in the Atlantic Ocean and 13 feet (4 m) in the North Pacific Ocean, according to modeling research. What's more, depositional evidence from the massive waves is preserved in the sediment record around Louisiana. A 3D seismic survey of the geology under Louisiana revealed long, asymmetrical 52-feet-tall (16 m) mega ripples that point back to the impact site in the Gulf.

And fires raged

The pulverized rock and ash cascading back to the surface after the impact also ignited a series of wildfires that researchers likened to a broiler igniting dry tinder. The additional smoke and ash likely contributed to the cooling shroud, further reducing incoming sunlight.

It's easy for geologists to see when the asteroid hit when they examine rock layers; in rocks around the world dating to the end of the Cretaceous period 66 million years ago, there's a thin layer of clay enriched with iridium, an element rare on Earth but common among space rocks, a landmark 1980 study published in the journal Science found. But while other spectacular events, including wildfires and tsunamis, capture the imagination, Gulick believes the bigger deal was changes in Earth's atmosphere, where the ghastly shroud led to cooling that lasted for more than a decade.

"The only way to make a mass extinction event is to mess with something that affects the entire planet," he said. "Here you have direct evidence of that happening."

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Another global pandemic is spreading—among pigs

2021-10-12

A DISEASE OUTBREAK blossoms in China. Exactly how it emerges, far from the eyes of any surveilling scientist, no one can quite explain. It spreads with incredible speed, killing in wide swaths, freezing transport and trade, and causing vast economic disruption. Hitchhiking on global travel, it

There is no cure, and no vaccine.

CHEMWATCH
Bulletin Board
Curiosities
OCT. 22, 2021

circles the world. There is no cure, and no vaccine. Inevitably, it arrives in the Americas, in July 2021.

Yup, 2021. The year is not a typo. This outbreak isn't Covid; it is a parallel, hidden pandemic, a deadly animal disease called African swine fever that was detected in the Dominican Republic in July. African swine fever poses no risk to humans, but it is incredibly destructive to livestock: Those deaths in China were millions of pigs, at least one-quarter—and possibly one-half—of the entire herd of the world's largest pork producer.

In the United States, animal health authorities are now on high alert. The US Department of Agriculture has pledged an emergency appropriation of $500 million to ramp up surveillance and keep the disease from crossing borders. African swine fever is so feared internationally that, if it were found in the US, pork exports—worth more than $7 billion a year—would immediately shut down.

"Long-distance transboundary spread of highly contagious and pathogenic diseases is a worse-case scenario," Michael Ward, an epidemiologist and chair of veterinary public health at the University of Sydney, told WIRED by email. "In agriculture, it's the analogue of Covid-19."

As with the Covid pandemic at its start, there is no vaccine—but also as with Covid, there is the glimmer of hope for one, thanks to basic science that has been laying down findings for years without receiving much attention. Two weeks ago, a multinational team led by scientists at the USDA's Agricultural Research Service announced that they had achieved a vaccine candidate, based on a weakened version of the virus with a key gene deleted, and demonstrated its effectiveness in a field trial, in pigs, in Vietnam.

The vaccine candidate is being developed by a commercial partner, a Vietnamese company called Navetco, on a timeline that isn't yet clear. It's the fifth experimental vaccine developed by the USDA team. (The first four are being developed by private companies without further federal involvement.) "As far as we know, we have the most advanced African swine fever vaccine in the process of commercialization," says Douglas Gladue, a microbiologist who is one of the developers.

To step back a bit: African swine fever is a longtime agricultural foe. Though it devastated China's pork industry, China isn't the disease's place of origin. The story of African swine fever actually does begin in Africa, almost exactly 100 years ago.

A Scottish veterinarian named Robert Eustace Montgomery, who was working for the British colonial government in East Africa, published the first description of it, in September 1921. Montgomery reported outbreaks of a hemorrhagic illness in farm pigs that was so destructive "an owner … must be prepared for a practically total loss," he wrote.

The new disease, caused by a virus, became a regular companion to farming in East Africa. Wild swine and warthogs harbor it and periodically spread it to livestock; so do certain species of ticks that feed on swine. The symptoms were always the same: Pigs would develop fevers, lose their appetites, develop bleeding under their skin and in their internal organs, and collapse. Whenever an outbreak flared, it either burned through a herd and killed all the pigs or was quenched when farmers slaughtered their pigs to stop it. The first farmers to observe the disease found that nothing could prevent it other than keeping pigs confined instead of letting them roam free, and building fences strong enough to keep wild swine out.

Once the virus was discovered, agriculture experts assumed the main route of transmission was direct contact, a healthy pig being exposed to a sick one's body fluids and feces. But the disease's first appearance in Europe showed that proximity wasn't the only risk. In 1957, crews cleaning an airplane that had traveled from Africa to Lisbon threw out leftover in-flight meals. The food went into the airport's garbage dump, and a herd of feral pigs invaded it. Among the food was ham sandwiches. The outbreak that erupted after the pigs ate the sandwiches showed for the first time that the virus also could travel in pork, even if it had been cooked or cured.

If that sounds like a formidable pathogen—yes, that's right. Portugal snuffed out that 1957 outbreak, but the disease kept being transported from East Africa into Europe. Research showed that the virus could remain stable in the environment, outside a pig's body, and could cling to clothing and farm equipment and contaminate dried feed, which is traded around the world.

That might help explain how it leapfrogged such long distances: It arrived in the Republic of Georgia in 2007 and then moved through the Caucasus and into Asia. It landed in China, the home of 45 percent of all the world's pigs, in 2018. In one year, according to a paper published in September in Nature Food, it killed or caused the slaughter of more than 43 million pigs, costing China more than $111 billion.

Those numbers—which are much larger than the Chinese central government ever admitted to—were tallied before the Covid-19 pandemic

CHEMWATCH
Bulletin Board
Curiosities
OCT. 22, 2021

began to chill world trade. But the researchers say the disease continues to simmer in China. They predict that if the country cannot get it under control, a further outbreak could cost more than 1 percent of its annual gross domestic product, almost $200 billion.

And now the disease is in the Americas, on the doorstep of the US. African swine fever has been in this hemisphere once before, with terrible consequences. In 1983, it appeared in Haiti, possibly due to an accidental importation from Brazil. To shut that outbreak down, the US and the Organization of American States forced the slaughter of all the swine in Haiti, taking away a crucial underpinning of its fragile rural economy and extirpating its treasured, locally adapted Creole pig. That 1983 slaughter demonstrated that African swine fever isn't just a profound animal disease; it also is an agent of severe economic damage. It cripples farms and also undermines rural economies.

This time, the disease has been found in multiple locations in the Dominican Republic and was identified in Haiti in September. If it comes to the US, its arrival and the measures needed to control it would threaten feed sales, equipment leases, truck transport, slaughterhouses, and the social fabric of small towns.

"The US is the largest pork exporter in the world," says Andres Perez, a veterinary epidemiologist and director of the Center for Animal Health and Food Safety at the University of Minnesota. "If African swine fever were to enter the US, there would be an extreme impact on the economy of a number of states. That is why it should be a concern for the public."

If the disease were detected in the US, the USDA would oversee comprehensive animal slaughter—delicately called "depopulation"—at the farm where it was found, ones nearby, and also farms that had any contact with the first farm via movement of people, trucks, rented-equipment operators, or field reps. At the same time, the agency would order a "national movement standstill" of all swine in the US (and even swine semen being shipped somewhere) for at least 72 hours. Depending on the location, the agency might also send out teams to hunt feral hogs that might be involved.

Because those measures would be so dire, the USDA already is imposing the preventions it is legally allowed. The US had previously forbidden importation of pork from Haiti and the Dominican Republic because of concerns over other animal diseases. Now it is also blocking importation of any pigs, tissue, or semen, and pork or pork byproducts, from the US territories of Puerto Rico and the US Virgin Islands, which are close to Haiti.

(The disease has not been detected in either territory.) That's in addition to putting strict new controls on rescue animals—dogs, for instance—being brought into the country from places where African swine fever is extant, a loophole that had infuriated North Carolina hog producers two years ago when Chinese strays were adopted into their state.

The challenge, says Raymond Robert Rowland, head of the department of pathobiology at the University of Illinois College of Veterinary Medicine, is that African swine fever—known to veterinarians as ASF—is a disease spread by movement. And as Covid demonstrated, the world is more linked by international movement than it has ever been. So a person who walks through a farm, stockyard, or abattoir where African swine fever is present could pick up the virus on their shoes or clothing and carry it with them as they fly across the world.

That might be the pathway African swine fever followed to reach the Caribbean this time—but, Rowland points out, the transfer may have occurred in other ways. "Where do people come from to vacation in the Caribbean?" he asks. "Name a country in the world: Eastern Europe, China, Africa, all areas that have ASF. You can easily think of a scenario where someone brings in a contaminated product, discards it into compost or garbage, and feral pigs come along and pick it up."

There are more sinister avenues by which the disease could be imported, through criminality instead of carelessness. In 2019, port authorities seized more than 1 million pounds of pork products that were being smuggled into the US, in 50 shipping containers packed with laundry detergent, in order to bypass agricultural controls. The products came from China, and they were shipped out just as African swine fever was hitting its peak there. That may have been the largest pork interdiction at US borders, but it's far from the only one: Pork is the single most-seized food item at airports and land crossing, according to an analysis of customs data that Bon Appetit conducted in 2014.

Pork that gets nabbed at the border (random examples: ham sandwiches in 2016, sausages in 2018, bologna in 2019 and this year) is incinerated. But pork that isn't detected, and gets discarded in the US—to evade detection, or maybe just because it's gone bad—could spark a chain of infection here. Analysts are convinced the vast expansion of African swine fever in China was triggered by feeding pigs swill, an industry term for a mix of discarded human food, cooked and raw food-waste garbage, used cooking oil, and abattoir leftovers such as guts and bones. That same practice, known in this country as "garbage feeding," is legal in 27 states.

CHEMWATCH
Bulletin Board
Curiosities
OCT. 22, 2021

All of which makes it clear how vital achieving a vaccine against the disease will be. Dozens of approaches have been tried over the years, but the research announced by the USDA in September appears the closest to making that hope into reality. (The four other candidates from the same research team are being developed by companies that have not disclosed what progress they have made.) This version was developed by deleting a gene in the virus that had not previously been characterized but turned out to code for how virulent the disease is. With that gene deleted, the virus was attenuated—or weakened—and was administered as a vaccine. It created immunity in all members of the small group of pigs that received it.

Many steps lie ahead, but as the Covid pandemic demonstrated, public health emergencies can force pharmaceutical innovation. It would be good for the pigs of the world—and for biosecurity and the food supply—if this animal health emergency could do the same.

wired.com, 12 October 2021

https://www.wired.com

Nostalgia may have bona fide benefits in hard times, like the pandemic

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Over 300 years ago, Swiss physician Johannes Hofer observed disturbing behaviors among Swiss mercenaries fighting in far-flung lands. The soldiers were prone to anorexia, despondency and bouts of weeping. Many attempted suicide. Hofer determined that the mercenaries suffered from what he called "nostalgia," which he concluded was "a cerebral disease of essentially demonic cause."

Nowadays, nostalgia's reputation is much improved. Social psychologists define the emotion — which Hofer saw as synonymous with "homesickness" — as a sentimental longing for meaningful events from one's past. And research suggests that nostalgia can help people cope with dementia, grief and even the disorientation experienced by immigrants and refugees (SN: 3/1/21).

Nostalgia may even help people cope with the COVID-19 pandemic. In a study published September 8 in Social, Psychological and Personality Science, researchers found when some lonely, unhappy people reminisced about better, pre-pandemic moments, they felt happier. The results

"A good analogy is the immune system," says social psychologist Tim Wildschut of the University of Southampton in England.

suggest that nostalgia can serve as an antidote to loneliness during the pandemic, the researchers conclude.

"A good analogy is the immune system," says social psychologist Tim Wildschut of the University of Southampton in England. "A viral infection may make you ill, but it also activates your immune system and your immune system makes you better. Loneliness reduces happiness but also triggers nostalgia, and nostalgia increases happiness."

In the new study, Wildschut and colleagues first surveyed over 3,700 participants in the United States, United Kingdom and China to assess people's levels of loneliness, nostalgia and happiness during the early days of the pandemic. Surveys varied slightly by country, but for most questions or statements, participants responded on a scale from 1 to 7, with 1 for "not at all" and 7 for "very much." For instance, participants in the United States rated how isolated they felt from the rest of the world in the week prior to the survey, how happy they felt compared with their peers and their overall feelings of nostalgia.

The researchers found that across the three countries, people who scored relatively high in loneliness also, not surprisingly, scored lower in happiness. But when the team drilled down on the role nostalgia plays, they found people who didn't indulge in those memories were the least happy.

"Loneliness [triggers] unhappiness and nostalgia. Then unhappiness and nostalgia fight with each other," says coauthor Constantine Sedikides, a social psychologist also at the University of Southampton.

Meanwhile, in three experiments with new sets of U.S. participants, the researchers manipulated people's nostalgia levels, using the spring 2020 lockdown as a proxy for heightened loneliness. For example, in one experiment conducted in April 2020, the researchers recruited just over 200 online participants. The team induced nostalgia in half the participants by having them write four words describing a specific nostalgic event from their past. Participants were then prompted to write freely for three minutes about how that past experience made them feel. People in the control group completed the same tasks but about ordinary past experiences.

Those experiments revealed that, compared with the control group, participants in the nostalgia group reported slight but statistically significant higher happiness levels, as measured by the same 1-7 scale used in the earlier surveys. For instance, in the experiment with the 200-

CHEMWATCH
Bulletin Board
Curiosities
OCT. 22, 2021

plus participants, the researchers found that happiness scores in the nostalgia group averaged 5.64 compared with 5.3 in the control group. Statistical analysis suggests that nostalgia can explain about 2 percent of the variation in happiness, the researchers say.

Those results may sound trivial, but even small variations can yield large results when viewed across large populations or across time, says personality psychologist Friedrich Götz of the University of British Columbia in Vancouver.

"Let's say you are a happy person every day of your life. Chances are you will have a more fulfilled life than if you are a less happy person," Götz says. "So 2 percent can make a difference because our happiness influences how we act, feel and think every day of our lives."

Nostalgia booster

Early in the pandemic, researchers tested the impact of nostalgia on happiness. Volunteers were asked to call up a special memory and spend three minutes writing about it. When asked to rate their happiness on a scale of 1 to 7, this group scored slightly higher than volunteers in the control group who were asked to think about an ordinary memory (Time 1). A day or two after the original experiment, researchers asked participants in the nostalgia group to think about their memory again. That "nostalgia booster" once again prompted higher happiness scores (Time 2).

The hope that nostalgia-induced happiness could build up over time underpins some researchers' long-term goal of harnessing and deploying techniques to trigger nostalgic memories as a form of therapy. Nostalgia can connect people to their past, present and even desired future selves, these researchers say. And since many nostalgic memories often involve other people, they can also help people feel linked to a wider community.

In one study, for example, existential psychologist Clay Routledge and colleagues tapped nostalgia's social side. Participants first completed an established "nostalgia inventory," where they rated on a scale from 1 to 5 how nostalgic they felt about 20 aspects of their past lives, such as family and vacations. The researchers then asked people about the types of studies that they might want to participate in later on. Two of those potential studies involved meeting other participants while two others did not.

Participants reporting high levels of nostalgia, especially those nostalgic for social experiences, were more likely than other participants to select the studies that involved meeting new people, the researchers reported in the December 2015 Journal of Personality and Social Psychology. That suggests that proneness to remembering meaningful past social experiences engenders future social experiences, the team says.

"Nostalgia isn't just people remembering time with loved ones," says Routledge, of North Dakota State University in Fargo. "It's orienting them toward building new social experiences."

A key question, though, is if nostalgia's benefits can persist beyond that fleeting moment of remembrance. Wildschut's team found that nostalgia's benefits, in terms of happiness, faded after just a day or two. But nostalgia-induced happiness persisted for a couple days when the researchers reminded people to think about that special memory.

Crucially, nostalgia therapy may not be for everyone. Researchers reported in October 2019 in Personality and Individual Differences that invoking nostalgia in individuals who viewed relationships as a source of comfort and security increased those people's intention to engage with others. The reverse, however, held true for individuals who saw relationships as a source of pain.

"For these types of avoidant people … nostalgia pushed them in the opposite direction. They were even less likely to want to connect with others on a deeper level," says existential and social psychologist Andrew Abeyta of Rutgers University–Camden in New Jersey.

Wildschut and colleagues found a similar result when investigating whether invoking nostalgia among Syrian refugees living in Saudi Arabia could increase self-esteem, sense of meaning in life, feelings of social belonging and optimism.

In that study, refugees in an experimental group wrote about meaningful events from their past, while refugees in a control group wrote about ordinary events. The experiment showed that triggering nostalgia in refugees high in resilience — a trait defined by a capacity to withstand and recover from adversity — resulted in more positive emotions than those reported by resilient refugees in a control group, the team concluded in the December 2019 European Journal of Social Psychology. But while inducing nostalgia in refugees low in resilience did help them feel a greater sense of continuity in life and more socially connected compared

CHEMWATCH
Bulletin Board
Curiosities
OCT. 22, 2021

with a low-resilience control group, nostalgic memories also made them feel less optimistic about the future.

"When you push the test of nostalgia to those extremes, it's a very, very tough test," Wildschut says.

Caveats aside, Wildschut remains optimistic about developing some form of nostalgia therapy. He recalls a conversation with his young daughter many years ago. When he asked her how long nostalgia lasts, she replied "forever," Wildschut says. "What she meant is that the memory is there, and you can recall it any time." Ultimately, he and other nostalgia researchers hope to one day identify suitable candidates for nostalgia therapy and then train those people to recall special memories whenever they feel blue.

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https://www.sciencenews.org

Why did more than 90 rattlesnakes move into a California home?

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A homeowner in California got a surprise after calling a reptile rescue to handle a few rattlesnake sightings in their home: They were sharing their space with at least 92 of the snakes.

Sonoma County Reptile Rescue director Al Wolf pulled 22 adult rattlesnakes and 59 babies from the house's foundations, and later returned to remove 11 more. The area was ideal for rattlesnake denning, Wolf told the Santa Rosa Press-Democrat, because most of the rocks in the ground had been left in when the home's foundation was dug. Wolf released the snakes in an area away from human habitation.

The foundations may have been a rookery, or a place where rattlesnakes gather in large numbers to give birth, said Emily Taylor, a herpetologist at California Polytechnic State University in San Luis Obispo, who also does rattlesnake relocations. That would explain the large number of babies, Taylor told Live Science. However, the choice of a home's foundations for a rookery is surprising, she said.

"It's not typical in California at low elevations to have that many snakes, and it's definitely not typical for them to be under a home," she said. PLAY SOUND

"It's not typical in California at low elevations to have that many snakes, and it's definitely not typical for them to be under a home," she said. PLAY SOUND

A nursery for snakes

The snakes were northern Pacific rattlesnakes (Crotalus oreganus), which are found in much of the western United States and western Canada. Rattlesnakes give live birth. Sometimes females find an abandoned rodent hole and give birth alone, Taylor said; other times, they gather in rookeries. These rookeries are more common in higher elevations, she said, where there are fewer warm dens available for the snakes. But otherwise, it's not really clear why some snakes choose rookeries and others go it alone. Perhaps, snakes that gather at rookeries are related, Taylor said, and they are cooperating to give their young a better shot at survival.

"Research has shown that the females will sometimes babysit for one another," she said, with one mom staying with the baby snakes while another mom goes off to hunt.

Researchers used to think that snake mamas raised their babies for about two weeks, before the young snakes shed their skin for the first time and set out on their own. But Taylor's research suggests snake motherhood is more complicated. This summer, she set up the first livestream of a rattlesnake rookery, and the initial observations hint that the moms and babies may come and go over a longer period. In a study area near Steamboat Springs, Colorado, where Taylor and her colleagues also observe rattlesnakes, the babies are born in August and stay with their mothers through the winter, while hibernating. In that population, the babies don't head out alone until spring.

"Rattlesnakes are much more complicated than we ever thought before," Taylor said.

Snake relocation services

Most of the snakes removed from the Sonoma County home were "mellow," Wolf told the Press-Democrat. In general, rattlesnakes prefer to steer clear of humans, Taylor said. They avoid high-traffic areas and will attempt to flee before they try to bite.

"Rattlesnakes generally tend to be very secretive and do not want to encounter people and are only going to bite a person or a pet if they feel like their life is at risk," Taylor said.

Rattlesnakes do, however, often find a comfortable habitat near humans, who tend to settle near water and shade and attract rodents, she said. California's recent periods of drought have brought snakes into yards, where sprinkler systems provide a water source.

CHEMWATCH
Bulletin Board
Curiosities
OCT. 22, 2021

The snakes in the foundation of the home were probably trying to keep to themselves, Taylor said, though if a homeowner had cornered them unexpectedly or stepped on a basking snake, there could have been a risk of a bite. Rattlesnake venom contains neurotoxins, which attack the nervous system, and hemotoxins, which break down the blood; but they are mostly hemotoxins. These hemotoxins cause the tissue to break down around the bite and can cause heavy bleeding, or hemorrhage. Other symptoms include pain, labored breathing, nausea, vomiting and a rapid or weak pulse. Antivenom can help treat the bite and limit the damage, if given within a few hours. According to the Centers for Disease Control and Prevention, between 7,000 and 8,000 people are bitten by venomous snakes of any species in the United States each year, and five of those individuals die.

It was once typical for homeowners to kill rattlesnakes on their property, but humans are increasingly recognizing that sudden death isn't the best way to deal with these snakes, Taylor said. In most regions, there are paid services or volunteers who will relocate snakes instead of killing them. One resource is the Free Snake Relocation Directory, which contains contact information for volunteer snake relocators around the United States.

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CHEMWATCH

Bulletin Board

Technical Notes

OCT. 22, 2021

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

CHEMICAL EFFECTS

EF24 exerts cytotoxicity against NSCLC via inducing ROS accumulation

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ENVIRONMENTAL RESEARCH ASSOCIATIONS BETWEEN PERSISTENT ORGANIC POLLUTANTS AND ENDOMETRIOSIS: A MULTIBLOCK APPROACH INTEGRATING METABOLIC AND CYTOKINE PROFILING

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Trans-disciplinary diagnosis for an in-depth reform of regulatory expertise in the field of environmental toxicology and security

OCCUPATIONAL

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PHARAMACEUTICAL/TOXICOLOGY

Overview of the Mechanisms of Action of Selected Bisphenols and Perfluoroalkyl Chemicals on the Male Reproductive Axes