CHEMWATCH

Bulletin Board

Contents

AUG. 27, 2021

(click on page numbers for links)

CONTACT US

subscribers@chemwatch.net
tel +61 3 9572 4700
fax +61 3 9572 4777

1227 Glen Huntly Rd
Glen Huntly
Victoria 3163 Australia

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CHEMWATCH

Bulletin Board

Contents

AUG. 27, 2021

CURIOSITIES

TECHNICAL NOTES

CHEMWATCH

Bulletin Board

Regulatory Update

AUG. 27, 2021

ASIA PACIFIC

DAWE consultation on proposed agvet chemical legislation changes 27 August

2021-08-18

The Department of Agriculture, Water and the Environment's (DAWE) consultation on proposed changes to regulations for agricultural and veterinary (agvet) chemicals closes 27 August 2021.

For more information about the proposed changes and how to make a submission, visit Have Your Say.

Questions about the proposed changes can be directed to agvetreform@agriculture.gov.au(link sends e-mail).

Read More

APVMA, 18 August 2021

https://apvma.gov.au/node/89856

Indonesia: Minister of Trade imposes more restrictions on the import of finished products by manufacturers – is it time to restructure?

2021-08-18

The Ministry of Trade (MOT) has issued Minister of Trade Regulation No. 59 of 2020 ("Regulation 59") which is an amendment to Minister of Trade Regulation No. 118/M-DAG/PER/12/2015 on Import Provisions for Complementary Goods, Goods for the Purpose of Market Testing, and After-Sales Service ("Regulation 118").

Regulation 59 was issued to limit the number of industries allowed to import manufactured goods in the form of complementary goods, goods for the purpose of market testing and goods for after-sales service ("Goods"). By putting a limitation on the number of industries allowed to import Goods, Regulation 59 is expected to boost the local manufacturing sector, which has been affected by the coronavirus pandemic.

For instance, Regulation 59 categorizes companies that want to import Goods into sectors/subsectors. Under the previous regulation, there was no categorization of sectors/subsectors.

The Department of Agriculture, Water and the Environment's (DAWE) consultation on proposed changes to regulations for agricultural and veterinary (agvet) chemicals closes 27 August 2021.

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The above provision is one of the key highlights of Regulation 59. We will further elaborate on the differences between Regulation 59 and the previous regulation below.

Read More

Lexology, 18 August 2021

https://www.lexology.com/library/detail.aspx?g=5f19acc9-8643-4bc8-988f-600e747bdde2

Sri Lanka pledges no new coal, makes push into rooftop solar

2021-08-17

In its latest climate plan, Sri Lanka is ruling out new coal power and aiming to reach 70 percent clean electricity by 2030, an important milestone on its way to reaching its goal of a carbon-neutral electricity generation system by 2050, Climate Home News reported.

In 2019, 35 percent of Sri Lanka's electricity came from renewables, mostly hydropower, with the remainder of its electricity coming from oil and coal. The new push into renewables is motivated, in part, by a drive for energy independence, as Sri Lanka produces no oil or coal, Climate Home reported.

Sir Lanka currently has just one coal-fired power plant, built in 2006 with Chinese backing. Since coming online, the plant has been the subject of protests over air and water pollution. Sri Lanka had plans to build a second coal plant, with financing from India, but that project was torpedoed by a legal challenge in 2016.

The small island nation plans to meet its clean power goal by ramping up investment in rooftop solar, offering low-interest loans funded by a $50 million investment from the Asian Development Bank, Climate Home reported.

"These solar energy schemes have been implemented across industrial parks, as well, including large-scale roofs and households," Anoka Abeyrathne, director of the Colombo, Sri Lanka-based sustainability firm Aayusha Global, told Climate Home. "This makes financial sense for both corporates and households as the costs for energy is greatly reduced. In addition, solar power buy-back to the grid is encouraging more people to install solar systems as an additional revenue system."

In 2019, 35 percent of Sri Lanka's electricity came from renewables, mostly hydropower, with the remainder of its electricity coming from oil and coal.

CHEMWATCH
Bulletin Board
Regulatory Update
AUG. 27, 2021

Read More

Yale Environment 360, 17 August 2021

https://e360.yale.edu/digest/sri-lanka-pledges-no-new-coal-makes-push-into-rooftop-solar?utm_source=ActiveCampaign&utm_medium=email&utm_content=Climate+news%3A&utm_campaign=TDC+Daily

APVMA wraps up 2020-21 with high performance

2021-08-20

The Australian Pesticides and Veterinary Medicines Authority (APVMA) has finished 2020–21 with a performance high, finalising 94% of product, active and permit applications within timeframe, ahead of the 88% recorded in 2019–20.

This included significant improvements in overall timeframe performance for:

- pesticides applications, increasing from 92% in 2019–20 to 99% in 2020–21
- veterinary medicines applications, up from 89% in 2019–20 to 99% in 2020–21
- active constituent applications, increasing from 85% in 2019–20 to 96% in 2020–21.

The APVMA also demonstrated improvements in timeframe performance for major applications, with:

- 97% of applications requiring major assessment for pesticides completed within timeframe, up from 81% in 2019–20.
- 94% of applications requiring major assessment for veterinary medicines completed within timeframe, increasing from 78% in 2019–20.

The percentage of permit applications completed within timeframe decreased from 81% in 2019–20 to 74% in 2020–21. This was attributed to the APVMA dedicating more resources to support the timely processing of emergency use permits in response to pest incursions, including mice and fall armyworm.

APVMA Chief Executive Officer, Ms Lisa Croft, praised the efforts of APVMA staff for delivering continued improvements in timeframe performance to ensure Australians were provided with timely access to agricultural and veterinary (agvet) chemical products.

The percentage of permit applications completed within timeframe decreased from 81% in 2019–20 to 74% in 2020–21.

"Australian producers have faced many challenges this past year, including the continued effects of the COVID-19 pandemic, drought and outbreaks of mice, fall armyworm, khapra beetle and fruit fly.

"The APVMA has worked diligently to ensure the timely introduction of safe and effective agvet chemical products to the Australian market, as well as prioritising the issuing of emergency permits to support producers throughout the outbreaks of these pests."

View the 2020–21 performance overview and June quarter 2021 performance report.

Read More

APVMA, 20 August 2021

https://apvma.gov.au/node/89936

AMERICA

FDA adds 13 new substances to FCS inventory

YYYY-MM-DD

US Food and Drug Administration (FDA) adds 13 new entries to its Inventory of Effective Food Contact Substances (FCS)

On July 30, 2021, the US Food and Drug Administration (FDA) added 13 entries to its Inventory of Effective Food Contact Substance Notifications (FCNs). Food contact substances within the inventory "have been demonstrated to be safe for their intended use" but are only effective for the "manufacturer or supplier identified in the notification."

The new substances are included with the following FCN numbers:

2148: Magnesium sodium fluoride silicate (CAS 56450-90-9)

2142: Copolymer of styrene (CAS 100-42-5), methyl methacrylate (CAS 80-62-6), and glycidyl methacrylate (CAS 106-91-2). Replaces FCNs 853 AND 1109

2139: Zinc pyrithione (CAS 13463-41-7) Replaces FCN 2031

2138: Polyethylene terephthalate copolyesters (diethylene glycol-isophthalate modified) prepared by the condensation of dimethyl terephthalate or terephthalic acid and ethylene glycol with one or more

Food contact substances within the inventory "have been demonstrated to be safe for their intended use" but are only effective for the "manufacturer or supplier identified in the notification."

CHEMWATCH
Bulletin Board
Regulatory Update
AUG. 27, 2021

of the following: dimethyl isophthalate, isophthalic acid, and diethylene glycol

2120: Paraffin waxes and hydrocarbon waxes, oxidized (CAS 68153-22-0)

2137: Chromium nitride

2136: Polyethylene terephthalate-azelate copolyester resin (CAS 25609-72-7)

2133: Hypochlorous acid (CAS 7790-92-3)

2121: Octyltriethoxysilane-modified titanium dioxide

2130: Acetic acid ethenyl ester, polymer with N-ethenylformamide, hydrolyzed, amine-containing (CAS 163879-68-3)

2127: Poly(tetramethylene terephthalate)(CAS 24968-12-5 and 26062-94-2) as manufactured from terephthalic acid and 1,4-butanediol

2125: 1,6-Hexanediol (CAS 629-11-8)

2122: Styrene-maleic anhydride copolymer (CAS 9011-13-6)

Read More

Food Packaging Forum, 13 August 2021

https://www.foodpackagingforum.org/news/fda-adds-13-new-substances-to-fcs-inventory

ACGIH® will not proceed with TLV® for carbon nanotubes in 2022

2021-08-04

As reported in our January 4, 2021, blog item, the American Conference of Governmental Industrial Hygienists (ACGIH®) Threshold Limit Values for Chemical Substances (TLV®-CS) Committee included carbon nanotubes on its 2021 list of chemical substances and other issues under study. Being placed on the under study list indicated that the TLV®-CS Committee had selected carbon nanotubes for development of a threshold limit value (TLV®). ACGIH® has now released its two-tier under study list. Tier 1 lists the chemical substances and physical agents that may move forward as a notice of intended change (NIC) or notice of intent to establish (NIE) in the upcoming year, based on their status in the development process. Tier 2 consists of those chemical substances and physical agents that will not move forward, but will either remain on or be removed from the under

Being placed on the under study list indicated that the TLV®-CS Committee had selected carbon nanotubes for development of a threshold limit value (TLV®).

study list for the next year. Carbon nanotubes are included in Tier 2. If carbon nanotubes are included on the **2022** under study list, stakeholders will have an opportunity to submit substantive data and comments.

Read More

Nano and Other Emerging Chemical Technologies Blog, 4 August 2021

https://nanotech.lawbc.com/2021/08/acgih-will-not-proceed-with-tlv-for-carbon-nanotubes-in-2022/

A chemical fix: Polartec takes stand against toxic 'PFAS' treatments

2021-07-15

The textile manufacturer's decision to ditch PFAS will add to its sustainability portfolio and affect a wide range of brands.

In a move that will impact a massive swath of the outdoor industry, Polartec announced Wednesday it will fully eliminate PFAS (per- and polyfluoralkyl substances) from its DWR treatments. The change affects the brand's entire line of DWR performance fabrics and goes into effect immediately.

Its new, more sustainable treatment will be used in its Hardface, Power Shield, Power Shield Pro, NeoShell, and Windbloc products. The technology will also extend to fleece and insulation treatments on products like Thermal Pro and Alpha.

Polartec claims that introducing the alternative treatment will constitute no performance loss in its products' water repellency or durability. But while performance ramifications may be minimal, the overall effect in the industry will not.

Read More

Gear Junkie, 15 July 2021

https://gearjunkie.com/apparel/polartec-drops-pfas

EPA to block pesticides tied to neurological harm in children

2021-08-18

The Biden administration announced on Wednesday that it is banning a common pesticide, widely used since 1965 on fruits and vegetables, from

In a move that will impact a massive swath of the outdoor industry, Polartec announced Wednesday it will fully eliminate PFAS (per- and polyfluoralkyl substances) from its DWR treatments.

CHEMWATCH
Bulletin Board
Regulatory Update
AUG. 27, 2021

use on food crops because it has been linked to neurological damage in children.

The Environmental Protection Agency said this week it would publish a regulation to block the use of chlorpyrifos on food. One of the most widely used pesticides, chlorpyrifos is commonly applied to corn, soybeans, apples, broccoli, asparagus and other produce.

The new rule, which will take effect in six months, follows an order in April by the Ninth Circuit Court of Appeals that directed the E.P.A. to halt the agricultural use of the chemical unless it could demonstrate its safety.

Labor and environmental advocacy groups estimate that the decision will eliminate more than 90 percent of chlorpyrifos use in the country.

In an unusual move, the new chlorpyrifos policy will not be put in place via the standard regulatory process, under which the E.P.A. first publishes a draft rule, then takes public comment before publishing a final rule. Rather, in compliance with the court order, which noted that the science linking chlorpyrifos to brain damage is over a decade old, the rule will be published in final form, without a draft or public comment period.

Read More

New York Times, 18 August 2021

https://www.nytimes.com/2021/08/18/climate/pesticides-epa-chlorpyrifos.html

EUROPE

Consultation on proposed changes to the COMAH Regulations 2015

YYYY-MM-DD

HSE is currently carrying out a consultation exercise relating to administrative changes to the Control of Major Accident Hazards Regulations 2015 (COMAH) which are required because of the dissolution of Public Health England (PHE).

Please read below for further information.

CD290 - Consultation on proposed minor administrative changes to the Control of Major Accident Hazards Regulations 2015

Following consultation, HSE will make a recommendation to the Secretary of State on the best way forward.

HSE consults stakeholders to seek their views on its proposals. It believes that public consultation provides an open and transparent approach to its decision-making.

Following consultation, HSE will make a recommendation to the Secretary of State on the best way forward.

We encourage you to draw the attention of your stakeholders and other interested parties to this consultation which **closes at midnight on Friday 27 August**.

Comments should be submitted by using an online survey. This is the most effective way for us to fully consider and analyse responses.

Read More

HSE, 18 August 2021

https://content.govdelivery.com/accounts/UKHSE/bulletins/2ed41aa

Toxicological and chemical profiling of plastic migrates

2021-08-18

Scientific study investigates in vitro toxicity and composition of chemical mixtures migrating from everyday plastic products made of eight polymer types; demonstrates that thousands of chemicals can leach under realistic use conditions, including compounds toxic in vitro that contribute to human exposure; emphasizes the importance to rethink and redesign plastics to achieve safe materials.

In an article published online on August 17, 2021, in the peer-reviewed journal *Environmental Science and Technology*, Lisa Zimmermann and co-authors from the *Goethe University* and the *Institute for Social-Ecological Research* in Frankfurt am Main, Germany, as well as the *Norwegian University of Science and Technology*, Trondheim, Norway, reported on the chemicals migrating from 24 consumer plastics and their *in vitro* toxicity.

In a publication in 2018, the scientists demonstrated that methanolic extracts of plastics contain a wide variety of chemicals and are toxic *in vitro* (FPF reported). As a follow-up, their current study aimed to find out whether these mixtures also leach under realistic use. To this aim, they performed migration experiments with water according to EU regulation's experimental standards on plastic food contact materials (FCMs) and analyzed the migrates with four *in vitro* bioassays and nontarget high-resolution mass spectrometry (UPLC-QTOF-MSE).

The study results showed that all 24 samples induced baseline toxicity, 22 activated an oxidative stress response, 13 contained antiandrogenic compounds, and one sample contained estrogenic compounds.

CHEMWATCH
Bulletin Board
Regulatory Update
AUG. 27, 2021

The study results showed that all 24 samples induced baseline toxicity, 22 activated an oxidative stress response, 13 contained antiandrogenic compounds, and one sample contained estrogenic compounds. Comparing the eight different polymer types, including petroleum- and bio-based products, demonstrated that chemicals migrating from polyvinyl chloride (PVC) and polyurethane (PUR) articles were highly toxic. However, toxicity levels varied within one polymer type leading the authors to conclude that "the toxicity migrating from plastics is specific to the product rather than the polymer type." A comparison of the 12 FCMs with the 12 non-FCMs further showed that FCMs, although mores strictly regulated, have a similar potential to induce oxidative stress and baseline toxicity as non-FCMs. According to the article, this "underpins concerns over the adequacy of the traditional approach of assessing the safety of FCMs that prescribes to assess the migration of starting substances." Moreover, Zimmermann and colleagues compared the effects of migrates to the effects of methanolic extracts analyzed in their previous study. They found that the chemical mixtures migrating into water are generally less toxic than those extractable with methanol. However, some migrate samples induced a greater toxic effect than their corresponding extract.

Read More

Food Packaging Forum, 18 August 2021

https://www.foodpackagingforum.org/news/toxicological-and-chemical-profiling-of-plastic-migrates

INTERNATIONAL

How COVID-19 lockdowns and car-free days affected air pollution in Rwanda's capital

2021-08-12

Rising levels of vehicle traffic, industrial activity and urban sprawl are contributing to rising levels of air pollution across the global South. This is particularly the case in cities where urbanisation is progressing fastest.

In Kigali, the capital of Rwanda, the population has surged from less than 500,000 in 2000 to more than 1 million today. It is set to increase to nearly 2 million by 2030. At the same time, vehicle numbers in the city have increased from just 55,000 in 1999 to more than 200,000 in 2019.

In Kigali, the capital of Rwanda, the population has surged from less than 500,000 in 2000 to more than 1 million today.

Air pollution is the fourth highest risk factor for premature mortality worldwide. And there is growing recognition that even at relatively low levels air pollution can cause significant health impacts, such as heart attacks and strokes.

Fine particulate matter (PM2.5) – such as dust, dirt, soot, or smoke – is 70 times smaller than a human hair and is one of the most significant contributors to urban air pollution. In Kigali, the amount of PM2.5 in the air is approximately double the level deemed permissible by the World Health Organisation. This emphasises the need for action and the scale of the potential benefit to be achieved. A challenge, however, lies in a lack of analysis on the sources of air pollution and the opportunities for action.

Read More

The Conversation, 12 August 2021

https://theconversation.com/how-covid-19-lockdowns-and-car-free-days-affected-air-pollution-in-rwandas-capital-165675

CHEMWATCH
Bulletin Board

Applications for authorisation

2021-08-20

Consultations: 7

- Start date: 18/08/2021
- Deadline: 13/10/2021

Calls for comments and evidence

Substances: 2

- Start date: 18/08/2021
- Deadline: 29/09/2021

Restrictions

Consultations on SEAC draft opinion: 1

- Start date: 07/07/2021
- Deadline: 07/09/2021

Restriction proposals: 1

- Start date: 24/03/2021
- Deadline: 24/09/2021

Restriction proposals: 1

- Start date: 23/06/2021
- Deadline: 03/01/2022

Read More

ECHA, 20 August 2021

https://echa.europa.eu/consultations/current

Janet's Corner

AUG. 27, 2021

Dinosaurs in charge

2021-08-27

Paleontology texts have changed a lot since dinosaurs took over the school board.

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

CHEMWATCH
Bulletin Board

Hazard Alert

AUG. 27, 2021

Selenium

2021-08-27

Selenium is a chemical element with symbol Se and atomic number 34. [1] It is an odourless metalloid (an element which has both metallic and non-metallic properties). It can be a grey (the 'metallic' and most stable form), red or black solid. [2] In nature selenium is usually combined with sulphide minerals or with silver, copper, lead, and nickel. [3]

USES [4]

Selenium has good photovoltaic and photoconductive properties, and it is used extensively in electronics, such as photocells, light metres and solar cells. The second largest use of selenium is in the glass industry: selenium is used to remove colour from glass, to give a red colour to glasses and enamels. The third main use is sodium selenite for animal feeds and food supplements. In addition, selenium can find applications in photocopying, in the toning of photographs. Its artistic use is to intensify and extend the tonal range of black and white photographic images. Other uses of selenium are in metal alloys such as the lead plates used in storage batteries and in rectifiers to convert AC current in DC current. Selenium is used to improve the abrasion resistance in vulcanised rubbers. Some selenium compounds are added to anti-dandruff shampoos.

SOURCES & ROUTES OF EXPOSURE

Sources of Exposure [4]

Selenium exposure takes place either through food or water, or through contact with soil or air that contains high concentrations of selenium. The exposure to selenium mainly takes place through food, because selenium is naturally present in grains, cereals and meat. Humans need to absorb certain amounts of selenium daily, in order to maintain good health. Food usually contains enough selenium to prevent disease caused by shortages. Selenium uptake through food may be higher than usual in many cases, because in the past many selenium-rich fertilisers have been applied on farmland. In addition, people that live near hazardous waste-sites will experience a higher exposure through soil and air. Selenium from hazardous waste-sites and from farmland will end up in groundwater or surface water through irrigation. This phenomenon causes selenium to end up in local drinking water, so that exposure to selenium through water will be temporarily increased. People that work in metal industries, selenium-recovery industries and paint industries also tend to experience

Selenium is an odourless metalloid with the chemical symbol Se and the atomic number 34.

a higher selenium exposure, mainly through breathing. Selenium is released to air through coal and oil combustion. People that eat a lot of grains that grow near industrial sites may experience a higher exposure to selenium through food. Exposure to selenium through drinking water may be increased when selenium from hazardous waste disposals ends up in water wells. Exposure to selenium through air usually only occurs in the workplace.

Routes of Exposure [3]

- Inhalation (breathing) – Not a significant route of exposure for the general population, but is the primary route of exposure for selenium workers.
- Ingestion– Primary route of exposure for the general population via consumption of food.
- Dermal – Not a significant route of exposure to selenium.

HEALTH EFFECTS [5]

Acute Effects

Acute exposure of humans via inhalation to selenium compounds (selenium dioxide, hydrogen selenide) results primarily in respiratory effects. Acute inhalation exposure to elemental selenium dust results in irritation of the mucous membranes in the nose and throat, producing coughing, nosebleeds, dyspnea, bronchial spasms, bronchitis, and chemical pneumonia. Gastrointestinal effects including vomiting and nausea; cardiovascular effects; neurological effects such as headaches and malaise; and irritation of the eyes were reported in humans acutely exposed to selenium compounds via inhalation. Acute human exposure to selenium compounds via the oral route has resulted in pulmonary oedema and lesions of the lung; cardiovascular effects such as tachycardia; gastrointestinal effects including nausea, vomiting, diarrhoea, and abdominal pain; effects on the liver; and neurological effects such as aches, irritability, chills, and tremors. "Blind staggers" disease is a disease in livestock that results from acute consumption of plants high in selenium. It is characterised by impaired vision, aimless wandering behaviour, reduced consumption of food and water, and paralysis. Acute animal tests in rats, mice, and guinea pigs, have shown hydrogen selenide to have extreme toxicity from inhalation exposure, sodium selenite to have extreme toxicity from oral exposure, and elemental selenium to have low toxicity from oral exposure.

CHEMWATCH
Bulletin Board
Hazard Alert
AUG. 27, 2021

Chronic Effects

No information is available on the chronic effects of selenium in humans from inhalation exposure. In epidemiological studies of populations exposed to high levels of selenium in food and water, discoloration of the skin, pathological deformation and loss of nails, loss of hair, excessive tooth decay and discoloration, garlic odour in breath and urine, lack of mental alertness, and listlessness were reported. "Alkali disease" is a disease in livestock resulting from chronic consumption of high levels of selenium; it is characterised by hair loss, deformation and sloughing of the hooves, erosion of the joints of the bones, anaemia, and effects on the heart, kidney, and liver. EPA has not established a Reference Concentration (RfC) for selenium. The Reference Dose (RfD) for selenium is 0.005 milligrams per kilogram body weight per day (mg/kg/d) based on clinical selenosis in humans.

Selenium Deficiencies

Two diseases, "Keshan disease" and "Kashin-Beck disease" have been reported in humans in selenium-deficient populations in China. Keshan disease is characterised by heart failure, cardiac enlargement, abnormalities of EKG, and cardiogenic shock. Kashin-Beck disease, which occurs primarily in children between the ages of 5 and 13 years, is characterised by atrophy, degeneration, and necrosis of cartilage tissue. Some epidemiological studies have suggested that selenium deficiency may contribute to cardiovascular disease in humans. However, these studies are inconclusive due to confounding factors.

Reproductive/Developmental Effects

No information is available on the developmental or reproductive effects of selenium in humans. The consumption of high levels of selenium in the diet by pigs, sheep, and cattle has been shown to interfere with normal foetal development and to produce foetal malformations. Sodium selenate, administered in the drinking water to mice, did not result in birth defects, but did result in an increased incidence of foetal deaths and a high proportion of runts, while chronic exposure of mice to selenium in the diet has been shown to affect their fertility and to reduce the viability of the offspring of pairs that are able to breed.

Cancer Risk

In one study of workers exposed to selenium (form not specified) over a 26-year period, no statistically significant increase in cancer deaths

was reported. Human studies have reported that patients with cancer, particularly gastrointestinal cancer, prostate cancer, or Hodgkin's lymphoma, had significantly lower selenium levels in the blood than healthy patients. Epidemiological studies that used the selenium concentration in crops as an indicator of dietary selenium have generally reported an inverse association between selenium levels and cancer occurrence. Animal studies have reported that selenium supplementation, as sodium selenate, sodium selenite, and organic forms of selenium, results in a reduced incidence of several tumour types. The only selenium compound that has been shown to be carcinogenic in animals is selenium sulphide, which resulted in an increase in liver tumours in rats and mice and lung tumours in female mice from oral exposure. Selenium sulphide is a pharmaceutical compound used in anti-dandruff shampoos and is very different than the inorganic or organic selenium compounds found in foods and the environment. EPA has classified elemental selenium as a Group D, not classifiable as to human carcinogenicity, and selenium sulphide as a Group B2, probable human carcinogen.

SAFETY [6]

First Aid Measures

- Eye Contact: Check for and remove any contact lenses. Do not use an eye ointment. Seek medical attention.
- Skin Contact: After contact with skin, wash immediately with plenty of water. Gently and thoroughly wash the contaminated skin with running water and non-abrasive soap. Be particularly careful to clean folds, crevices, creases and groin. Cover the irritated skin with an emollient. If irritation persists, seek medical attention. Wash contaminated clothing before reusing.
- Inhalation: Allow the victim to rest in a well-ventilated area. Seek immediate medical attention.
- Serious Inhalation: Evacuate the victim to a safe area as soon as possible. Loosen tight clothing such as a collar, tie, belt or waistband. If breathing is difficult, administer oxygen. If the victim is not breathing, perform mouth-to-mouth resuscitation. Seek medical attention.
- Ingestion: Do not induce vomiting. Loosen tight clothing such as a collar, tie, belt or waistband. If the victim is not breathing, perform mouth-to-mouth resuscitation. Seek immediate medical attention.

CHEMWATCH
Bulletin Board
Hazard Alert
AUG. 27, 2021

Exposure Controls & Personal Protection

Engineering Controls

Use process enclosures, local exhaust ventilation, or other engineering controls to keep airborne levels below recommended exposure limits. If user operations generate dust, fume or mist, use ventilation to keep exposure to airborne contaminants below the exposure limit.

Personal Protective Equipment

The recommended personal protective equipment includes:

- Splash goggles;
- Lab coat;
- Dust respirator (be sure to use an approved/certified respirator or equivalent);
- Gloves

Personal Protection in Case of a Large Spill:

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

REGULATION [2,6,7]

United States

- EPA Office of Drinking Water regulates the amount of selenium allowed in drinking water. Public water supplies are not allowed to exceed 50 ppb total selenium.
- FDA regulations allow a level of 50 ppb of selenium in bottled water.
- OSHA exposure limit for selenium compounds in the air for an 8-hour period is 0.2 mg selenium/m3.

Australia

- Australian Drinking Water Guidelines (NHMRC and ARMCANZ, 1996): Maximum of 0.01 mg/L
- Worksafe Australia has set the exposure standard for selenium compounds (excluding selenium hydride) to 0.2 milligram/m3 (TWA, as selenium). The exposure standard for selenium hydride and selenium hexafluoride is 0.05 ppm or 0.16 milligram/m3 (TWA, as selenium). Selenium and selenium compounds are classified as toxic by inhalation and if swallowed.

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The definition of planet is still a sore point—especially among Pluto fans

2021-08-24

For 76 years, Pluto was the beloved ninth planet. No one cared that it was the runt of the solar system, with a moon, Charon, half its size. No one minded that it had a tilted, eccentric orbit. Pluto was a weirdo, but it was our weirdo.

"Children identify with its smallness," wrote science writer Dava Sobel in her 2005 book The Planets. "Adults relate to its inadequacy, its marginal existence as a misfit."

When Pluto was excluded from the planetary display in 2000 at the American Museum of Natural History in New York City, children sent hate mail to Neil deGrasse Tyson, director of the museum's planetarium. Likewise, there was a popular uproar when 15 years ago, in August 2006, the International Astronomical Union, or IAU, wrote a new definition of "planet" that left Pluto out. The new definition required that a body 1) orbit the sun, 2) have enough mass to be spherical (or close) and 3) have cleared the neighborhood around its orbit of other bodies. Objects that meet the first two criteria but not the third, like Pluto, were designated "dwarf planets."

Pluto was a weirdo, but it was our weirdo.

Science is not sentimental. It doesn't care what you're fond of, or what mnemonic you learned in elementary school. Science appeared to have won the day. Scientists learned more about the solar system and revised their views accordingly.

"I believe that the decision taken was the correct one," says astronomer Catherine Cesarsky of CEA Saclay in France, who was president of the IAU in 2006. "Pluto is very different from the eight solar system planets, and it would have been very difficult to keep changing the number of solar system planets as more massive [objects beyond Neptune] were being discovered. The intention was not at all to demote Pluto, but on the contrary to promote it as [a] prototype of a new class of solar system objects, of great importance and interest."

For a long time, I shared this view. I've been writing about Pluto since my very first newspaper gig at the Cornell Daily Sun, when I was a junior in college in 2006. I interviewed some of my professors about the IAU's decision. One, planetary scientist Jean-Luc Margot, who is now at UCLA, called it "a triumph of science over emotion. Science is all about

recognizing that earlier ideas may have been wrong," he said at the time. "Pluto is finally where it belongs."

But another, planetary scientist Jim Bell, now at Arizona State University in Tempe, thought the decision was a travesty. He still does. The idea that planets have to clear their orbits is particularly irksome, he says. The ability to collect or cast out all that debris doesn't just depend on the body itself.

Everything with interesting geology should be a planet, Bell told me recently. "I'm a lumper, not a splitter," he says. "It doesn't matter where you are, it matters what you are."

Not everyone agrees with him. "Fifteen years ago we finally got it right," says planetary scientist Mike Brown of Caltech, who uses the Twitter handle @plutokiller because his research helped knock Pluto out of the planetary pantheon. "Pluto had been wrong all along."

But since 2006, we've learned that Pluto has an atmosphere and maybe even clouds. It has mountains made of water ice, fields of frozen nitrogen, methane snow–capped peaks, and dunes and volcanoes. "It's a dynamic, complex world unlike any other orbiting the sun," journalist Christopher Crockett wrote in Science News in 2015 when NASA's New Horizons spacecraft flew by Pluto.

The New Horizons mission showed that Pluto has fascinating and active geology to rival that of any rocky world in the inner solar system. And that solidified planetary scientist Philip Metzger's view that the IAU definition missed the mark.

"There was an immediate reaction against the dumb definition" when it was proposed, says Metzger, of the University of Central Florida in Orlando. Since then, he and colleagues have been refining their views: "Why do we have this intuition that says that it's dumb?"

Retelling the tale

It turns out that the "we just learned more" narrative isn't really true, Metzger says. Though the official story is that Pluto was reclassified because new data came in, it's not that simple. Teaching that narrative is bad for science, and for science education, he says.

The truth is, there's no single definition of a planet — and I'm beginning to believe that's a good thing.

For centuries, the word "planet" was a much more inclusive term. When Galileo turned his telescope at Jupiter, any largish moving body in the

CHEMWATCH
Bulletin Board
Gossip
AUG. 27, 2021

sky was considered a planet — including moons. When astronomers discovered the rocky bodies we now call asteroids in the 1800s, those too were called planets, at least at first.

Pluto was considered a planet from the very beginning. When Clyde Tombaugh, an amateur astronomer from Kansas newly recruited to the Lowell Observatory in Flagstaff, Ariz., spotted it in photos taken in January 1930, he rushed to the observatory director and declared: "I have found your Planet X."

The discovery was no accident. In 1903, U.S. astronomer Percival Lowell hypothesized that a hidden planet seven times the mass of Earth orbited 45 times farther from the sun. Lowell had searched for what he called Planet X until he died in 1916. The search continued without him.

The new planet was thought to be "black as coal, nearly as dense as iron, twice as dense as the heaviest earthly surface rocks," Science News Letter, the predecessor of Science News, reported in 1930.

Further research showed Lowell had grossly overestimated Pluto's mass: It's more like one five-hundredth the mass of Earth. Things got even weirder when scientists realized Pluto wasn't alone out there. In 1992, an object about a tenth the diameter of Pluto was found orbiting the sun "in the deep freeze of space well beyond the orbits of Pluto and Neptune," as Science News described it.

Since then, more than 2,000 icy bodies have been found hiding in that frigid zone dubbed the Kuiper Belt, and there are many more out there. Awareness of Pluto's neighbors brought new questions: What characteristics could unite these strange new worlds with the more familiar ones? And what sets them apart? With so many new objects coming into focus, there was a growing desire for a formal definition of "planet."

In 2005, Brown spotted the first of the Kuiper Belt bodies that seemed to be larger than Pluto. If Pluto was the ninth planet, then surely the new discovery, nicknamed Xena (in honor of the TV show Xena: Warrior Princess), should be the 10th. But if Xena was an icy leftover from the formation of the solar system undeserving of the "planet" title, so too was Pluto.

Tensions over how to categorize Pluto and Xena came to a head in 2006 at a meeting in Prague of the IAU. On the final day, August 24, after much acrimonious debate, a new definition of "planet" was put to a vote. Pluto

and Xena got the boot. Xena was aptly renamed Eris, the Greek goddess of discord.

Textbooks were revised, posters were reprinted, but many planetary scientists, especially those who study Pluto, never bothered to change. "Planetary scientists don't use the IAU's definition in publishing papers," Metzger says. "We pretty much just ignore it."

In part that might be cheek, or spite. But Metzger and colleagues think there's good reason to reject the definition. Metzger, Bell and others — including Alan Stern of the Southwest Research Institute, the planetary scientist who led the New Horizons mission and has argued since before the discovery of the Kuiper Belt that the solar system contains hundreds of "planets" — make their case in a pair of recent papers, one published in 2019 in Icarus and one forthcoming.

After examining hundreds of scientific papers, textbooks and letters dating back centuries, the researchers show that the way scientists and the public have used the word "planet" has changed over time, but not in the way most people think.

In and out

Consider Ceres, the first of what are now known as dwarf planets to be discovered. Located in the asteroid belt between Mars and Jupiter, Ceres was considered a planet after its 1801 discovery, too. It's often said that Ceres was demoted after astronomers found the rest of the bodies in the asteroid belt. By the end of the 1800s, with hundreds of asteroids piling up, Ceres was stripped of its planetary title thanks to its neighbors. In that sense, the story goes, Ceres and Pluto suffered the same fate.

But that's not the real story, Metzger and colleagues found. Ceres and other asteroids were considered planets, sometimes dubbed "minor planets," well into the 20th century. A 1951 article in Science News Letter declared that "thousands of planets are known to circle our sun," although most are "small fry." These "baby planets" can be as small as a city block or as wide as Pennsylvania.

It wasn't until the 1960s, when spacecraft offered better observations of these bodies, that the term "minor planets" fell out of fashion. While the largest asteroids still looked planetlike, most small asteroids turned out to be lumpy and irregular in shape, suggesting a different origin or different geophysics than bigger, rounder planets. The fact that asteroids didn't

CHEMWATCH
Bulletin Board
Gossip
AUG. 27, 2021

"clear their orbits" had nothing to do with the name change, Metzger argues.

And what about moons? Scientists called them "planets" or "secondary planets" until the 1920s. Surprisingly, it was nonscientific publications, notably astrological almanacs that used the positions of celestial bodies for horoscope readings, that insisted on the simplicity of a limited number of planets moving through the fixed sphere of stars.

Metzger thinks that older definition of a planet that included moons was forgotten when planetary science went through a "Great Depression" between about 1910 and 1950. So many asteroids had been discovered that searching for new ones or refining their orbits was getting boring. Telescopes weren't good enough to start exploring asteroids' geology yet. Other parts of space science were way more exciting, so attention went there.

But new data that came with space travel brought moons back into the planetary fold. Starting in the 1960s, "planet" reappeared in the scientific literature as a description for satellites, at least the large, round ones.

Real-world usage

The planet definition that includes certain moons, asteroids and Kuiper Belt objects has had staying power because it's useful, Metzger says. Planetary scientists' work includes comparing a place like Mars (a planet) to Titan (a moon) to Triton (a moon that was probably born in the Kuiper Belt and captured by Neptune long ago) to Pluto (a dwarf planet). It's scientifically useful to have a word to describe the cosmic bodies where interesting geophysics, including the conditions that enable life, occur, he says. There's all sorts of extra complexity, from mountains to atmospheres to oceans and rivers, when rocky worlds grow big enough for their own gravity to make them spherical.

"We're not claiming that we have the perfect definition of a planet and that all scientists ought to adopt our definition," he adds. That's the same mistake the IAU made. "We're saying this is something that ought to be debated."

A more inclusive definition of "planet" would also give a more accurate concept of what the solar system is. Emphasizing the eight major planets suggests that they dominate the solar system, when in fact the smaller stuff outnumbers those worlds tremendously. The major planets don't even stay put in their orbits over long time-scales. The gas giants have

shuffled around in the past. Teaching the view of the solar system that includes just eight static planets doesn't do that dynamism justice.

Caltech's Brown disagrees. Having the gravitational oomph to nudge other bodies in and out of line is an important feature of a world, he says. Plus, the eight planets clearly dominate our solar system, he says. "If you dropped me in the solar system for the first time, and I looked around and saw what was there, nobody would say anything other than, 'Wow, there are these eight — choose your word — and a lot of other little things.'"

Thinking of planets that way leads to big-picture questions about how the solar system put itself together.

One common argument in favor of the IAU's definition is that it keeps the number of planets manageable. Can you imagine if there were hundreds or thousands of planets? How would the average person keep track of them all? What would we print on lunch boxes? I'm not making fun of this idea; as an astronomy writer who has been obsessed with space since I was 8, I would be reluctant to turn people off to the planets.

But Metzger thinks teaching just eight planets risks turning people off to all the rest of space. "Back in the early 2000s, there was a lot of excitement when astronomers were discovering new planets in our solar system," he says. "All that excitement ended in 2006." But those objects are still out there and are still worthy of interest. By now, there are at least 150 of these dwarf planets, and most people have no clue, he says.

This is the argument I find most compelling. Why do we need to limit the number of planets? Kids can memorize the names and characteristics of hundreds of dinosaurs, or Pokémon, for that matter. Why not encourage that for planets? Why not inspire students to rediscover and explore the space objects that most appeal to them?

I've come to think that what makes a planet may just be in the eye of the beholders. I may be a lumper, not a splitter, too.

sciencenews.org, 24 August 2021

https://www.sciencenews.org

In all, the experiment, performed August 8, released about 70 percent of the energy of the laser light used to set off the fusion reactions, putting the facility much closer to ignition than ever before.

CHEMWATCH
Bulletin Board
Gossip
AUG. 27, 2021

With a powerful laser blast, scientists near a nuclear fusion milestone

2021-08-18

With a powerful laser zap, scientists have blasted toward a milestone for nuclear fusion.

A fusion experiment at the world's biggest laser facility released 1.3 million joules of energy, coming close to a break-even point known as ignition, where fusion begins to release more energy than required to detonate it. Reaching ignition would strengthen hopes that fusion could one day serve as a clean, plentiful energy source, a goal that scientists have struggled to make progress toward (SN: 2/8/18).

By pummeling a tiny capsule with lasers at the National Ignition Facility, or NIF, at Lawrence Livermore National Laboratory in California, scientists triggered fusion reactions that churned out more than 10 quadrillion watts of power over 100 trillionths of a second. In all, the experiment, performed August 8, released about 70 percent of the energy of the laser light used to set off the fusion reactions, putting the facility much closer to ignition than ever before.

Notably, because the capsule absorbs only a portion of the total laser energy focused on it, the reactions actually produced more energy than directly went into igniting them. "That, just fundamentally, is a truly amazing feat," says plasma physicist Carolyn Kuranz of the University of Michigan in Ann Arbor, who was not involved with the research. By that metric, the fusion reactions produced about five times as much energy as was absorbed.

"It's a really exciting result, and it wasn't clear that NIF would be able to get to this result," Kuranz says. For years, NIF scientists have strived to reach ignition, but they have been plagued with setbacks (SN: 4/4/13). While the new results have yet to be published in a scientific journal, NIF scientists went public with their discovery after word got out to the scientific community and excitement mounted.

"It makes me very hopeful … for fusion in the future," Kuranz says.

Nuclear fusion, the same process that powers the sun, would be an appealing source of energy on Earth because it checks several boxes for environmental friendliness: It wouldn't generate climate-warming greenhouse gases or dangerous, long-lived radioactive waste. In nuclear fusion, hydrogen nuclei meld together to form helium, releasing energy

in the process. But fusion requires extreme temperatures and pressures, making it difficult to control.

NIF is not alone in the fusion quest. Other projects, such as ITER, an enormous facility under construction in southern France, are using different techniques to tackle the problem (SN: 1/27/16). But those efforts have also met with difficulties. Perhaps unsurprisingly, controlling reactions akin to those in the sun is challenging no matter how you go about it.

In NIF's fusion experiments, 192 laser beams converge on a small cylinder containing a peppercorn-sized fuel capsule. When that powerful laser burst hits the cylinder, X-rays stream out, vaporizing the capsule's exterior and imploding the fuel within. That fuel is a mixture of deuterium and tritium, varieties of hydrogen that respectively contain one or two neutrons in their atomic nuclei. As the fuel implodes, it reaches the extreme densities, temperatures and pressures needed to fuse the hydrogen into helium. That helium can further heat the rest of the fuel, what's known as alpha heating, setting off a fusion chain reaction.

That last step is crucial to boosting the energy yield. "What's new about this experiment is that we've created a system in which the alpha heating rate is far larger than we've ever achieved before," says NIF physicist Arthur Pak.

Scientists navigated a variety of quagmires to get to this stage. "There's a whole host of physics issues … that we've faced off and mitigated," Pak says. For example, researchers took pains to make the capsule absorb more energy, to eliminate tiny defects in the capsule and to carefully tune the laser pulses to maximize fusion.

In 2018, researchers began seeing the payoff of those efforts. NIF achieved a then-record fusion energy of 55,000 joules. Then, in spring 2021, NIF reached 170,000 joules. Further tweaking the design of the experiment, scientists suspected, could increase the output even more. But the new experiment went beyond expectations, producing nearly eight times the energy of the previous effort.

Further studies will help NIF scientists determine exactly how their changes created such bountiful energy and how to enhance the output further. Still, even if NIF achieves full-fledged ignition, using fusion to generate power for practical purposes is still a long way off. "There will be a huge amount of work needed to turn the technology into a viable source of energy," says laser plasma physicist Stuart Mangles of Imperial College

CHEMWATCH
Bulletin Board
Gossip
AUG. 27, 2021

London, who was not involved with the research. "Nevertheless, this is a really important milestone on the way."

sciencenews.org, 18 August 2021

https://www.sciencenews.org

Lab-made mini brains grow their own sets of 'eyes'

2021-08-19

Scientists recently grew mini brains with their own sets of "eyes," according to a new study.

Organoids are miniature versions of organs that scientists can grow in the lab from stem cells, or cells that can mature into any type of cell in the body. Previously, scientists have developed tiny beating hearts and tear ducts that could cry like humans do. Scientists have even grown mini brains that produce brain waves like those of preterm babies.

Now, a group of scientists has grown mini brains that have something their real counterparts do not: a set of eye-like structures called "optic cups" that give rise to the retina — the tissue that sits in the back of the eye and contains light-sensing cells, according to a statement.

PLAY SOUND

In the human body, the retina sends signals to the brain via the optic nerve, allowing us to see images. "In the mammalian brain, nerve fibers of retinal ganglion cells reach out to connect with their brain targets, an aspect that has never before been shown in an in vitro system," senior author Jay Gopalakrishnan, a researcher at University Hospital Düsseldorf, said in the statement. (Ganglion cells are neurons located in the inner surface of the retina that communicate directly with the brain.)

Previously, researchers had grown optic cups individually in labs, but this is the first study that integrated optic cups into brain organoids, according to the statement.

Gopalakrishnan and his team adapted a technique they previously developed for turning stem cells into neural tissue in order to create the mini brains with optic cups. Once the stem cells had developed into mini brains, the organoids formed optic cups. The optic cups appeared as early as 30 days and matured within 50 days, a timeframe similar to how the retina develops in a human embryo, according to the statement.

Organoids are miniature versions of organs that scientists can grow in the lab from stem cells, or cells that can mature into any type of cell in the body.

In total, the researchers created 314 mini brains, and 72% of them formed optic cups. The organoids contained different types of retinal cells that formed active neuron networks that responded to light, according to the statement. The organoids also formed lens and corneal tissue.

"Our work highlights the remarkable ability of brain organoids to generate primitive sensory structures that are light sensitive and harbor cell types similar to those found in the body," Gopalakrishnan said in the statement.

Why are scientists growing mini brains like these in the lab? These organoids can be useful for studying human brain development and related diseases. Scientists could use the new organoids — with their optic cups — to study brain-eye interactions during embryo development, Gopalakrishnan said. What's more, they can be used to study retinal disorders and maybe even be used to create personalized retinal cell types for therapies.

The researchers now hope to figure out how to keep the optic cups viable for a long time and use them to research the mechanisms behind retinal disorders.

The findings were published Aug. 17 in the journal Cell Stem Cell.

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https://www.livescience.com

Massive volcanoes could cool Earth more in a warming world

2021-08-19

There are few forces on Earth more powerful than a large volcanic eruption. At their most potent, volcanoes inject millions of tons of Sun-blocking particles high into the atmosphere that can cool Earth for nearly 5 years, endangering crops and leading to "years without summer." The most recent, the Philippines's Mount Pinatubo eruption in 1991, caused a temporary 0.5°C drop in global temperatures.

Yet it's become increasingly clear that even these monumental forces are being altered by human-driven climate change. Declining ice cover can trigger more frequent eruptions near the poles, in Iceland and elsewhere. And an increasingly layered ocean will allow more volcano-induced cooling to linger at Earth's surface. Now, a new study suggests increased

The most recent, the Philippines's Mount Pinatubo eruption in 1991, caused a temporary 0.5°C drop in global temperatures.

CHEMWATCH
Bulletin Board
Gossip
AUG. 27, 2021

greenhouse gases will help the plumes from large eruptions reach higher, spread faster, and reflect more sunlight, causing more abrupt and extreme cooling.

Before humanity started in on its planet-altering course, volcanoes were one of the biggest climate players. Over the long term, they belched carbon dioxide from Earth's interior, causing warming. But in the short term, their sulfur gases often react with water to form highly reflective particles called sulfates, triggering spells of global cooling. Dark smudges of ash littering ice cores—our best evidence of these early eruptions—are a dim reflection of the wild weather left in their wake.

But the opposite is also true, it turns out: Climate can have a big impact on volcanoes. In the new study, Thomas Aubry, a geophysicist at the University of Cambridge, and colleagues combined computer simulations of idealized volcanic eruptions with a global climate model. They simulated the response to plumes released from midsize and large volcanoes both in historical conditions and by 2100, in a scenario when Earth is predicted to warm very rapidly.

The researchers found two countervailing trends. Normally just one or two midsize volcanic eruptions shoot through the troposphere each year, bypassing this cradle of Earth's weather to reach the stratosphere, the calm, dry zone above. As reflective particles spread through the stratosphere, they cause a small spurt of global cooling. But when the troposphere warms, it expands in height, eventually putting the stratosphere out of reach for these eruptions.

"It's as if regulation basketball hoops around the world were suddenly raised a few inches, making it that much harder to score," says Benjamin Black, a volcanologist at Rutgers University, New Brunswick, who is not affiliated with the study.

The story changes with Pinatubo-scale eruptions, however. In a world that warmed 6°C by 2100—an increase that matches only the most dire, and unlikely, projections of the latest Intergovernmental Panel on Climate Change report—the troposphere would grow 1.5 kilometers in height. But ultramassive eruptions would still be able to punch through to the stratosphere; what's more, their gases would actually reach higher and travel faster than in the present climate, amplifying their cooling effect by 15%, the researchers report this month in Nature Communications. The reasons why come down to the bizarro world that is the stratosphere, Aubry says.

As greenhouse gases trap heat near Earth's surface, the stratosphere is cooling, especially in its upper layers. That lets air mix more easily up and down in this layer of the atmosphere. By 2100, this mixing should help volcanic plumes travel about 1.5 kilometers higher than before, according to the team's model. In addition, warming will accelerate the stratosphere's primary wind pattern, causing the reflective volcanic particles to spread more quickly throughout the upper atmosphere to the poles, before they have time to coalesce into larger particles. And the smaller the particle, the more light it reflects.

The fact that midsize eruptions may no longer reach the stratosphere is "interesting and important," says Michael Mills, an atmospheric chemist at the National Center for Atmospheric Research who was not involved with the study. And many of the trends identified in the new model—the cooling stratosphere, rising troposphere, and accelerating circulation—have already been seen in the real world. But it's still uncertain whether the limited particle growth simulated by the new model reflects what would happen in the real world, Mills adds.

Indeed, the study raises more questions than it answers, Aubry says. "It's more like opening a can of worms." For one, it studies only tropical eruptions, not those closer to the poles, where the stratosphere is closer. And it is hard to say whether the increased cooling from large volcanoes or decreased cooling from smaller ones will win out as the bigger climate influence. "My gut feeling is that the large eruption effect will dominate," he adds, simply given those eruptions' sheer power as a climate lever.

The next step will be testing how these trends work under more realistic future warming levels—and in additional climate models. Researchers also hope to integrate other trends, including the increased eruptions expected to take place as glaciers melt off some polar volcanoes and the increasing stratification of the ocean, which allows more volcanic cooling to linger at the water's surface, cooling the atmosphere. "My hope is we will never warm the climate enough to influence volcanoes," Aubry says. "But it's becoming a narrow, narrow pathway."

sciencemag.org, 19 August 2021

https://www.sciencemag.org

Since the 1980s, Thwaites has lost an estimated 595 billion tons (540 billion metric tons) of ice[.]

CHEMWATCH
Bulletin Board
Gossip
AUG. 27, 2021

Antarctica's 'Doomsday Glacier' is fighting an invisible battle against the inner Earth, new study finds

2021-08-21

West Antarctica is one of the fastest-warming regions on Earth. For evidence, you need look no further than Thwaites Glacier — also known as the "Doomsday Glacier."

Since the 1980s, Thwaites has lost an estimated 595 billion tons (540 billion metric tons) of ice, single-handedly contributing 4% to the annual global sea-level rise during that time, Live Science previously reported. The glacier's rate of ice loss has accelerated substantially in the past three decades, partially due to hidden rivers of comparatively warm seawater slicing across the glacier's underbelly, as well as unmitigated climate change warming the air and the ocean.

Now, new research suggests that the warming ocean and atmosphere aren't the only factors pushing Thwaites to the brink; the heat of the Earth itself may also be giving West Antarctica's glaciers a disproportionately nasty kick.

In a study published Aug. 18 in the journal Communications Earth & Environment, researchers analyzed geomagnetic field data from West Antarctica to create new maps of geothermal heat flow in the region — essentially, maps showing how much heat from Earth's interior is rising up to warm the South Pole.

The researchers found that the crust beneath West Antarctica is considerably thinner than in East Antarctica — roughly 10 to 15 miles (17 to 25 kilometers) thick in the West compared with about 25 miles (40 km) thick in the East — exposing Thwaites Glacier to considerably more geothermal heat than glaciers on the other side of the continent.

"Our measurements show that where the Earth's crust is only 17 to 25 kilometers thick, geothermal heat flow of up to 150 milliwatts per square meter can occur beneath Thwaites Glacier," lead study author Ricarda Dziadek, a geophysicist at the Alfred Wegener Institute (AWI), Helmholtz Centre for Polar and Marine Research in Germany, said in a statement.

Because West Antarctica sits in an oceanic trench, the crust beneath the seabed is much thinner than the crust below East Antarctica. Scientists have long suspected that this comparatively thin crust must be absorbing more heat from the planet's upper mantle (which experiences average temperatures of 392 degrees Fahrenheit, or 200 degrees Celsius),

impacting the formation and evolution of glaciers there over millions of years.

In the new study, the researchers quantified that difference in heat flow for the first time. Using a variety of magnetic field datasets, the team calculated the distance between the crust and the mantle at various spots throughout Antarctica, as well as the relative heat flow in those areas.

It's hard to tell exactly how warm the glacier is where the ice meets the seabed, as different types of rock conduct heat differently — however, the researchers said, it's clear that this extra supply of heat in the West can only mean bad news for Thwaites.

"Large amounts of geothermal heat can, for example, lead to the bottom of the glacier bed no longer freezing completely or to a constant film of water forming on its surface," study co-author Karsten Gohl, also a geologist at AWI, said in the statement. Either of these conditions could cause the glacier's ice to slide more easily over the ground, causing the glacier's ice loss to "accelerate considerably," Gohl added.

A scenario like that could put the Doomsday Glacier's name to the test; if Thwaites Glacier were to entirely collapse into the ocean, global sea levels would rise by about 25 inches (65 centimeters), devastating coastline communities around the world, Live Science previously reported. What's more, without the glacier plugging the edge of the West Antarctic Ice Sheet like a cork in a bottle of wine, ice loss could accelerate dramatically in the entire region, leading to unprecedented levels of sea level rise.

Researchers will soon have a chance to further hone their measurements of the heat flow below Antarctica. A major international research project is currently underway at the South Pole, including missions to drill ice cores that stretch down to the bed of Thwaites Glacier. Heat flow measurements from these core samples could give scientists a better idea of how much time is left on the Doomsday Glacier's ticking clock.

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HYBRIT started test operations at its pilot plant for fossil-free steel in Lulea, northern Sweden, a year ago.

CHEMWATCH
Bulletin Board
Gossip
AUG. 27, 2021

Sweden's HYBRIT delivers world's first fossil-free steel

2021-08-20

STOCKHOLM, Aug 18 (Reuters) - Swedish green steel venture HYBRIT said on Wednesday that it had made the world's first customer delivery of steel produced without using coal as it looks to revolutionize an industry that accounts for around 8% of global greenhouse gas emissions.

HYBRIT, owned by SSAB (SSABa.ST), state-owned utility Vattenfall (VATN.UL) and miner LKAB, said it would deliver the steel to truck-maker Volvo AB (VOLVb.ST) as a trial run before full commercial production in 2026.

"I'm happy to be minister for enterprise and energy in a country where industry is bubbling with energy for a (green) reset," Ibrahim Baylan, Minister for Business, Industry and Innovation, told a press conference on Wednesday.

HYBRIT started test operations at its pilot plant for fossil-free steel in Lulea, northern Sweden, a year ago.

It aims to replace coking coal, traditionally needed for ore-based steel making, with fossil-free electricity and hydrogen. Hydrogen is a key part of the EU's plan to reach net zero greenhouse gas emissions by 2050.

SSAB, which accounts for 10% of Sweden's and 7% of Finland's carbon dioxide emissions, said the trial delivery was an "important step towards a completely fossil-free value chain".

"The goal is to deliver fossil-free steel to the market and demonstrate the technology on an industrial scale as early as 2026," it said in a statement.

Another green steel venture, H2 Green Steel, is planning to build a fossil fuel-free steel plant in the north of Sweden, including a sustainable hydrogen facility, with production starting in 2024.Report ad

Volvo said in April it would start production this year of prototype vehicles and components from the green steel. Read more

reuters.com, 20 August 2021

https://www.reuters.com

In 2020, Facebook said, it withdrew 3.7 million cubic meters of water — a volume equivalent to nearly 1,500 Olympic-size swimming pools — or a total consumption of 2.2 million cubic meters.

Facebook pledges to restore more water than it uses by 2030 as part of effort to combat climate change

2021-08-19

Facebook announced plans Thursday to restore more water than it consumes by the year 2030, the company's latest initiative targeting climate change.

The company mostly uses water for cooling the banks of computers that run in its data centers. In 2020, Facebook said, it withdrew 3.7 million cubic meters of water — a volume equivalent to nearly 1,500 Olympic-size swimming pools — or a total consumption of 2.2 million cubic meters.

Facebook intends to focus its efforts in regions where it uses local water resources, but it will also look at high-risk areas that face the most challenges in terms of their water supply, said Sylvia Lee, sustainability water lead at Facebook.

"If you look at the biggest impact as a result of climate change — some of the really big ones like wildfires, droughts, floods — at the end of the day, it's actually all tied to water," Lee said in an interview.

Extreme weather events have become increasingly common across the globe, from wildfires in Facebook's home state of California to historic storms and record heat waves.

Earlier this month, the United Nation's climate panel delivered a dire report calling for immediate action. The agency warned that limiting global warming to close to 1.5 degrees Celsius or even 2 degrees Celsius above pre-industrial levels "will be beyond reach" in the next two decades without rapid and large-scale reductions in greenhouse gas emissions. The report said that at 2 degrees Celsius, heat extremes would often reach critical tolerance thresholds for agriculture and health.

Big Tech companies, which consume hefty amounts of energy in their data centers and are growing at a much faster clip than the broader economy, are making their plans known.

Apple said Wednesday it supports a clean energy standard proposed by the Biden administration to eliminate greenhouse gases from power plants by 2035. Facebook rival Snap announced in March its own climate strategy to reduce greenhouse gas emissions and purchase 100% renewable energy back. In 2019, Amazon's Jeff Bezos unveiled a "Climate Pledge," and said he expects 80% of the company's energy use to come from renewable sources by 2024.

CHEMWATCH
Bulletin Board
Gossip
AUG. 27, 2021

Outside of the tech industry, firms like 3M and Pespi have made a similar promise to protect the water supply. 3M joined the Water Resilience Coalition earlier this month, pledging to use its resources to improve the water supply. Pepsi pledged earlier this month to replenish more water than it uses by 2030.

Facebook previously launched water restoration projects in New Mexico, Arizona, Texas, Utah, Oregon and California. These include funding to support the Colorado River Indian Tribes System Conversation Project to conserve and stabilize the water levels of Lake Mead in Arizona. The company said it's also supporting the planting of 70,000 trees in California to help restore areas burned by wildfires in 2018.

Moving forward, Facebook said it will expand its water restoration efforts in Ireland, Singapore, India, the U.K. and Mexico.

"When we focus on water restoration, we focus on projects that go into the same watershed that we're a part of," Lee said.

The company plans to verify its water restoration efforts through LimnoTech, a sustainability consulting firm. Facebook will update the public on its efforts through annual sustainability reports.

Earlier this year, Facebook announced it has reached net-zero emissions and that it's now 100% reliant on renewable energy. In September 2020, the company set a goal to become net zero throughout its entire supply chain by 2030.

cnbc.com, 19 August 2021

https://www.cnbc.com

Eerie albino alligator babies hatched at Florida animal park

2021-08-25

What's tiny, toothy and devoid of pigment? Two new baby albino alligators born at a wildlife attraction in Florida.

The rare reptiles hatched this summer at Wild Florida in Kenansville, Florida. They're the babies of 27-year-old Snowflake and 16-year-old Blizzard, a pair of albino alligators the zoo and safari park purchased in 2017. This is the second set of hatchlings born to Snowflake and Blizzard, who also had a pair of babies last year according to Wild Florida.

Not only does their pink-white skin predispose them to dangerous sunburns, but their lack of camouflage is a real disadvantage.

Albinism is a condition marked by a lack of pigmentation in the skin, eyes, claws and (in mammals, at least) hair. There are probably only about 200 albino alligators in the world, according to the South Florida Sun-Sentinel. Not only does their pink-white skin predispose them to dangerous sunburns, but their lack of camouflage is a real disadvantage.

"They're like candy canes," said Joe Wasilewski, a wildlife biologist and member of the International Union for Conservation of Nature (IUCN) crocodilian specialist group. In other words, they're highly visible and tasty to predators ranging from birds to adult alligators.

Rare find

The hatchlings' eggs were two of 18 collected from their mother Snowflake on April 30, 2021. The eggs were put in an incubator for about 60 days to keep them at a stable temperature and increase the chances of survival. The genetic mutations that cause albinism tend to make animals less hardy in general, Wasilewski told LIve Science.

The new babies are part of a decades-long history of albino alligators at attractions in Florida, Louisiana and other gator farms. Alligators were once endangered, Waskilewski said, but conservation and management has grown their numbers to high levels — 1.2 million in Florida alone. For that reason, many states now issue permits for alligator hunting and egg collection from the wild. This keeps alligator population numbers sustainable in the amount of habitat available to them, Wasilewski said. As part of this program, some licensed facilities and individuals are allowed to harvest, purchase and breed alligators.

The family line of the new babies hails from Louisiana, where a permitted egg collector found a nest with several albino babies in the 1990s. The Saint Augustine Alligator Farm Zoological Park in Florida bought the rights to harvest the nest in subsequent years (gators nest in the same area year after year). Wild Florida purchased Snowflake and Blizzard from the Saint Augustine Alligator Farm.

There's no real conservation advantage to owning or breeding albinos or other alligators with unusual coloration, Wasilewski said, but they're a tourist draw.

"It's kind of like designer alligators, you can buy a regular alligator, if you're licensed, for $50 or you can buy an albino for $15,000," he said.

Alligators on display

CHEMWATCH
Bulletin Board
Gossip
AUG. 27, 2021

The new babies are small enough to be picked up in one hand, with red eyes and barely visible yellow and pinkish stripes along their white backs. They're not on public display yet, but they will soon be moved to an aquarium in the gift shop, according to the Sun-Sentinel. The babies can't be kept with their parents, zoo co-owner Sam Haught told the newspaper, lest the mother decide to snack on them.

Albino alligators have to be sheltered more than non-albino alligators do, Haught added, so they'll live in climate-controlled habitats.

"Because of their albino skin, they get sunburned really easily. And they don't know they're albino," Haught told the Sun-Sentinel. "So, they'll sit out in the sun all day and get sunburned and kill themselves, basically."

Zoos like Wildlife Florida have to abide by regulations such as caging requirements, according to the state Fish and Wildlife Conservation Commision. Because of their decreased hardiness, it's hard to breed albino alligators, Wasilewski said. The fact that Snowflake and Blizzard have produced viable eggs suggests they're healthy and being treated well, he said. Similar wildlife attractions in Florida also have odd-colored alligators, Wasilewski said. Gatorland in Orlando, for example, is home to several albino alligators as well as a pair of leucistic alligators, which have a partial loss of pigmentation. Albino alligators have a total loss of pigmentation, causing their eyes to turn pink, while leucistic alligators have white bodies and blue or black eyes. In captivity, these unusual alligators can live for decades.

The zoo posted a video of the brand-new babies on Facebook on Aug. 10.

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https://www.livescience.com

Australian frogs are on the brink of extinction, and four species likely already lost, scientists say

2021-08-20

Australian frogs are being pushed towards the precipice of extinction by disease, climate change and invasive animals.

Key points:

A team of 29 scientists from across Australia has warned that a number of frog species will go extinct in the next two decades if no action is taken.

- Eight Australian frog species are at "high risk" of becoming extinct in the next 20 years
- Chytrid fungal disease, climate change, and invasive species are behind the decline
- Creating safe refuges for frogs in the wild and captive breeding are key to averting more species loss

A team of 29 scientists from across Australia has warned that a number of frog species will go extinct in the next two decades if no action is taken.

Eight species are at "high risk" of extinction in the next 20 years, but four of those are likely to be already lost, according to the research published in the journal Pacific Conservation Biology today.

The study ranked the extinction probability for Australia's threatened frogs to identify the species most in need of intervention, according to study author Graeme Gillespie of the Northern Territory Department of Environment, Parks and Water Security.

Dr Gillespie said frogs would soon follow the path of Australian reptiles, mammals, birds and plants that have already become extinct, adding to the country's already dire biodiversity record.

"The evidence is there, the patterns are there, this study tells us we're about to lose more," he said.

The study's lead author, Hayley Geyle of the NESP Threatened Species Recovery Hub, said urgent action was needed to protect these unique species.

"Current resourcing and management is just not cutting it in terms of preventing declines," she said.

Disease causing extinction

The amphibian disease chytridiomycosis (or chrytrid), caused by the fungal skin pathogen Batrachochytrium dendrobatidis, has likely already driven four species extinct, according to Dr Gillespie.

Species likely extinct:

- Northern tinker frog, Taudactylus rheophilus, QLD.
- Northern gastric-brooding frog, Rheobatrachus vitellinus, QLD.
- Mountain mist frog, Litoria nyakalensis, QLD.

CHEMWATCH
Bulletin Board
Gossip
AUG. 27, 2021

- Yellow-spotted tree frog, Litoria castanea, NSW/ACT.

"This disease has been responsible for the extinction of hundreds of species of frogs around the world, including in Australia, and the decline of many others," he said.

"For the species which we believe are extinct, chytrid is probably the exclusive factor."

But for many of our other critically endangered frogs, the threats of climate change, invasive species and habitat loss are also at play.

"What these things do is they reduce the overall resilience of the species to cope with a new threat," Dr Gillespie said.

"If a frog occurs on one mountaintop like Kosciuszko, there is a chance for the entire species to be knocked out by one event like a fire."

Climate change may be impacting lowland frog species too, according to Ed Meyer of the Queensland Frog Society, who has been involved in monitoring frogs in groundwater dependent wetlands.

"We think the rainfall deficits we've had in south-east Queensland have resulted in the local extirpation of populations of some of those species," Dr Meyer said.

Dr Meyer said the study clarified just how dire the situation was for a large number of Australian frogs.

"We risk losing additional species in a very short time space, perhaps shorter than people realise," said Dr Meyer, who was not one of the authors.

Disparity in frog conservation investment

After the Black Summer bush fires tore across Mt Kosciuszko in 2019/20, a rescue mission was launched to see how the critically endangered southern corroboree frogs had fared in their protected enclosures in the alpine bogs.

Several enclosures were destroyed and close to two-thirds of the frogs died, but scientists hope frog numbers could bounce back thanks to an extensive captive breeding program for the species.

But there isn't adequate data on the ecology or populations of many other frog species at risk of extinction, let alone captive management programs.

"There's definitely a big disparity in those frogs on the list in terms of the amount of investment that's gone into securing their future," Ms Geyle said.

"So one of the key actions would be to put in place more research and monitoring of the populations."

Dr Meyer agreed that because some species receive more attention than others, we don't have a good understanding of their vulnerability to threats.

"We perhaps don't appreciate just how how much of a knife edge they're on, until they fall over the other side," he said.

Captive breeding challenges

Even for species that do have captive management programs underway, their release into the wild is not immediately guaranteed.

The Kroombit tinker frog that lives in rainforest streams in central Queensland is the species most likely to go extinct by 2040 according to the new study, after the four species already believed to have disappeared.

Dr Meyer has been studying the frog since the mid 1990s and has witnessed its decline in the wild.

He said his team faced political and funding challenges when they set up a captive breeding program for the Kroombit tinker frog 13 years ago, but they've now successfully bred the frog in captivity.

"We're currently putting together a formal captive release plan strategy to make sure that we get [the release] right," he said.

"We're going to give it a red-hot go and hopefully we can buy the species some time and maybe give it a brighter future."

Captive breeding programs are expensive, time-consuming and the last resort, said Dr Gillespie, but there are other things that can be done.

"We can build resilience in these species by addressing management issues that we do have some control over," he said.

"In some cases, it's just a matter of putting in appropriate fencing or undertaking appropriate pest management.

"We know how to control pigs. It's not technologically very difficult."

CHEMWATCH
Bulletin Board
Gossip
AUG. 27, 2021

Relocating frogs to safer habitats or even wild refuges is another potential solution.

Dr Gillespie also thinks crisis funding for threatened species could be put to better use.

"If the resources that were being thrown around in response to those [2019] fires had been spread out uniformly over the previous 10 years, we would've had a better outcome," he said.

"We would have been more informed about the likely impacts, and there would have been more resilience in the system.

"But a big bag of money gets thrown at it, it gets spent in a short period of time, and then it goes back down to being inadequate until the next crisis."

A spokesperson for the federal environment department said they welcomed the research findings, and that the government was committed to recovering threatened species.

They said government programs were "increasingly incorporating monitoring for on-ground projects to better assess the outcomes of Australian government investment and to inform future actions".

abc.net.au, 20 August 2021

https://www.abc.net.au

COVID-19 vaccine effectiveness dropped to 66% against delta, CDC finds

2021-08-25

The delta variant has dealt a blow to COVID-19 vaccine effectiveness, which has dropped by about 25 percentage points since the variant became the dominant strain of coronavirus in the U.S., a new study among healthcare workers finds.

The study, from the Centers for Disease Control and Prevention (CDC), found that the vaccines' effectiveness against COVID-19 infections declined from 91% prior to the delta variant's emergence, to 66% after the rise of the delta variant in the summer.

Despite this "moderate reduction," health officials stressed that "the sustained two-thirds reduction in infection risk underscores the continued importance and benefits of COVID-19 vaccination," the authors wrote in

The study is based on information from more than 4,000 health care workers in six U.S. states (Arizona, Florida, Minnesota, Oregon, Texas and Utah), from mid-December 2020 through mid-August 2021.

the study, published Tuesday (Aug. 24) in the CDC journal Morbidity and Mortality Weekly Report (MMWR).

The study is based on information from more than 4,000 health care workers in six U.S. states (Arizona, Florida, Minnesota, Oregon, Texas and Utah), from mid-December 2020 through mid-August 2021. During the study period (both before and after the rise of the delta variant), the effectiveness of COVID-19 vaccines against infection was 80%, the study found.

Eight-three percent of healthcare workers in the study were vaccinated; 65% had received the Pfizer-BioNTech vaccine, 33% had received the Moderna vaccine and 2% had received the Johnson & Johnson vaccine.

The researchers say their finding showing a decline in vaccine effectiveness after the rise of delta should be interpreted with caution, because vaccine effectiveness may also be declining as a result of the increased time since people were vaccinated. In other words, people's immunity may have waned somewhat with the passage of time, rather than just as the result of a new variant.

The study also did not examine the severity of the infections. But a second CDC study, also published Tuesday in MMWR, did examine severity by looking at the rate of hospitalizations for COVID-19 among vaccinated and unvaccinated people in Los Angeles.

This second study, which examined more than 43,000 COVID-19 infections among L.A. residents from May 1 through July 25, 2021, found that 71.4% of infections were among unvaccinated people, 25.3% of infections were among fully vaccinated people and 3.3% of infections were among partially vaccinated people. At the end of the study period, the COVID-19 infection rate among unvaccinated people was nearly 5 times higher, and the hospitalization rate nearly 30 times higher, than the rate among fully vaccinated people.

"These infection and hospitalization rate data indicate that authorized vaccines were protective against SARS-CoV-2 infection and severe COVID-19 during a period when transmission of the delta variant was increasing," the authors wrote. "Efforts to increase COVID-19 vaccination, in coordination with other prevention strategies, are critical to preventing COVID-19-related hospitalizations and deaths."

Is the ancient Egyptian 'mummy's curse' real?

2021-08-23

Within months of the discovery of King Tutankhamun's tomb in 1922, the man who financed its excavation — George Herbert, the fifth Earl of Carnarvon in England — became ill and dropped dead. It didn't take long for people to question whether a "mummy's curse" had doomed the earl.

"Pharaoh's 3,000 year-old Curse is Seen in Illness of Carnarvons" read the headline on the front page of the March 21, 1923, edition of "The Courier Journal," a newspaper published in Louisville, Kentucky.

Similar headlines appeared in newspapers around the world as news broke of Carnarvon's illness and death. He suffered an infection that reportedly resulted from a shaving accident when he cut a bite mark made by a mosquito. Reports claimed that his wife, Almina Herbert, was also ill, but she recovered and would live until 1969, dying at the age of 93.

Despite Almina's longevity, her husband's death raises a question: Is there any evidence supporting the concept of a mummy's curse? PLAY SOUND

Carnarvon had been financing the search for and excavation of Tutankhamun's tomb. When Howard Carter found the tomb in November 1922, he delayed exploring inside until Herbert could arrive from Britain. After Carnarvon's arrival, they ventured into the tomb, seeing the "wonderful" artifacts buried with Tutankhamun. No writing from ancient Egyptians mentioning a curse was found in the tomb.

While the notion of a "curse" may sound ridiculous, it has actually been studied seriously by scientists, with several papers published on the topic. In an effort to determine whether a long-lived pathogen could have caused the "curse," scientists used mathematical modeling to determine how long a pathogen could survive inside a tomb, according to papers published on the subject in 1996 and 1998 in the journal Proceedings of the Royal Society B: Biological Sciences.

"Indeed, the mysterious death of Lord Carnarvon after entering the tomb of the Egyptian pharaoh Tutankhamun could potentially be explained by an infection with a highly virulent and very long-lived pathogen," Sylvain Gandon wrote in the 1998 journal article. Gandon was a researcher at Pierre and Marie Curie University in Paris when the paper was published.

However, more recent publications appear to rebut this possibility. An analysis of brown spots on Tutankhamun's tomb found that "the organism that created the spots is not active," a team of researchers wrote in a

While the notion of a "curse" may sound ridiculous, it has actually been studied seriously by scientists, with several papers published on the topic.

paper published in 2013 in the journal International Biodeterioration & Biodegradation.

Additionally, a study published by Mark Nelson, a professor of epidemiology and preventive medicine at Monash University in Australia, found no evidence that those who went inside the tomb died at unusually young ages. His study examined records of 25 people who worked or went into the tomb shortly after it was discovered. On average, the people who went inside the tomb lived to be 70 years old, an age of death that was not particularly low in the early to mid-20th century. The study found "no evidence to support the existence of a mummy's curse," Nelson wrote in a 2002 paper published in the British Medical Journal.

Origins of the curse

The idea of a mummy being associated with a curse actually predates the discovery of Tutankhamun's tomb. "The curse is a legend that developed gradually, since sometime in the mid-19th century, and has grown progressively with cumulative contributions by fiction literature, horror films, news media and most recently, the internet," said Jasmine Day, an Egyptologist who holds a doctorate in cultural anthropology and wrote the book "The Mummy's Curse: Mummymania in the English-Speaking World" (Routledge, 2006).

"My research uncovered forgotten American fiction stories from the 1860s, in which male adventurers strip female mummies and steal their jewels, only to suffer a horrible death, or dreadful consequences for those around them," Day told Live Science. "These stories, written by women, emphasise the unwrapping of mummies as a metaphor for rape. In turn, this shocking comparison seems to condemn the destruction and theft of Egypt's heritage in the heyday of Western colonialism."

Other scholars agreed that the association of curses and magic with mummies was widespread before the discovery of Tutankhamun's tomb. "The idea that Egypt was a land of mystery went back to the Greeks and the Romans," said Ronald Fritze, a history professor at Athens State University in Alabama and author of the book "Egyptomania: A History of Fascination, Obsession and Fantasy" (Reaktion Books, 2016). "Over time, the ancient Egyptians were credited with all sorts of supernatural and magical knowledge."

"When Egypt began to open up to the West after the expedition of Napoleon, there was a fascination with mummies, and well-to-do people bought them to have them unwrapped as entertainment," Fritze added.

CHEMWATCH
Bulletin Board
Curiosities
AUG. 27, 2021

"Many people were troubled by this sort of meddling with the dead." At that time, fictional stories that told of curses associated with mummies began to appear in literature. Fritze noted that Irish author Bram Stoker, who is most famous for his "Dracula" novel, published a 1903 book called "The Jewel of the Seven Stars," in which modern-day archaeologists suffer from a mummy's curse.

Cinema also picked up on the idea of a curse being associated with mummies said Eleanor Dobson, a lecturer of English literature at the University of Birmingham in the U.K. and author of the book "Writing the Sphinx: Literature, Culture and Egyptology" (Edinburgh University Press, 2020). "Essentially, by the time of Carnarvon's death, audiences were primed to see discoveries of Egyptian artefacts in terms of these Gothic narratives," Dobson told Live Science in an email.

Day noted that when the Titanic sank in 1912, some people believed that the mummy of a priestess in the British Museum had caused the sinking. British Museum curator Ernest Wallis Budge "received so many public enquiries regarding the allegedly cursed mummy at the museum that he was obliged to write a flyer debunking the rumours that could be distributed to members of the public," Day said in an email. "Despite this, some people sent money for the museum to purchase flowers to lay at the feet of the dead priestess to placate her soul — and the tale of the mummy that sank the Titanic continues to circulate on the internet today."

The curse explodes

The press exclusive sold to the Times of London played a major role in the spread of the idea that Tut's tomb was cursed. Other media outlets were outraged that they were shut out and ran stories on the curse, Day said.

"Foremost among the disgruntled reporters was Arthur Weigall, a journalist, novelist, former Egyptologist and bitter rival of Howard Carter," Day said. When Carnarvon died, "Weigall pounced, claiming that the curse of Tutankhamun had killed him," even though Weigall reportedly did not believe in the curse himself.

"Millions of gullible people, however, were eager to believe the tale [of a curse], having been raised on a diet of curse lore and fiction for decades — and desperate to confirm the idea that it was possible to communicate with the dead, having lost so many young men during World War I," Day said, and Carter blamed Weigall for the idea that the tomb was cursed.

The fact that a number of famous authors believed in the curse — such as Arthur Conan Doyle, the writer of the Sherlock Holmes novels — help spread belief in the curse, Day said. Doyle "stated to the press that Carnarvon had been killed by 'elementals,' protective spirits living in the tomb," Day said.

Carter himself got involved in the curse brouhaha when he teamed up with a magazine writer named Percy White in 1923 to write a semifictional magazine story called "Tomb of the Bird: Death of the White Canary" that told an account of the death of Carter's pet canary. "It was a semifictionalised account of the death of Carter's canary, supposedly from a scare or bite from a cobra," Day said. "Carter's indulgence in curse speculations came back to haunt him, however, when newspapers were awash with more lies than truth about Tutankhamun's alleged curse, which irked him."

Curse today

Even today, some people like to link archaeological discoveries and contemporary events with curses. When a massive 2,000-year-old coffin was found in Alexandria, Egypt, in 2018, some people feared that opening it would unleash a curse. Similarly, when a ship blocked the Suez Canal in 2021, some people tried to place the blame on mummies, noting that the mummies of several ancient Egyptian pharaohs were set to be transported to a museum in Fustat.

"People want life to have meaning and not be chaotic and random or coincidental," Fritze said. "Traditionally, formal religion has supplied that need to explain existence. But many people have [turned] to magical and supernatural beliefs, and these include curses."

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How fossilization preserved a 310-million-year-old horseshoe crab's brain

2021-08-20

Paleontologists can spend years carefully splitting rocks in search of the perfect fossil. But with a 310-million-year-old horseshoe crab brain, nature did the work, breaking the fossil in just the right way to reveal the ancient arthropod's central nervous system.

Of all soft tissues, brains are notoriously difficult to preserve in any form.

CHEMWATCH
Bulletin Board
Curiosities
AUG. 27, 2021

Of all soft tissues, brains are notoriously difficult to preserve in any form (SN: 10/31/16). Stumbling across such a detailed specimen purely by chance was "a one-in-a-million find, if not rarer," says evolutionary paleontologist Russell Bicknell of the University of New England in Armidale, Australia.

The fossilized brain is remarkably similar to the brains of modern horseshoe crabs, giving clues to the arthropods' evolution, Bicknell and colleagues report July 26 in Geology. And the brain's peculiar mode of preservation could point paleontologists toward new places to look for hard-to-find fossils of soft tissues.

Horseshoe crabs have a fossil record spanning roughly 445 million years. But having a long fossil record is one thing. For many animals, including the crabs, fossils of their soft tissues are extremely uncommon because the tissues tend to degrade far quicker than fossilization can occur. Finding the delicate fatty structures that form a brain preserved in rock is especially rare. Only about 20 samples of fossilized arthropod neural tissue have been identified to date.

The newly described brain — part of a larger fossil of the extinct Euproops danae that Bicknell found at the Yale Peabody Museum of Natural History — was originally dug up from the Mazon Creek fossil beds roughly an hour southwest of Chicago. That site is one of the only known places in the world that could have saved the brain's structure, says paleontologist Victoria McCoy of the University of Wisconsin–Milwaukee.

"The fossilization at Mazon Creek is really, really exceptional," McCoy explains. "It's interesting because the fossils are preserved inside concretions," which are spherical rocks that form around a central nugget of material, such as a long-dead crab. Most concretions in other fossil beds have no fossils or fossils that are just bones and hard parts, but "Mazon Creek has really good, soft-tissue preservation inside these concretions," she says.

That's because the concretions there are partly made of an iron-carbonate mineral called siderite that only forms in low-oxygen environments. That low-oxygen setting almost certainly slowed tissue decay, the scientists say, giving it time to be preserved. In an oxygenated environment, the decay could have happened in weeks, and the brain would have probably wasted away too quickly.

The actual process of preservation was a multistep ordeal, Bicknell says. "First, of course, the horseshoe crab had to die." As the crab decayed,

surrounded by mud and not much oxygen, that siderite coated the crab's body, allowing it and its fragile brain structure to be preserved. After the brain degraded, the siderite "mold" was filled in with a pale, clay mineral called kaolinite, creating a white brain structure that stands out starkly on the otherwise tan fossil. Over time, a sphere of rock formed around the fossil before eventually breaking open in a fortuitous way.

Based on studies in similar modern environments, such as the North Norfolk marshes in England, the whole preservation process probably took fewer than 50 years, McCoy says. That's much faster than some other fossilization processes, which can take thousands of years or more. "Neural tissue degrades fairly quickly. We have no reason to think it would be stable," she says. "While we don't completely understand how concretions form, all the evidence so far is that it's the concretion itself that is the preservation force keeping things from decaying away."

The high preservation quality in these siderite concretions may point paleontologists in new directions for finding soft-tissue fossils. Only several environments capable of producing siderite concretions in the rock record have been identified so far, but the sites could be practical targets for future fossil searches.

"The most important part here is that purely by chance, the fossil was split along its brain," Bicknell says. The concretion was cracked in just the right orientation to reveal a near-perfect cross section of the brain's structure. "If it hadn't broken that way, we wouldn't have this level of information. It was ultimately quite lucky."

The preserved central nervous system lends insight into the ancient crab's behavior, the researchers say. Because the fossil brain is so similar to the brains of modern horseshoe crabs, Bicknell says, it's safe to say the ancient animal's walking, breathing and even feeding habits were probably similar to horseshoe crabs' today, including eating with their legs. "Imagine eating a hamburger with your elbows," Bicknell says.

sciencenews.org, 20 August 2021

https://website

Environmental injustice and disability: Where is the research?

2021-08-23

Environmental injustice and disability: Where is the research?

CHEMWATCH
Bulletin Board
Curiosities
AUG. 27, 2021

Due to a lack of data and understanding, the disabled community remains left out of most environmental justice research

Despite a revived national focus on environmental injustice, one group remains largely ignored: disabled people, who make up more than 25% of the U.S population.

Even the definition of environmental justice provided by the U.S. Environmental Protection Agency (EPA) doesn't currently include disability.

Yet, a recent study suggests that disability status—especially in combination with race, ethnicity, and income—can determine how much environmental harm one could be exposed to.

Pollution in the U.S. has never been evenly distributed. Our long history of discriminatory housing and zoning laws have forced marginalized groups to live in areas that disproportionately expose them to environmental hazards—the effects of which are still present today.

In response, environmental justice researchers have spent decades trying to document these inequalities. What started out with a focus on Black and Brown Americans, has since expanded to include other marginalized groups, such as low-income households, immigrants, and the LGBTQ+ community.

Few studies also consider disability. But in one of these rare studies, Jayajit Chakraborty, a professor of geography at the University of Texas at El Paso, observed that Houston neighborhoods located near pollution sources—like Superfund sites and hazardous waste facilities—were home to a significantly higher proportion of disabled people compared to the rest of the city. In addition, race, ethnicity, and age all further amplified these inequalities—disabled people of color and those aged 75 years or older both lived in even closer proximity to polluted areas, likely decreasing their quality of life.

These findings came as no surprise to Chakraborty. In his past work, he reached a similar conclusion when investigating how close disabled people lived next to toxic chemical spills, and again when looking at where disabled communities were placed relative to facilities that use hazardous materials.

"And that got me thinking, what about other kinds of environmental hazards?" he told EHN, adding that he wanted to look at more chronic pollution sources which "have traditionally received a lot of focus in

Even the definition of environmental justice provided by the U.S. Environmental Protection Agency (EPA) doesn't currently include disability.

previous [environmental justice] research…but not so much with regards to disability."

He stresses, however, that these conclusions are specific to the Houston area and more work needs to be done to see how it translates across the country.

But expanding on this research will be difficult as work like Chakraborty's is uncommon.

"There are few studies of [environmental justice] and disability, let alone the intersection of race, class and disability," Arrianna Planey, an assistant professor of health and policy management at the University of North Carolina, Chapel Hill, told EHN.

Yet, the disabled community has known about these types of issues "for forever," disabled youth organizer Daphne Frias told EHN. Researchers, she added, "have so much to do to catch up."

Disability data lacking

Part of the reason for this gap in environmental justice research is a lack of data on disability.

"I would prefer to do field work to get primary data—surveys or interviews—to understand the lived experiences [of this community]." Chakraborty said. However, due to time and funding constraints, this isn't always feasible. So, Chakraborty, like many other environmental justice scholars, relies on information obtained through other methods, such as through the American Community Survey (ACS).

Unfortunately, this can have several limitations. "The ACS has large margins of error and generally underestimates the prevalence of disability," said Planey, who was not involved with the Houston study.

That's because, for one, people in the disabled community face difficulty being counted by these surveys for reasons that range from inaccessible survey design to the distrust of government surveyors. Also, these surveys are self-reported. Stigma surrounding disability often leads people to forgo identifying as disabled, resulting in an underestimation of their numbers.

That said, despite its imperfections at least the ACS includes data about disability. Chakraborty has noticed that other research surveys often don't even inquire about disability status in the first place.

CHEMWATCH
Bulletin Board
Curiosities
AUG. 27, 2021

"There [are questions] for race, ethnicity, and housing status, and other kinds of stuff," he explained. "For a lot of these forms there's no identifier for people with disabilities."

Conflating disability, disease, and environmental justice

Frias said the lack of available data is just a symptom of a larger problem: ableism.

"It's the idea that disabled lives are unimportant and disabled lives are invisible," she said. "It doesn't matter if where we live makes us even more unhealthy."

Disability is also rarely seen as a full-fledged identity, which is reflected on how it's often framed in environmental justice research. The "focus has generally been more on how environmental injustices cause disability," Catherine Jampel, fellow of the American Council Learned Societies (ACLS), told EHN, "but much less on the specific vulnerabilities of disabled people to environmental injustices."

It's likely this kind of framing that has led to terms like "disability-adjusted life year," which is a common metric used to determine "the years of healthy life lost due to disability" and has recently been used with regards to the health effects of environmental pollution.

But disability isn't just a negative state of being. It's a community who deserves access to a clean environment. Any opposing mindset can hinder developing solutions when it comes to protecting the disabled community from environmental issues, said Planey. "In the ableist cultural milieu, it's difficult to advocate to address both the social conditions that produce disablement and advocate for rights and protections for disabled people," explained Planey.

That's why Frias believes this framing needs to change. "Our community is beautiful and powerful, and I think that needs to be embodied instead of this doom and gloom narrative of how we're perceived."

Expanding environmental justice research

Chakraborty's goal has always been to expand the scope of environmental justice research. He hopes that studies like his recent one in Houston will "lead to a better inclusion of people with disabilities in environmental justice research and environmental policy." He also believes that it's important that environmental justice uses an intersectional approach when looking at disability.

"We like to see disability as a monolithic system of oppression," said Frias, "But that is not necessarily true." Multiple marginalized identities can compound on each other to increase one's pollution exposure risk.

For example, "Disabled people—especially disabled people of color—are much more likely to be impoverished," said Planey, forcing them into low-income housing that is more likely to be built near pollution sites.

Still, there is hope. "With each study that's published, it creates more of a dialogue between [environmental justice and disabled] communities," said Frias, adding that moving forward, it's important that researchers begin reaching out directly to the community and listen to their lived experiences.

"It's the phrase that [disabled people] always say, 'Nothing about us without us.'"

ehn.org, 23 August 2021

https://www.ehn.org

California family found dead on trail had 'no obvious cause of death.' Could toxic algae be responsible?

2021-08-24

A family was recently found dead on a hiking trail along the Merced River in a remote area of the Sierra National Forest in California. There were no signs of damage to their bodies.

Investigators are looking into the possibility that toxic algal blooms may be to blame. But is that the likeliest explanation? One researcher told Live Science, that while possible, that scenario would be unusual.

After a friend reported the family missing, searchers discovered the bodies of John Gerrish, Ellen Chung, their 1-year-old daughter Miju and their dog, Oski on Tuesday (Aug. 17) in Mariposa County, along the Hite Cove Trail near Devil Gulch.

"This is a very unusual, unique situation," Kristie Mitchell, a spokesperson for the Mariposa County Sheriff's Office, told the San Francisco Chronicle. "There were no signs of trauma, no obvious cause of death. There was no suicide note. They were out in the middle of a national forest on a day hike." What's more, the couple were known to be avid hikers, according to the Chronicle.

"There were no signs of trauma, no obvious cause of death. There was no suicide note. They were out in the middle of a national forest on a day hike."

CHEMWATCH
Bulletin Board
Curiosities
AUG. 27, 2021

Investigators briefly considered the possibility that the family may have been exposed to toxic fumes from nearby abandoned mines.

As many as half a million abandoned mines may dot the U.S., according to the Bureau of Land Management (BLM). Back when these mines were in operation, their operators could just simply abandon them without removing hazards.

Abandoned mines can accumulate many different lethal gases, including methane, carbon monoxide, hydrogen sulfide and toxic levels of carbon dioxide. If people breathe in these gases, their muscles stop responding normally, thinking becomes clouded and a person can become unconscious and die. What's more, these chemicals are often odorless and there are no other warning signs that you're breathing them in, according to the BLM.

When the bodies were found, the area was briefly designated a hazmat site — or an area that may have "hazardous materials" to a person's health; the designation was lifted the next day, according to NPR.

The Mariposa County Sheriff Jeremy Briese told The Fresno Bee that he didn't believe the deaths were connected to a nearby mine. The nearest known mine was over 3 miles (4.8 kilometers) away from the bodies; still, because that area had a community of mines, there could be some that we don't know about, Briese said. In the mid-19th century, an area around Hites Cove held a hard-rock gold mine, where certain techniques are used to extract "hard" minerals holding metals like gold, according to The Associated Press.

Toxic algae

Briese also said investigators were considering toxic algae blooms as a possible cause, and that the U.S. Forest Service had recently posted warnings about toxic algae at the start of the trail near Hites Cove, where the bodies were found, according to the Fresno Bee.

Such blooms are caused by algae or cyanobacteria that grow in the water and can release toxins that can sometimes poison animals, such as cattle or dogs, according to The California Department of Public Health. These toxins can get into the body through ingestion, through the skin or even through inhalation.

People who swim, wade or participate in other aquatic activities in water laced with cyanobacterial toxins can develop health effects such as skin rashes, diarrhea and vomiting (if they ingest the toxins), or

develop problems with the liver, kidneys or nervous system. But there are no known human deaths connected to drinking or wading in such contaminated water, according to the California Department of Public Health.

Indeed, Alan Wilson, a professor at the School of Fisheries, Aquaculture and Aquatic Sciences at Auburn University in Alabama, said that it's unusual for people to die from algal blooms. "There are reports, but they're usually kind of anecdotal reports," Wilson told Live Science. "I get more people calling me this time of year normally for pet or livestock deaths."

Dogs tend to be more susceptible to the algal toxins, in part because they get into the water and then get out and lick their fur, potentially ingesting a high dose of toxins, he said. "Human exposure when swimming is fairly low, we don't ingest tons of water."

In this case, if this family were to be exposed to such toxins, it would likely be from toxic algal mats and not blooms, he said. While algal blooms are not attached to anything, algal mats cling onto the bottom of water, such as on rocks.

The Merced River doesn't look particularly deep and the water moves, which would make it hard for algae to build up and form algal blooms like it does in lakes, he added. But algal mats, because they're clinging onto the rocks, wouldn't flow down the stream.

On July 13, the Sierra National Forest posted a warning on their Facebook page about toxic algal mats in the Merced River near Hites Cove. "The Sierra National Forest (SNF) would like to inform those visitors who like to enjoy this area of the Merced River and SNF, not to swim, wade or allow their pets to enjoy the water," due to these mats, the agency warned.

The trail the family was hiking, the Savage Lundy Trail, snakes along the Merced River. On Thursday (Aug. 19), the State Water Resources Control Board said they were testing waterways in the area for such toxic algae, according to The Fresno Bee.

"The fact that it was two adults, a kid and a dog," makes this a really unusual situation, he said. "You think that even if people were exposed they're not all going to be exposed at the same rate." Investigators are hoping that autopsies and toxicology tests will ultimately reveal more about what happened in this tragic story.

CHEMWATCH
Bulletin Board
Curiosities
AUG. 27, 2021

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Baby bats babble just like human toddlers. What does this mean?

2021-08-20

Deep in the jungles of Costa Rica and Panama, Ahana Aurora Fernandez eavesdrops on bat conversations from dawn until dusk.

Armed with a microphone and sound recorder, Dr Fernandez is capturing the squeaky sounds of baby bats learning how to talk.

Key points:

- Babbling is an essential phase of speech and language development in human infants
- Bats in Central and South America also learn how to "talk" through babbling
- These bat babbles follow a similar pattern to human babbling, offering clues about the evolutionary origins of language

And it turns out these bat babbles have remarkably similar patterns to human baby talk, according to a study published today in Science.

Like babies and toddlers, bat pups learn how to "talk" by copying adult sounds and repeating them to a regular beat.

While bats and humans appear totally different on the surface, Dr Fernandez said the findings could offer clues about how human speech and language evolved.

"It's striking that two mammalian species with different evolutionary histories have the same vocal practice behaviour that leads to the same end product: to learn the adult vocal repertoire. That's amazing," said Dr Fernandez, one of the study's co-authors at the Natural History Museum in Berlin.

From babbling to grown-up chatter

They start making this chatter at around four months old, starting with making sounds that imitate vowels, like "coo" and "ga".

While it can be enough to drive some parents crazy, babbling allows babies and toddlers to begin mastering speech by learning how to control their tongue, lips and jaw to form their first words.

They start making this chatter at around four months old, starting with making sounds that imitate vowels, like "coo" and "ga".

At around six months, babies begin slipping consonants into their babbling, blurting out sounds like "ba" and "da" in repeated sequences that have a regular beat, such as "da-da-da".

Every "coo", "ba" and "da-da-da" brings infants one step closer to stringing full sentences together, Dr Fernandez said.

"Without vocal imitation, we wouldn't be able to speak or learn a language."

But humans aren't the only animals to babble their way to mature conversation.

Songbirds, such as zebra finches, also learn how to sing by babbling and copying the songs of adult birds.

But it's tricky to use babbling birds as models for exploring the development of human language because their anatomy is vastly different to ours.

The greater sac-winged bat (Saccopteryx bilineata), a species found in the rainforests of Central and South America.

"These bats are very special because they really learn a part of the adult vocal repertoire from scratch through imitating their adult tutors," Dr Fernandez said.

Capturing bat baby talk

What Dr Fernandez and her team wanted to know was whether the babbling produced by bat pups followed a similar pattern to human baby talk.

To find out, the researchers spent three months recording the babbling behaviour of 20 bat pups from eight wild colonies across Costa Rica and Panama.

They also ploughed through the literature to compile a list of human babbling features to see whether the bats' babbles followed a similar pattern.

CHEMWATCH
Bulletin Board
Curiosities
AUG. 27, 2021

The team analysed over 55,000 syllables from 216 babbling bouts produced by the bat pups.

While syllables in human infant babbling consist of consonant sounds that transition into vowel-like sounds ("ba" and "ga"), bat syllables are defined as tones surrounded by silence.

The bat pups proved to be a chatty bunch from a young age, babbling away in the trees from just three weeks' old.

By the time they were 10 weeks' old, the pups were spending nearly half of their waking hours giving their vocal skills a workout, with a single babbling session lasting for up to 43 minutes.

Much like human babies learning how to combine vowels and consonants, the bat pups' babbling consisted of a mash-up of syllables their parents use.

"The pups produced syllables from the adult territorial song, followed by syllables from the adult courtship song," Dr Fernandez said.

"They completely mix them up."

While the pups were from different colonies and locations, they all picked up the same syllables, just as humans produce similar babbling sounds regardless of the culture they are growing up in.

And just like a human baby saying "da-da-da", the bat pups spent most of their babbling time repeating the same syllables to a clockwork-like beat.

Dr Fernandez suspects the bat pups babble repeatedly to get their communication skills up to speed and learn how to use their vocal apparatus properly.

But it's not all hard work.

"While you're babbling, you're happy," Dr Fernandez said.

"It's not only practising and learning, but also having fun and just babbling away. It's a comfort behaviour."

Do Australia's bat babies babble?

Nicola Hanrahan, an ecologist at Charles Darwin University who has studied social communication in bats, welcomed the study and said it would be interesting to explore babbling behaviour in other bat species.

"The behaviour demonstrated by greater sac-winged bats is unlikely to be restricted to this species, with a number of bat species already shown to use vocal learning," said Dr Hanrahan, who was not involved in the study.

And while few studies have explored social communication in Australian bats, some of our native species would be good candidates for exploring babbling and vocal learning, Dr Hanrahan said.

For instance, the ghost bat (Macroderma gigas) is a very talkative species that uses its complex vocal repertoire to communicate during foraging and roosting.

"Studies into the social communication of Australian bats are few, although increasing," Dr Hanrahan said.

"We have yet to delve into investigating the presence of vocal learning or babbling."

The next step for Dr Fernandez and her team is to explore what is happening in the bats' brains while they are learning how to talk.

"What is really exciting about bat pup babbling is that it shows you when learning is taking place," Dr Fernandez said.

"Seeing what is happening in the mammalian brain during vocal learning could also tell us something about what is happening in our brain when we are vocally learning."

abc.net.au, 20 August 2021

https://www.abc.net.au

How endocrine disruptors affect menstruation

2021-09-01

In 2017, a Korean media outlet decided to investigate the chemicals found in commercial menstrual pads, based on the advocacy and awareness-raising efforts of the Korean Women's Environmental Network, who had pointed out that menstruating people seemed to be developing rashes, discomfort, and even infertility from the pads.

QUICK TAKE

- Women, gender minorities, and children are most likely to be exposed to endocrine disruptors because of the products they are more likely to use.

Phthalates are very common in plastics, cosmetics, and apparently menstrual pads, because certain phthalates (there are many of them) can help a substance dissolve or can make plastics harder to break.

CHEMWATCH
Bulletin Board
Curiosities
AUG. 27, 2021

- People are exposed to many different types of endocrine disruptors, from phthalates to lead. Many are known to be harmful to human health.
- The solution is not as simple as deciding on acceptable thresholds of chemicals or replacing ingredients. The key question is: How were these materials permitted in the first place?

This group sent samples to reproductive toxicologists Jodi Flaws and Jay Ko at the University of Illinois, where I am also employed. Flaws and Ko found volatile organic compounds and phthalates in every single sample of sanitary pads and disposable diapers they received, and published their results in Reproductive Toxicology. The products they sampled were made in 2017 and came from Korea, the United States, Japan, Finland, France, and Greece; the researchers were kept ignorant as to the sources of their samples as they were conducting their analyses, to avoid bias. Although the quantities of volatile organic compounds were not too alarming—they weren't too different than what we are already exposed to, and you can reduce them by letting these products air out a bit before using them—the phthalates were another story.

Phthalates, a class of endocrine-disrupting chemicals, are widely known to be harmful to human health. Phthalates are very common in plastics, cosmetics, and apparently menstrual pads, because certain phthalates (there are many of them) can help a substance dissolve or can make plastics harder to break. Women, femme-identified gender minorities, and children are most vulnerable to exposure because phthalates are so often found in the products they are more likely to use: cleaning products, cosmetics, baby toys, and more. (To be clear, this is a general statement based on how gender roles inform and even constrain choices.) Additionally, people who experience incontinence, from babies and toddlers to postpartum people to elders, are going to be exposed to diapers, and menstruating people (including nonbinary people and transmen) to menstrual pads. These put phthalates right up against our thin genital skin.

Endocrine-disruptor exposure also comes from the food we eat: Foods that are encased in plastic (wrapped produce, plastic water bottles) are likely to have absorbed the chemicals used to give that plastic its structure or softness. Some prescription and over-the-counter medicines are even coated in phthalates. When we receive intravenous fluids in the hospital, those fluids have been sitting in plastic made with phthalates, and although these injections do not seem to have significant short-term

effects, rodent studies suggest that those literal injections of phthalates can have intergenerational effects on the health of our children and grandchildren.

Whenever I find myself discussing this issue with others, I tend to encounter two main reactions: Either people immediately want to know what they should throw out (and what they should use as replacements), or people throw up their hands at the futility of avoiding endocrine disruptors. I understand and have harbored both of these viewpoints at times. However, I think a third reaction is possible, one where we step back and recognize the broader structural problems that have brought us here. We must consider our varying responsibility and power within those structures that have put all of us at risk, but some of us especially so based on sexism, racism, and ableism, and sometimes just based on physiology. This approach means sitting with this knowledge for a minute, rather than immediately reacting. After all, these endocrine disruptors are not going

Periods on Phthalates

Krakow, Poland, is one of my favorite cities on the planet. It is one of the first places I ever visited on my own, and is the closest city to the rural mountainous region where I have conducted much of my fieldwork on menstrual cycles. I remember being picked up at the airport on my first visit in 2002 by my mentor and collaborator, public health researcher and anthropologist Grazyna Jasienska of Jagiellonian University, in part because of where she had parked in the city. Jasienska lived in a lovely apartment in the Old Town, and as a resident, she had a special permit to drive and park in the central part of the city. Although some of the initial decisions to limit traffic in Krakow were about tourism and support for local residents, one of the by-products of these driving and parking restrictions has been that it may reduce some local pollution. Because Krakow sits in a valley, air pollutants can drift in from surrounding industry and linger, and traffic emissions can stagnate there as well. The Old Town area is gorgeously preserved, with stone buildings that are many hundreds of years old and a city center with churches, flower sellers, and booths of traditional souvenirs such as amber jewelry and embroidered blouses. Air pollutants are bad for the buildings, bad for the inhabitants, and bad for tourism.

The air pollution from traffic, particularly from higher-emission cars, comes from particulate matter (bits of dust, soot, and smoke of varying origins), sulfur dioxide, carbon monoxide, and nitrogen oxides. (See "Air Pollution and Sunlight Q&A," January–February 2016.) A 2017 paper in

CHEMWATCH
Bulletin Board
Curiosities
AUG. 27, 2021

the International Journal of Environmental Research and Public Health by Anna Merklinger-Gruchala of Krakow University, Jasienska, and Maria Kapiszewska, also of Krakow University, looked at these different types of air pollution together, to try and understand whether fossil fuel combustion from industry and heating, traffic fuel emissions, or both together produce cumulative effects on the menstrual cycle.

The sampling period was 2001 to 2003, right around the time of my first visit to Poland. My colleagues looked at the air pollution measures in Krakow at that time, based on municipal ecological monitoring data by the state, and menstrual cycle characteristics from 133 research participants living in the city. In this study, there were no effects on the menstrual cycle when considering any one pollutant on its own. However, the authors found that particulate matter and sulfur dioxide exposure together were associated with a shortened luteal phase (the second half of the menstrual cycle, starting at ovulation and ending at menses). These pollutants derive mostly from fossil fuel emissions—the kind that come from older heating units and factories. The effects on the menstrual cycle of the other pollutants studied—carbon monoxide and nitrogen oxides—were not statistically significant in this sample.

The authors mathematically estimated that exposure to air pollution at the level found in this study led to a shortening of the luteal phase by a third of a day. Given that nearly all embryo implantations occur within a three-day window in the middle of the luteal phase, a disruption by a third of a day could represent a significant biological event. A shorter luteal phase also means a shorter menstrual cycle, which means in the long run more ovulations and more periods. Some research has suggested that a higher frequency of ovulation may be associated with an increased risk of reproductive, particularly ovarian, cancer.

A number of other papers have looked at the effects of air pollution on fecundability (the probability of conception in a given cycle), fertility (number of offspring), and fetal and infant health, and they have all reached similar conclusions. Several studies looked at people who are occupationally exposed to certain pollutants. Nail salon workers experience occupational exposure to phthalates, phthalate alternatives, and volatile organic compounds; recent work published in Environmental Science and Technology found the problem may lie not only in nail product formulations but also in nail salons not adhering to proper ventilation guidelines. What's more, the volatile organic compounds emitted from salons are probably contributing to volatile pollution more broadly, according to a 2019 paper in Indoor Air. Traffic police are exposed

to particulate matter and other airborne pollutants; these subjects have been found to have lower estradiol concentrations (a type of estrogen), and higher follicle stimulating hormone concentrations (a hormone important to ovulation) than controls who are less exposed. Another study, published in 2017 in Human Reproduction, looked at mostly middle class white women from Michigan and Texas, and even with their relatively low exposure to air pollution compared to other people, the authors found some weak associations between acute exposure to some pollutants and how many cycles it took for couples to conceive. Similar research, published in 2018 in Human Reproduction, has shown reduced in vitro fertilization rates with increased exposure to certain air pollutants.

Then there are the endocrine disruptors in our water. Many communities in the United States are exposed to lead, cadmium, arsenic, and other heavy metals in the water they drink. (See "Arsenic, the 'King of Poisons,' in Food and Water," January–February 2015; "First Person: Mona Hanna-Attisha," September–October 2019; and "Moving Forward After Flint," May–June 2016.) In many parts of the country, these exposures are considered to be under an acceptable threshold by, say, the U.S. Centers for Disease Control and Prevention (CDC), but not necessarily by the members of those communities. The CDC's reference value for the acceptable quantity of lead in the blood, for instance, is 5 micrograms per deciliter and under. This is a recent shift from 10 micrograms per deciliter and under, and other experts recommend moving down this value even further to 2 micrograms per deciliter. Experts at the CDC and elsewhere are clear that there is no actual acceptable amount of lead or any other endocrine disruptor in the body: The tightrope they are walking is one of risk assessment (more on that later).

I found examples in Korea, Mexico, Canada, and the United States where lead exposure that led to a blood concentration of less than 5 micrograms per deciliter still had a negative effect on children's cognition, growth, and development. And despite the known risks, much higher exposures are experienced by kids in Nigeria whose cough syrups are often contaminated with lead, or by child laborers in Pakistan who work in battery recycling plants, an occupation with significant exposure to lead. These kinds of effects, from learning disabilities to shorter stature to delayed growth or menarche (age at first period), have downstream effects. Although lead is discussed most frequently in terms of the significant harm it causes to child development, this endocrine disruptor can also influence the reproductive systems of adults. Lead exposure does not seem to lower the concentrations of estrogens in the body; instead, it

CHEMWATCH
Bulletin Board
Curiosities
AUG. 27, 2021

interferes with estrogen receptors in a way that can block ovarian follicle development or embryo implantation, and suppress hormone secretion during puberty.

From here, we could find ourselves going back to where we started: the endless endocrine disruptors found in plastics, cleaners, cosmetics, and food. Bisphenols and phthalates, parabens, polychlorinated biphenyls, heavy metals, and all sorts of other chemicals are in our pesticides, packaging, and pore-refining serums. (See "Plastics, Plastics Everywhere," September–October 2019.) Exposure to some endocrine disruptors seems to delay menarche, yet exposure to others largely accelerates it. Phthalates and bisphenols in particular are implicated in endometriosis and endometrial cancer because both, as weak estrogens, can disrupt the natural estrogen-to-progesterone ratio in the body and therefore encourage extra growth of uterine tissue. Phthalates, even at lower doses, influence adult reproduction in mice. Most of us are exposed to many different types of endocrine disruptors that may all exert slightly different and even opposing effects, so it is hard to say for sure which ones cause the most harm, or, if you are a company relying on these chemicals, whether they really cause any harm at all.

Phthalates and bisphenols are implicated in endometriosis and endometrial cancer.

Endocrine disruptors even have effects across generations. In the case of lead, much of it is stored in bone. Because bone turnover increases in pregnancy and because lead can pass through the placenta, fetuses can experience significant lead exposure if their mothers were previously exposed. Researchers have just started measuring the epigenetic effects of phthalates across the generations—that is, the ways in which the expression of genes can be modified, and those modifications passed down, even without changes to the DNA itself. Epigenetic effects have the potential to occur not only in, say, a prenatally exposed generation, but also in the unexposed offspring of the following generation: the grandchildren of the originally exposed parents. Exposure to endocrine disruptors, then, can affect generations of children who are completely unexposed, which means that even with tighter regulation today, some populations may continue to experience disruptions of development, puberty, menstrual cycle function, and reproduction for years to come.

Many of us in the United States, with our individualistic culture, continue to think of these problems as ones that affect individuals, and therefore as having individual solutions. In addition to the fact that I now vent my

disposable menstrual pads in my bathroom to let them release volatile organic compounds before I place them against my body, I have switched my toddler to a combination of reusable and disposable bamboo pullups, and my kids now eat off stainless steel instead of using plastic plates and utensils. But you might also have noticed that although many of these exposures come from household objects we are bringing into our homes, other exposures are not up to us. Air and water pollution get into our homes and can be found not only in our food and water but also in the dust under our beds. There are ways our built environment, landscape, and neighborhoods can protect us, but even here we can see that gender and race continue to play a role in who can access risk-reducing resources.

Going Green

When I was in graduate school, the nearest park with running paths was eight blocks from my apartment. Between union organizing, teaching, and lab work, I had a lot of long days and so I often wanted to work out early. But the nearby East Rock Park in New Haven, Connecticut, was a bit creepy to run in alone, so I tended to go to the gym or run with a friend; even with a friend along, we often opted to run at the nearby high school track instead of going to the park. Green spaces are supposed to be good for us: They provide ways to reduce air and noise pollution, avoid indoor pollution, and get some physical activity. These are all good for menstrual health. But who can use them? Women, gender diverse, and gender nonconforming runners do not feel comfortable running alone in many settings, for good reason: They have both legitimate and acculturated fears for personal safety. I've had cars pull over and men yell at me to smile; an acquaintance recently shared a time a driver pretended to hit her in a crosswalk. And sexism is not the only factor that can put you at risk when you try to enjoy the outdoors. Tamir Rice was playing in a park. Ahmaud Arbery was going for a run.

Green spaces are supposed to be places for people to reduce their psychosocial stress and improve their mental health, but people who are not men don't necessarily experience them that way. In one study, published in 2014 in Landscape and Urban Planning, researchers had participants go through a classic stress test, and then exposed them to realistic, three-dimensional videos of neighborhoods with varying amounts of greenery to measure whether greenery exposure had any effect on participant recovery from the stress test. The researchers found that the men who participated had mild improvements in recovery, but the women did not. In another paper, published in 2014 in the Journal of Epidemiology and Community Health, researchers looked at green space

CHEMWATCH
Bulletin Board
Curiosities
AUG. 27, 2021

availability within neighborhoods as well as a number of mental health indicators: Again, there were different relationships between mental health and green space by gender. For men, the relationship was linear, meaning the more green space in their neighborhoods, the better their mental health. For women, however, the relationship was U-shaped, where better mental health was associated with moderate rather than low or high green space. The greatest benefit of green space for mental health in men was seen starting in their early thirties and remained fairly stable throughout their lives; for women, there was no benefit of green space until their mid-forties, and the benefit then increased with age. As a woman in my forties, I can say that my experience with street harassment has dropped off considerably, and I can't help but wonder if that helps explain the gender difference.

When it comes to endocrine disruptors, one of the main things a green space should do is serve as a literal buffer between a person and these pollutants. And this buffering has been supported in two recent studies published in Environmental Research, one out of the United States and one out of Iran. These papers have shown that exposure to air pollutants is associated with lower anti-Müllerian hormone levels—this hormone is often used as a rough estimate of one's "ovarian age," and a lower value of anti-Müllerian hormone generally corresponds to fewer eggs. This finding matches the aforementioned literature that many endocrine-disrupting pollutants can compromise menstrual health.

Both studies have also shown that green space in one's neighborhood is associated with an increase in anti-Müllerian hormone; in the U.S. sample, the green space effect was only true if the air pollutants were also low. Air pollution and green space are differentially distributed in the United States by socioeconomic status and race. So, not all communities with access to green space are able to reap their health benefits (which extend far beyond buffering from pollution exposure), because of the ways air pollution or safety concerns nullify any of the effects.

Is Resisting Phthalates Futile?

If any of you are like me, you've hit this portion of the article and wanted to go on a shopping spree to replace all the plastic in your home. A menstrual cup might reduce one's exposure to some endocrine disruptors—but only when one buys the most expensive cups, because medical-grade silicone is not a strongly regulated material and in some cases could still contain endocrine disruptors. These cups can still leak, so a heavier bleeder will need a backup, but most disposable and many reusable backups also

contain plastic. Green space will help—but only if one is rich enough to live in a lower-pollution area, and if one's body (usually white, usually male) is not threatened regularly. Maybe some of these things will reduce your exposure.

But this framing around individual product replacement is a scam for two reasons. First, this idea of personal responsibility tends to be gendered, falling in particular on women and gender-diverse people. Women often perform the labor of minding risks and trying to reduce them, and many studies of intergenerational harms are framed in ways that blame mothers for their own exposures.

The second reason is that this individual framing misses out on the chance to notice the structural one. To see the structural problem clearly, it helps to look back to a time when plastics were not widely disposable or a major source of pollution.

The temptation so often when dealing with pollutants is to imagine an "away" where they do no harm.

In 1956, Lloyd Stouffer, then-editor of the magazine Modern Packaging, encouraged a room full of attendees at a conference of the Society of the Plastics Industry to start thinking about one-time use plastics as the key to get continuing customers. "The future of plastics is in the trash can," he said, meaning that disposable plastics would gain more consumers and make more money than multiuse plastics that one buys only once. In 1963, Stouffer wrote a review for the Society's annual conference reflecting on that talk and where plastics had gone. "It is a measure of your progress in packaging in the last seven years that this remark will no longer raise any eyebrows. You are filling the trash cans, the rubbish dumps and the incinerators with literally billions of plastics bottles, plastics jugs, plastics tubes, blisters and skin packs, plastics bags and films and sheet packages—and now, even plastics cans." He continued, "The happy day has arrived when nobody any longer considers the plastics package too good to throw away."

Because that's just it, isn't it? The temptation so often when dealing with pollutants is to imagine an "away" where they do no harm. But as Max Liboiron of Memorial University in Canada says in their recent book Pollution Is Colonialism, there is no "away." (For more on Liboiron's work, see "How Climate Science Could Lead to Action," January–February 2020.) People live near landfills; people rely on polluted waterways for food and income. Pollutants from landfills leach into groundwater. We are at the

CHEMWATCH
Bulletin Board
Curiosities
AUG. 27, 2021

point where we have polluted our planet, affecting not just our species but entire ecosystems.

In the early days of conservation efforts by settler scientists in the United States, researchers applied locational data on the Ohio River to our understanding of how pollution gets into (and supposedly out of) our water more broadly. They developed a threshold model, where there is a quantity of pollution you can pump into a river, under which the river can still recover. As Liboiron points out, both the eager corporate development of disposable plastics and the well-meaning conservationists' threshold model assume one has access to Indigenous Land to put pollutants. Here, Liboiron does not just mean current tribal lands and reservations, but rather the land that was originally occupied by Indigenous peoples, and that settlers took from them. The assumption that this land is available to take and use as settlers wish, and that they consider some parts of the land acceptable for storing pollutants (to protect some but not all people, places, and beings), undergirds the entire mitigation strategy of the United States. In other words, the disposable model from the plastics industry and the threshold model from conservationists are both permission-to-pollute models that never really asked permission.

Pollution, then, is an ongoing and essential component of colonialism. "Colonialism is more than the intent, identities, heritages, and values of settlers and their ancestors," Liboiron writes. "It's about genocide and access." And although endocrine disruptors are everywhere, they are unevenly distributed, causing additional violence toward Indigenous communities.

When scientists participate in pollution science, or in a discussion, say, about phthalate exposure, we enable a process of what Patricia O'Brien, in her classic 1993 Professional Biologist article "Being a Scientist Means Taking Sides," called assimilative capacity assessments rather than alternatives assessments. An assimilative capacity assessment would ask how much pollution scientists have decided the planet can tolerate, whereas an alternatives assessment would entail imagining a path where scientists and nonscientists together decide that no harm to people, other beings, or land is acceptable. As of now, most of the replacements for phenols and phthalates appear to be as bad, if not worse, than the originals. An alternatives assessment here is not as simple as replacing an ingredient. We need to reconsider the ubiquity of endocrine disruptors in our society as a whole.

Taking this broader view, you could consider getting a menstrual cup (not everyone can tolerate them and it takes time to find the right one), and also teaching others to use them, because there is a significant learning curve. Maybe get a water filter if you can afford one (the ones that filter lead can be expensive), and also discuss with your local politicians about allocating more funds to your community's infrastructure. Changing the frame allows us to see and act in solidarity across many communities and constituencies affected by the production, distribution, and dumping of polluting substances. What do you see when you change yours?

americanscientist.com, 1 September 2021

https://www.americanscientist.org

As populations grow, how will thirsty cities survive their drier futures?

2021-08-18

"Apocalyptic." That's how it felt, says Charlene Pepler of life in Cape Town, South Africa, as the metropolis edged toward Day Zero in 2018. Following a record-breaking drought, this city of more than 4 million people was about to turn off the taps: Day Zero referred to the point at which dams supplying the city's water fell below 13.5% of capacity, forcing the shutoff of municipal supplies.

"There were these photos of how we'd have to queue for water at places guarded by the military with guns. It was very scary," recalls Pepler, a Cape Town citizen and tour guide who depends on showcasing the appeal of her city to international tourists for a living.

Saved by the rain, and substantial voluntary reductions in daily water use by Capetonians, Day Zero was narrowly averted, but it serves as a grim reminder of the unprecedented challenges faced by the world's expanding cities as they try to guarantee safe and sufficient water for residents in a time of escalating climate chaos and increased precipitation uncertainty.

The mega challenges of a water insecure future

Though more than half the world's nearly 8 billion people now reside in urban areas, a projected 68% will do so by 2050 — meaning that lessons learned in Cape Town and elsewhere need to be rapidly applied to avoid disaster.

Over the past 20 years, progress has been made to improve living standards and help billions gain access to safely managed drinking water

Day Zero referred to the point at which dams supplying the city's water fell below 13.5% of capacity, forcing the shutoff of municipal supplies.

CHEMWATCH
Bulletin Board
Curiosities
AUG. 27, 2021

services. But over that same period, the number of city inhabitants lacking safely managed drinking water has still grown by more than 50%. Worse news: electricity generation and domestic use will be major drivers of a global increase in water demand of 55% by 2050, according to the 2021 Progress Report on SDG 6, the Sustainable Development Goal to ensure access to clean water and sanitation for all by 2030.

Over the coming decades, climate change will bring unexpected changes in the temporal and spatial distribution of water resources. As greenhouse gas emissions increase, the frequency and intensity of water-related disasters, including droughts and floods, are projected to rise significantly, with impacts felt in developing and developed nations.

In fact, those effects are already hitting home. Brazil is currently facing its worst drought in 91 years, with rain likely to remain scarce in some states until September, potentially impacting a third of the country's population. Large tracts of the western United States are also currently experiencing severe and exceptional drought — referred to by some as a mega drought (a period of extreme dryness lasting for decades), a water crisis pushed into extreme territory by climate change.

Additionally, industrialized agricultural practices and their expansion, along with destructive land-use change, ranging from deforestation to pollution, will widely disrupt ecosystems, further contributing to a decline in water quality and availability in cities.

The search for urban water solutions

In the past, governments trying to meet soaring urban water demand would typically look to the expansion of existing water infrastructure. But in many urbanized areas today, available surface water and groundwater sources have already been fully allocated, or even depleted.

Instead of looking farther afield, or digging deeper, progressively stronger calls are being made to find sustainable answers within urban areas and their catchments, and via urban water management strategies.

"We certainly believe that's where solutions lie," says Kirsty Carden, acting director of the Future Water Institute (FWI) at the University of Cape Town. This transdisciplinary research institute addresses issues of water scarcity across South Africa and is one of a handful of organizations globally that focus on water-sensitive urban design (WSUD). This approach entails a complete reimagining of the role and use of water in urban areas, and

is already being applied to varying extents in cities worldwide with promising results.

Water-sensitive urban design

A city's structure and population pose a severe disruption to the planetary and regional water cycle, with water management on a megalopolis scale traditionally achieved via an engineering feat by which a vast amount of water is extracted from surface and groundwater sources, treated and piped over large distances for use, only to be treated again, and discharged.

Concurrently, as urban impermeable surfaces — including roads, parking lots and buildings — increase, water that can no longer infiltrate underground becomes a flood risk. As a result, stormwater systems swiftly transport rainwater out of a traditional city, often via combined sewer and stormwater outflows (CSOs) with pollutants picked up along the way. When built, these gigantic but antiquated systems rarely considered environmental sustainability or the impacts within the city's watershed, both upstream where water is stored and extracted, and downstream where it is discharged.

By contrast, WSUD embraces the water cycle, integrating cities into it. The concept, developed in Australia in the early '90s, originally focused on sustainable stormwater drainage systems. As an alternative to traditional stormwater systems, WSUD relies heavily on nature-based management solutions. Green roofs, rain gardens, permeable pavements and vegetation strips are examples of "green" infrastructure applied close to where stormwater is generated. On a larger scale, artificial wetlands and detention ponds (large depressions that store stormwater runoff) can serve to decrease the volume and speed of runoff and guide water to seep underground to recharge the water table.

WSUD's benefits ripple far beyond stormwater and flood management. Less pollutants are transported via the stormwater system, improving water recreation areas, while plants cool cities down, improve air quality, increase biodiversity and create pleasant urban living spaces.

And it saves money: the city of Toronto, Canada's most populous metropolitan area, adopted a "green roof" bylaw in 2009 that required the construction of green roofs on new developments. Program achievements published in 2018 included the diversion of 11 million liters (2.9 million gallons) of stormwater from sewers annually, saving the city about $100,000 in stormwater management. Due largely to a reduced need

CHEMWATCH
Bulletin Board
Curiosities
AUG. 27, 2021

for air-conditioning, roughly 1,000 megawatt-hours per year in energy savings is also achieved, with roughly 220 metric tons of greenhouse gas emissions avoided.

WSUD has over time developed into a sweeping vision that focuses attention broadly over the entire urban water cycle to create a city that is resilient to the impact of shock events like droughts and floods, while delivering sustainable benefits to all residents and the environment.

Conscious design allows water to be recycled and reused repeatedly for various purposes depending on its quality. Under WSUD, waste and grey water, stormwater and treated sewage effluent are not negatives to be gotten rid of, but are positive potential water resources to draw supply from, as are groundwater and desalinated seawater, over and above the traditional options of surface and groundwater.

A key aspect of WSUD is water conservation all along the supply path; water resources must be protected, and water must be used as efficiently as possible by all users.

WSUD also seeks to not only create water security in the urban area where it is being practiced, but is cognizant of the impact of achieving water security throughout the entire watershed in which that city is located. Such an approach must factor in other uses that compete with urban requirements, such as agriculture and industry. By considering and integrating all these aspects, the threat of shortages due to system stress is reduced.

Our water future: Singapore puts WSUD into practice

Commonly, the evolution of water-resilient urban areas proceeds through different states, starting historically with the traditional development of clean and sufficient water supply systems, sewage and drainage systems. The next stages include considerations for environmental health and threats to water supply security.

Further along the continuum, city utilities start to tap into nontraditional water sources such as wastewater and stormwater. Finally, in a so-called water-sensitive city, water is embedded as a critical element of urban planning. Infrastructure becomes adaptive and multifunctional. Communities partner with utilities to deliver water services, while governance supports accountability and collaboration.

Still, WSUD is not a one-size-fits-all solution. "Everybody's situation is different depending on climate, water, development status and so forth,"

FWI's Carden says. But importantly, there are functioning WSUD examples out there demonstrating that things can be done differently and well, and pointing the way toward a hopeful future. Singapore is perhaps the best-known case.

Identified by the World Resources Institute in 2015 as one of 33 out of 167 countries most likely to face extreme water stress, Singapore's future water security is built on a suite of solutions in line with water-resilient rationales.

Already, the sovereign island city state is maximizing water yield, and is one of the few nations on Earth to substantially harvest urban stormwater for potable consumption. Though water is still imported from neighboring Malaysia, Singapore's future water security will depend on highly purified reclaimed water known as NEWater, produced from treated used water, including sewage, and further purified with advanced membrane technologies and ultraviolet disinfection. Singapore will also increasingly depend on desalination, with a number of plants already opened since 2005. In this far-seeing, all-encompassing hydro system, waterways and reservoirs double up as public recreation facilities, while residents are expected to play a critical role, conscientiously reducing daily per capita water use.

But Singapore is a wealthy nation, and attaining water resilience there and elsewhere in the developed world is relatively easy when compared to challenges encountered in developing countries, Carden says.

According to U.N. statistics, developing countries account for 93% of urbanization globally, 40% of which occurs in often haphazard slum expansion — 30% of today's city dwellers reside in extremely poor neighborhoods. In a country like South Africa, for example, many residents do not even have access to basic services. That is why in South Africa reference to the word "urban" in WSUD has been removed, with water-sensitive design (WSD) the preferred term, in recognition of informal settlements included in development plans. "The need here is for a balance between providing all residents a similar level of service to maintain their livelihoods," Carden says.

Our water future: South Africa's WSD water-resilient settlements

In South Africa, the WSD concept is relatively new, with the country's first framework, co-authored by Carden, published in 2014. However, due to rapidly mounting pressure on the country's freshwater resources, Carden says there is already a significant push in the nation's big metro areas to set up WSD strategies. In the wake of the worst drought that the Cape

CHEMWATCH
Bulletin Board
Curiosities
AUG. 27, 2021

Town region has confronted in recorded history, the infamous Day Zero water emergency, the city has emerged at the forefront of ambitious WSD planning.

Cape Town aims to be water resilient by 2030, and a water-sensitive city by 2040. Resilience is defined as the ability to withstand and thrive in the context of an extreme shock event, says Gareth Morgan, Cape Town's director of resilience. In this scenario, Cape Town should be able to withstand a significant drought event, with water restrictions only marginally impacting the continuity of businesses and households, compared to the Day Zero drought that had a discernable impact, Morgan says.

In the 2040 scenario of a water-sensitive city, Morgan says there will be far more integrity embedded into the city's water cycle. This means water will be reused to a much greater degree, and the quality of water discharged into downstream waterways will be good enough for people and the environment when used for recreation or by ecosystems.

In Cape Town's Water Strategy, the roadmap leading to a sustainable future where there will be sufficient water for all, despite climate and other shocks, the first priority remains safe access to water and sanitation for all residents, with well-defined minimum standards. Second, the city has committed to promote the wise use of water; that includes water conservation and minimizing losses in the water transport system, a critical concern.

Globally, water loss, or non-revenue water (NRW), is a serious challenge. Research shows that an estimated 346 million cubic meters (91.4 billion gallons) of water is lost by water utilities around the world every day, either through leakage in vast water transport systems or illegal connections, worth about $39 billion per year. A reduction of just one-third of these losses would save enough water to supply 800 million people with a sufficient amount of 150 liters (40 gallons) of water each per day.

Cape Town has already substantially improved on its water losses. Currently, an average of 37% of all water supplied to South African municipalities is lost, but Cape Town's loss figure comes in at around 16%, less than half the national rate, and the lowest of any South African metro area.

Ensuring that the water cities already have is used as efficiently as possible, before sourcing new water supplies, is fundamental to any urban water

solution, says Robert McDonald, lead scientist for nature-based solutions at The Nature Conservancy (TNC), an NGO. McDonald researches the impact and dependencies of cities on the natural world.

He notes that invasive vegetation, for example, has become a chronic problem in the world's urban areas, with invasive plants continuously being cleared from Cape Town's water catchment. Research shows that investment in clearing these system-clogging exotic plant species and restoring the city's primary catchments will yield water at a cheaper rate than building new dams, installing desalination plants or drilling boreholes — demonstrating that cooperating with nature is not only smart, but economically beneficial.

Sourcing new supplies in Cape Town

When water supplies do have to be increased in future as part of the long-term city planning process, the natural limits of an urban watershed's water supply should be respected, McDonald says.

For Cape Town, future water resources being explored include underutilized aquifers, water reuse, and desalination. Over and above reliance on diversified water resources, the water transition of Cape Town includes making optimal use of stormwater and urban waterways for the purposes of flood control, aquifer recharge, water reuse and recreation, based on sound ecological principles.

The future of Cape Town's water security is dependent on everyone in the sector, ranging from local and national government, to users at the household and business level, Morgan explains. It will require close collaboration between stakeholders and partners in the catchment, including other urban and agriculture water users and spheres of government.

Despite the work done so far, FWI's Carden says she doesn't expect to see a transformative moment when the municipality can suddenly proclaim itself a water-sensitive city. Instead, the transition will be incremental, and happen as a combination of city- and resident-led initiatives integrate a groundswell of support in communities, involving everyone in activities such as river cleanups and water conservation efforts.

"Cities have overcome huge water challenges" in the past, TNC'S McDonald says. "When there's an economic need for cities to grow, cities tend to find water." However, he adds there are big costs associated with that growth, and the political will to succeed is integral.

CHEMWATCH
Bulletin Board
Curiosities
AUG. 27, 2021

Over the long term, water stress can be overcome, he argues, but options will become much more limited and expensive the longer stakeholders wait, and the intensity and occurrence of climate change-induced extreme droughts increase. McDonald hopes cities start planning for their water security and for extreme climate events now, rather than waiting for the crisis to deepen.

Cape Town is a case in point. The water conservation strategies it began implementing before the infamous drought contributed greatly to averting disaster. Since 2018, the city has taken large steps to become more resilient to crises. And, Morgan says, the lessons learned are as applicable to drought as to floods and fire. "I would encourage many other cities to look at water through a multitude of angles and not merely as an engineered service," he says.

For many Capetonians, the direct experience of their city's nearly disastrous collision with Day Zero forever changed their perspectives regarding water. "All the things that we now do in Cape Town, like growing water-wise gardens and not flushing our toilets after every pee can be incorporated in other big cities," Pepler concludes. "I absolutely used to take water for granted, but I will never do it again."

news.mongabay.com, 18 August 2021

https://www.news.mongabay.com

World's most elusive giant squid could be monogamous, female corpse hints

2021-08-20

A female of the world's largest squid — sometimes called the "kraken" after the mythological sea monster — that was caught off the coast of Japan apparently had just one amorous encounter in her lifetime.

The female had sperm packets from just one male giant squid embedded in her body, which surprised researchers. Because giant squid are solitary creatures that probably run across potential mates only occasionally, scientists expected that females would opportunistically collect and store sperm from multiple males over time.

"We were almost confident that they are promiscuous," said Noritaka Hirohashi, a biologist at Shimane University in Japan. "We just wanted to know how many males are involved in copulation. So this is totally unexpected."PLAY SOUND

The female had sperm packets from just one male giant squid embedded in her body, which surprised researchers.

Mysterious mating

Hirohashi and his colleagues study reproduction and sperm biology in several squid species, but the most mysterious of all is Architeuthis dux, the giant squid. Rarely seen alive, the giant squid has a life cycle shrouded in deep ocean mystery. Video of living giant squid in their natural habitats has been captured only twice. The only thing researchers know about these mysterious creatures' mating habits is that female giant squid are sometimes found with large sperm packets known as spermatangia embedded in their muscles. Researchers writing in a 1997 paper in the journal Nature posited that male giant squid probably use their "muscular elongate penis" to inject the sperm packets into the females.

How sperm meets egg from there isn't entirely clear. It's possible that the female releases chemical cues that activate the sperm when she's ready to spawn, or perhaps she releases her eggs in such a way that they trail along the sperm packets as they leave her body. Squid females do have organs near the mouth called seminal receptacles, where some species storm sperm, and it's possible that in those species, the embedded sperm can travel over the skin to these receptacles.

Knowing that witnessing two giant squid mating is highly unlikely, Hirohashi and his team developed a window into the process, using genetics. Examining squid specimens from fisheries and museum archives, they pinpointed some segments of the giant squid genome that would distinguish one set of squid DNA from another. Think of it like a squid paternity test: Any sperm packets found on a female can be tested to see if they came from multiple males and, if so, how many.

The researchers are always on the lookout for sperm-spangled females. They send out flyers to local museums, fisheries and aquariums, asking them to alert the research lab if a giant squid specimen turns up. In February 2020, they got good news.

"In this case, we found [a] Yahoo News [article] telling that the giant squid was caught," Hirohashi wrote in an email to Live Science.

Saving sperm

The specimen was a female, with a mantle, or main body, 5.25 feet (1.6 meters) long. It was missing a pair of tentacles and one eye but still weighed 257 pounds (116.6 kilograms). The squid had been caught in a fisher's net in Kyoto and was displayed at the Miyazu Energy Aquarium before being dissected.

CHEMWATCH
Bulletin Board
Curiosities
AUG. 27, 2021

When Hirohashi's team examined the body, they found that the squid was just reaching maturity and that it had squiggly spermatangia 3.9 inches (10 centimeters) long embedded in five separate locations: three places on the squid's mantle, one by an arm and one on the head. Each location hosted at least 10 spermatangia. Some were near gashes that may have been caused by a mating male's beak.

Genetic analysis of the spermatangia revealed that each and every one came from the same male. This was shocking to the research team; giant squid are often found bearing sperm packets, in a way that suggests that males aren't particularly picky. Spermatangia have been found on immature females, perhaps as a way for males to make their sperm available after the female matures, and even on males, perhaps because males are willing to try anything (or perhaps because they sometimes accidentally self-fertilize). All of the evidence pointed to a species that would mate first and ask questions later.

The specimen, of course, is just one female, so more research is needed to see if monogamy is the norm among giant squid females. It's possible that this female had simply only encountered one male before she was entangled in the net that ended her life, the researchers wrote in the September issue of the journal Deep Sea Research Part 1. Or perhaps it is typical for females to mate with just one male. The gashes might be part of the males' strategy for ensuring other males don't move in, perhaps by limiting a female's life span after mating so that she doesn't have time to collect more sperm. Or, the researchers speculated, the aggression and injuries could spur the females to mature and spawn so that the sperm is speedily fertilized.

The next step is to study the spermatangia of more specimens, Hirohashi said. And researchers need to figure out how the stored sperm reaches the eggs, which are not deposited particularly close to the spermatangia. Researchers also need to figure out basically everything else about this elusive creature, including its life span, migration and habitats, he added.

"Kids ask these questions at the aquarium, so we must answer," Hirohashi said.

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The outdoors is having an automotive moment

2021-08-19

A Land Rover drives through the wilderness. Beside it, trees tower above a packed dirt path. A straight couple with two kids sit inside, in splendorous isolation, as callouts appear and fade: Improved performance. Enhanced second row seat comfort. Intuitive infotainment. And then a midscreen chyron appears, surrounded by animated oxygen molecules flowing from the vents: Cabin air ionization. It's a telling proclamation as Americans begin to resume somewhat regular life 20 months after the arrival of COVID-19.

"Going into the pandemic, the narrative was very strong around shared mobility. But coming out of the pandemic, it was very clear that private-car ownership is back at the top of consumers' agenda, because a car becomes a part of your cocoon," says Rich Agnew, global brand communications director for Land Rover.

Unlike a house during lockdown, a vehicular cocoon is mobile, and it has a destination—away. So carmakers are capitalizing on our desires to get there. "We have a campaign running at the moment, which is Outspiration," says Agnew. "We're on a mission to reconnect the nation with the great outdoors."

Land Rover is not alone. Brands across the economic spectrum have enhanced the role of the outdoors in their consumer messaging over the past year and a half, showing individuals and family units that are using their vehicles to get away from it all—the enclosed spaces, crowds, and urban density.

This isn't exactly a new message. The desire to be immersed in, or conquerors of, the land—and freed from citified confines—is foundational to the American mythos. It is entrenched in the racist and colonialist notion of Manifest Destiny, in the reverential landscape paintings of Frederic Church, and in our ostensible handbook, the Holy Scriptures.

The most recent spate of consumer messaging does more than simply capitalize on our fantasy to separate ourselves from other humans and our innate misery. It reflects a shift in consumer behavior.

Automotive brands have been capitalizing on this notion since the inception of the car. The song "In My Merry Oldsmobile," from 1905, tells the story of a couple who go for a ride in the country and fall in love, and it was used for decades as an ad. In the 1920s, camping in cars in the great

It's a telling proclamation as Americans begin to resume somewhat regular life 20 months after the arrival of COVID-19.

CHEMWATCH
Bulletin Board
Curiosities
AUG. 27, 2021

outdoors became such a national fad that ads for the pastime proliferated in newspapers—even Thomas Edison, Henry Ford, and President Warren Harding went "vagabonding" together. (Car camps took a turn during the Depression and became Hoovervilles—villages where the despondent lived in their vehicles.) The first ads for Land Rover, in the late 1940s, read "The Go Anywhere Vehicle" and showed the truck driving over an ocean, on a globe. The modern luxury SUV, the Jeep Grand Wagoneer—with its rectilinear styling, leather interior, iconic fake-wood paneling, and power windows, seats, and locks—was introduced in the 1980s and ended up being the most appealing regular production vehicle to Americans with the highest household income. Automakers noted the trend. Predicated on cheap gas, a blind reverse mortgaging of the planet's health, and a bunker ideology, these vehicles grew—and grew in popularity. Today more than three-quarters of new vehicles sold in America are trucks, vans, and SUVs.

Communications professor Shane Gunster, in his 2004 Ethics and the Environment journal article "You Belong Outside: Advertising, Nature, and the SUV," presciently labeled commercial images of the outdoors in automotive advertising as "common signifiers of utopia, tirelessly making the case that a certain commodity or brand will enable an escape from the malaise and drudgery of urban existence." Yet the most recent spate of consumer messaging does more than simply capitalize on our fantasy to separate ourselves from other humans and our innate misery. It reflects a shift in consumer behavior.

According to Alexander Edwards, president of the automotive-research and consulting firm Strategic Vision, this shift has been quite profound. "Pre-pandemic, people were using their vehicles mainly to perform tasks like commuting, chauffeuring their kids, and running errands," Edwards says. "But deep into the pandemic, and after, they are significantly more likely to have increased behavior in four key areas, including going on vacation, carrying large items like bikes or kayaks, going off-road in dirt and gravel, or going off-road in rocks and sand."

Edwards notes that the increases in usage are between 5 percent and 8 percent, specifying that, in an annual new-vehicle market of 17 million cars, "even a 1 percent increase is huge. There are literally hundreds of thousands of people who are doing these activities more often."

Sales of electric vehicles hit record highs in the first quarter of 2021. Purchases of pure electric vehicles increased by nearly 45 percent over 2020, and those of hybrids more than doubled.

Those of us who use the trails regularly have noticed this shift, and not always pleasurably, as parking lots and garbage cans overflow and etiquette diminishes. Automakers with an outdoorsy fan base have found creative ways to assist with these issues—and alert consumers to their efforts. Subaru used the pandemic to advertise the fact that it is the largest corporate donor to the National Parks Foundation and was working with the parks to help reduce the amount of trash and make them zero-landfill destinations.

Subaru also recognizes that its consumers want to get away from these invading hordes. "With the parks being so crowded, our owners are going to go a little further out, because they're probably more comfortable outdoors than the new arrivals," says Nicole Riedel, the brand's carline planning manager. "So we had to get a vehicle to them that can get them there."

The brand's solution was the creation of an all-new model, the Outback Wilderness. (Ad line: "The need for adventure lives within all of us. But for some, the need is much greater.") Equipped with a jacked-up suspension, stouter tires, modified front and rear overhangs, and an enhanced all-wheel-drive system, it's a factory-built overlanding vehicle, with full-warranty coverage.

Automakers do not see these pandemic-influenced shifts as temporary. "Reconnecting with their families and with the outdoors is valuable for mental health, for resilience to get through every day, not just in the pandemic," says Agnew. "I think that's a good correction in society. We predict that won't go anywhere in the short term."

Subaru concurs. So much so that it's expanding its Wilderness into a full family of vehicles. "As the customer moves more to the millennial and Gen Z, they're looking for authentic experiences. They don't want fussy fancy meals or hotels, they want to get out and do things themselves," Riedel says. "And with mental wellness joining physical as part of a wellness package, the outdoors ticks two boxes. We think it's definitely something that is going to become a bigger and bigger part of people's lives."

Yet all of this masks larger, darker issues occupying our collective dreams and destinies.

But isn't there some hypocrisy to utilizing the outdoors to promote a purchase that is, in many ways, responsible for the destruction of the planet? (Outside has enthusiastically reviewed many such vehicles and partnered with these companies on advertising deals.) Carmakers

CHEMWATCH
Bulletin Board
Curiosities
AUG. 27, 2021

have noted their moves toward electrification, their commitments to sustainability during the manufacturing process, and their general insistence on beneficent environmental stewardship. Some of this is clearly marketing lip service, and far greater regulatory efforts are needed to help nudge consumers into more sustainable choices, and place checks on a slow-moving industry that contributes heavily to climate change.

Interestingly, engagement with the outdoors is affecting consumers' automotive attitudes in other significant ways. "With the pandemic, and this reawakening, people have been even more likely to look at electric vehicles and hybrids," says Edwards. "Not because of saving gas money—that wasn't on their mind at all—but to be globally conscious and mindful of the world around them."

Again, this has translated to direct action. Sales of electric vehicles hit record highs in the first quarter of 2021. Purchases of pure electric vehicles increased by nearly 45 percent over 2020, and those of hybrids more than doubled. This is an important trend, as it takes numerous considerations for people to shift to more environmentally friendly, battery-powered vehicles. "In the pandemic, and since, people who looked at hybrids and EVs five or six years ago and dismissed them decided maybe it's time to look at them again," says Edwards. "That was the starting point, in March to May of 2020, as reporting on great environmental changes around the world took on greater importance, and people were attending to it, in part because they were not traveling."

Automakers will continue to roll out dozens of new electric-powered vehicles over the next year or so. And one of the key areas of focus is creating EVs in market segments where consumers are already shopping: trucks and SUVs. This kind of paradigm shift will be necessary—perhaps more necessary than consumers are able to change—to help overcome the global environmental issues we face. But this change in our understanding will also require confronting darker issues occupying our collective dreams and destinies.

"When most people think about the future, they come up with images of a post-apocalyptic world," says Richard Louv, bestselling author of Last Child in the Woods, The Nature Principle, and Our Wild Calling. "And one of the questions I ask is, What happens to a culture when those are the only images it can easily conjure of the future? You know the saying, 'Be careful what you wish for, it might come true'? Be careful what you imagine, it might come true."

Louv posits that we need to conceptualize a new way of envisioning our fate, and our place in it, which he calls imaginative hope. "We have to start to come up with images of a new future. A beautiful future. Not just a sustainable future," he says. "This is going to take a real effort."

Images of electric cars rolling silently through vibrant, sustainably powered greenbelt cities might represent just this and take the place of automakers' alfresco fantasies. Whether the cars' windows are open or closed remains to be seen.

outsideonline.com, 19 August 2021

https://www.outsideonline.com

Rattlesnake rattles use auditory illusion to trick human brains

2021-08-20

The menacing rattle of a rattlesnake's tail is far more sophisticated than first thought, as the sound can create an auditory illusion that suggests the venomous snake is closer to a potential threat than it really is, according to a new study.

Scientists think that rattlesnakes "rattle" the keratin structure on their tails to warn off predators, gradually increasing the frequency as a possible attacker gets closer. But now they've found the snake may have another trick in its arsenal — a sudden frequency jump in the rattling sound that it uses to fool its listener.

"Our data show that the acoustic display of rattlesnakes, which has been interpreted for decades as a simple acoustic warning signal about the presence of the snake, is in fact a far more intricate interspecies communication signal," senior study author Boris Chagnaud, a professor of neurobiology at Karl-Franzens-University Graz in Austria, said in a statement.

Chagnaud discovered the first clue to the mystery of rattlesnakes' "smart signal" high-frequency mode while approaching one of the snakes during a visit to a laboratory. He noticed that the frequency of the snake's iconic rattle increased before suddenly jumping as he approached, but decreased as he retreated.

To figure out what was behind this phenomenon, he and his team recorded the frequency of the rattle as various objects — including a human-like torso and a black disk — were brought closer to the snake. As

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CHEMWATCH
Bulletin Board
Curiosities
AUG. 27, 2021

threats first approached, the rattling rose by a steady rate to a frequency of 40 Hz, but as the objects came closer, the frequency suddenly jumped to between 60 and 100 Hz. According to the researchers, the rattling rate increased more quickly the faster the object approached, but changing the size of the object didn't impact the frequency level.

To figure out why the snake was changing its rattling rate, and why it was using a sudden jump in frequency, the researchers designed a virtual reality grassland with a virtual snake hiding inside of it. Sending 11 volunteers inside the simulation, the researchers asked the volunteers to approach the virtual snake and indicate when the creature was 3.3 feet (1 meter) away. The cyber snake increased its rattling rate as the humans approached, suddenly leaping to 70 Hz as the volunteers came within 13 feet (4 m), and was able to trick all of the human participants into underestimating their distance to it.

Chagnaud thinks that rattlesnakes weave this weird auditory illusion in order to create a "distance safety margin" between them and a potential attacker. He hypothesizes that human hearing, alongside the other mammalian auditory systems that it is closely related to, picks up on the frequency of the rattle and the rule of how it increases with distance, only to be fooled when the snake changes this rule with an unexpected, and sudden, jump in the frequency.

"Imagine you walk towards the snake, it starts to rattle slowly, increasing the rattle events incrementally. If at a distance of 2 meters [6.5 feet] from the snake, the snake suddenly changes this rule, and instead of making the 2 meter sound, it makes the sounds like it's only at 1 meter [3.3 feet], then it fooled you," Chagnaud told Live Science in an email.

Sure enough, when Chagnaud tested this hypothesis by repeating his virtual reality experiment without the frequency jumps, his human participants were far better at guessing the distance to the virtual snake.

"Snakes do not just rattle to advertise their presence, but they evolved an innovative solution: a sonic distance warning device similar to the one included in cars while driving backwards," he said in the statement. "Evolution is a random process, and what we might interpret from today's perspective as elegant design is in fact the outcome of thousands of trials of snakes encountering large mammals. The snake rattling coevolved with mammalian auditory perception by trial and error, leaving those snakes that were best able to avoid being stepped on."

Curiosities

AUG. 27, 2021

The researchers published their findings Aug. 19 in the journal Current Biology.

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AUG. 27, 2021

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CHEMICAL EFFECTS

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