CHEMWATCH

Bulletin Board

Contents

APR. 02, 2021

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Contents

APR. 02, 2021

CHEMWATCH
Bulletin Board
Contents
APR. 02, 2021

ASIA PACIFIC

How the pollution control commission been effective in curbing pollution in the NCR?

2021-03-22

Air pollution constitutes the most critical environment health risk facing our global population. It is estimated to contribute to seven million premature deaths every year. For 92% of the world population, it is estimated to breathe toxic air quality (WHO 2016). India has been endeavouring to reduce air pollution in the country since decades. Enactments and guidelines of courts to reduce air pollution includes Air (Prevention and control of pollution) Act, 1981, Environment (Protection) Act, 1986, National Green Tribunal Act, 2010, L.K. Koolwal v. State of Rajasthan case upholding the Constitutional right to a clean environment, MC Mehta's case Union Carbide corporation v. UOI propounding absolute liability principle and so on.

Regardless of the profuse of statutory and administrative framework, especially in the National Capital Region (NCR), the quality of air remains a cause of concern on account of the absence of vigorous implementation of measures and policies. In July 2019, India formally joined the Climate and Clean Air Coalition (CACC) of the United Nations Environment Programme (UNEP). The Minister of Environment, Forest and Climate change Mr Prakash Javadkar underlined India's commitment to combat air pollution with a solution oriented approach.

In the World Air Quality Report, 2019, six out of the 10 most polluted cities of the planet were in India, all located in the NCR. In order to provide a permanent solution and establish a self-regulated, democratically-monitored mechanism for tracking air pollution in Delhi and adjoining states, the President of India, in exercise of the powers conferred by Clause (1) of Article 123 of the Constitution of India promulgated the ordinance "The Commission for Air Quality Management in National Capital Region and Adjoining Areas Ordinance, 2020, on October 28, 2020.

About The Ordinance

Composition of the New commission

The Commission will be chaired by a full-time chairperson who has been a Secretary to the Government of India or Chief Secretary to a State government.

For 92% of the world population, it is estimated to breathe toxic air quality (WHO 2016).

CHEMWATCH
Bulletin Board
Regulatory Update
APR. 02, 2021

The chairperson will hold the post for three years or until they attain the age of 70 years.

The Commission will have members from several Ministries as well as representatives from the States.

The Commission will have experts from the Central Pollution Control Board (CPCB), Indian Space Research Organization (ISRO)and Civil Society.

Powers

In matters of air quality and pollution management, the Commission will supersede all existing bodies such as the CPCB, and even the state governments of Haryana, Punjab, Rajasthan and Uttar Pradesh. It will have the power to give instructions to the states.

The CPCB and its public power has the power to enforce provisions of the Environment Protection Act, 1986, for air, water and land pollution. Their power will continue. However, in case of dispute or a clash of jurisdictions, the Commission's writ will prevail specific to matters concerning air pollution.

The Commission will also coordinate efforts of state governments to reduce air pollution and lay down the parameters of air quality for the region.

It will have the power to restrict the creation of industries in vulnerable areas and be able to conduct site inspections of industrial units.

In the event of non-compliance with its instructions, the Commission may impose a fine of up to Rs 1 crore and imprisonment for up to five years.

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YKA, 22 March 2021

https://www.youthkiawaaz.com/2021/03/commission-on-air-quality-management-a-general/

Gazette No. 6, 23 March 2021

2021-03-23

Contents

- Agricultural Chemical Products and Approved Labels – 4
- Veterinary Chemical Products and Approved Labels – 16
- Approved Active Constituents – 18

- Amendments to the APVMA MRL Standard – 19
- Proposal to amend Schedule 20 in the Australia New Zealand Food Standards Code – 20
- Notice of Cancellation at the Request of the Holder – 24

APVMA, 23 March 2021

https://apvma.gov.au/node/83641

AMERICA

EPA finalizes cross-state air pollution rule

2021-03-23

On March 15, 2021, the U.S. Environmental Protection Agency (EPA or the Agency) published **a final rule**, pursuant to the good-neighbor provision of the Clean Air Act, which directs EPA and states to address interstate transport of air pollution that affects downwind states' ability to attain and maintain compliance with the 2008 National Ambient Air Quality Standard (NAAQS) for ozone. As we explained **previously**, the Revised Cross-State Air Pollution Rule (CSAPR) Update is EPA's rulemaking in response to the U.S. Court of Appeals for the D.C. Circuit's decision in ***Wisconsin v. EPA***, in which the court remanded an earlier EPA CSAPR update rule. EPA here found nine states (Alabama, Arkansas, Iowa, Kansas, Mississippi, Missouri, Oklahoma, Texas, and Wisconsin) required no additional regulation. For 12 states (Illinois, Indiana, Kentucky, Louisiana, Maryland, Michigan, New Jersey, New York, Ohio, Pennsylvania, Virginia, and West Virginia), EPA found that projected 2021 ozone season nitrogen oxides (NOx) emissions contribute significantly to downwind states' nonattainment or maintenance problems for the 2008 ozone NAAQS. Accordingly, EPA issued new or amended Federal Implementation Plans, which include replacement of NOX Ozone Season Group 2 emissions budgets for electric generating units (EGUs). In the final rule, EPA maintained its determination not to require additional controls on non-EGUs.

This rule does not address state obligations under the more **stringent 2015 ozone NAAQS**, which bears close watching. The 2015 rule likewise was challenged in court, with the most recent **action** on remand at the end of the last administration among the EPA regulations **being reviewed** by the Biden administration.

EPA here found nine states (Alabama, Arkansas, Iowa, Kansas, Mississippi, Missouri, Oklahoma, Texas, and Wisconsin) required no additional regulation.

CHEMWATCH
Bulletin Board
Regulatory Update
APR. 02, 2021

Read More

Lexology, 23 March 2021

https://www.lexology.com/library/detail.aspx?g=0fd71f53-959a-4469-8a23-1ea05a626543

Study: Preservative used in Pop-Tarts and hundreds of popular foods may harm the immune system

2021-03-25

A food preservative used to prolong the shelf life of Pop-Tarts, Rice Krispies Treats, Cheez-Its and **almost 1,250** other popular processed foods may harm the immune system, according to a new **peer-reviewed study** by Environmental Working Group.

For the study, published this week in the International Journal of Environmental Research and Public Health, EWG researchers used data from the Environmental Protection Agency's Toxicity Forecaster, or **ToxCast,** to assess the health hazards of the most common chemicals added to food, as well as the **"forever chemicals"** known as PFAS, which can migrate to food from packaging.

EWG's analysis of ToxCast data showed that the preservative tert-butylhydroquinone, or TBHQ, has been found to harm the immune system both in animal tests and in non-animal tests known as high-throughput in vitro toxicology testing. This finding is of particular concern during the coronavirus pandemic.

"The pandemic has focused public and scientific attention on environmental factors that can impact the immune system," said Olga Naidenko, Ph.D., EWG vice president for science investigations and lead author of the new study. "Before the pandemic, chemicals that may harm the immune system's defense against infection or cancer did not receive sufficient attention from public health agencies. To protect public health, this must change."

TBHQ

TBHQ is a preservative that is pervasive in processed foods. It has been used in foods for many decades and serves no function besides increasing a product's shelf life. Using new non-animal test results from ToxCast, EWG found that TBHQ affected immune cell proteins at doses similar to those that cause harm in traditional studies. Earlier studies have found that TBHQ

"Before the pandemic, chemicals that may harm the immune system's defense against infection or cancer did not receive sufficient attention from public health agencies. To protect public health, this must change."

might influence **how well flu vaccines work** and may be **linked to a rise in food allergies**.

PFAS

Using ToxCast, EWG analyzed all publicly available studies that show how PFAS migrate to food from packaging materials or processing equipment. This is the first known compilation of available research on PFAS migration from packaging to food. In 2017, **nationwide tests** showed that many fast-food chains used food wrappers, bags and boxes coated with highly fluorinated chemicals.

Human epidemiological **studies** show that PFAS suppresses immune function and decreases vaccine efficacy. Recently published **research** has also found a link between high levels of PFAS in the blood and the severity of Covid-19.

Surprisingly, for most PFAS, the ToxCast results did not match previous animal and human test data. This illustrates the limitations of this new chemical testing method. More research is needed to understand how PFAS harm the immune system.

Food Chemicals Regulation

The Food and Drug Administration's approach to the regulation of food additives does not consider the latest science on the health harms of additives that may be legally added to processed foods manufactured in the U.S. Last year, EWG published **Food Additives State of the Science**, which highlighted additives known to increase the risk of cancer, harm the nervous system and disrupt the body's hormonal balance.

Chemicals linked to health harms can be legally added to packaged foods because the FDA frequently allows food manufacturers to determine which chemicals are safe. Additives like TBHQ were approved by the FDA decades ago, and the agency does not consider new science to reassess the safety of food chemicals.

"Food manufacturers have no incentive to change their formulas," said Scott Faber, senior vice president for government affairs at EWG. "Too often, the FDA allows the food and chemical industry to determine which ingredients are safe for consumption. Our research shows how important it is that the FDA take a second look at these ingredients and test all food chemicals for safety."

CHEMWATCH
Bulletin Board
Regulatory Update
APR. 02, 2021

Read More

EWG, 25 March 2021

https://www.ewg.org/release/study-preservative-used-pop-tarts-and-hundreds-popular-foods-may-harm-immune-system

EUROPE

Regulation renewals for Turkey's environmental vision

2021-03-24

Environmental problems are one of the root causes of today's frequent disasters and pandemics. In this respect, a substantial transformation is happening in the world, whereby a new order is being established: A transformation that centers around the environment.

The world is moving towards the goal of using limited resources more effectively and efficiently, in a circular manner. This transformation is imperative.

The world is moving towards the goal of using limited resources more effectively and efficiently, in a circular manner.

The Human Development Report (HDR) of the United Nations Development Program (UNDP), which has been published annually since 1990, states that we have entered a new era – the Human Age. As scientific studies show, currently, the amount of mass produced biomass exceeds naturally-existing biomass.

In Turkey, a similar transformation can be seen. It is still fresh in many minds that, only in 1993, a horrific garbage explosion took the lives of 39 citizens in the country. However, right now, we are observing a transition period to the zero-waste model.

It is an environmental transformation that aims to boost a good deal of investment in the country. The more investment made in the environment, the lower health costs will be.

It can be said that Turkey is acting in line with this fact. Nevertheless, this initially requires a solid legal infrastructure.

The country's Environmental Law No. 2872 of 1983 is almost 40 years old. Although the environment is a highly dynamic issue, Turkish law has remained untouched for many years, except for some minor regulations.

Environmental investments that started in Istanbul in 1994 have been spreading nationwide since 2002. Turkey's environmental law has been

subject to comprehensive revision three times, two of which were edited in the last two years, in order to correspond to the needs of the day and to be in harmony with the rest of the world.

The first comprehensive regulation was implemented in 2006. Upon the discovery of barrels containing hazardous chemical waste in the Orhanlı neighborhood of Istanbul's Tuzla district, along with the increase in environmental concerns at the societal level, the regulation, which had been obsolete for years, was passed by the Parliament thanks to great efforts by then Prime Minister Recep Tayyip Erdoğan. The regulation increased environmental penalties as well as inspection activities.

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Daily Sabah, 24 March 2021

https://www.dailysabah.com/opinion/op-ed/regulation-renewals-for-turkeys-environmental-vision

The call for greener construction products

2021-03-19

A report by the European Parliament (EP) on the Construction Products Regulation (CPR) calls for an ambitious revision of the regulation. The EP is moving towards clarifying what can be defined as green construction products and has now directly integrated EU environmental policies into the construction sector legislation.

The EP has approved a report calling for minimum performance requirements that construction products will need to meet before they are put on the EU market. The resolution was adopted with 686 votes in favour (four against, five abstentions).

Taking matters further

Furthermore, MEPs are calling on the European Commission to enhance the current CPR regulation with requirements for environment, health, and safety. These stricter requirements are intended to make construction products and buildings more sustainable.

However, there are calls for more action to be taken. Michael Neaves, programme manager of the Environmental Coalition on Standards (ECOS), said: "The European Commission must raise the bar for construction products, and exclude the worst performers from the market. A standards-only approach will not guarantee progress, and stronger policy tools are

The EP has approved a report calling for minimum performance requirements that construction products will need to meet before they are put on the EU market.

CHEMWATCH
Bulletin Board
Regulatory Update
APR. 02, 2021

needed to achieve this. Introducing a framework for direct EU information and performance requirements for all aspects is the only way to meet the EU climate law targets and give Europe a first-mover advantage."

Meanwhile, Gonzalo Sánchez, policy officer at EEB, welcomed the EP's positive step on green construction products: "EU construction product policy has great potential to create a market of products that help make our built environment more sustainable, supported by strong market surveillance and delivering zero carbon emissions in the construction sector to meet the EU's 2050 environmental target. The market is currently dominated by highly impactful products, and direct integration of EU environmental policies into construction sector legislation is long overdue, so this is an important step towards policy in support of a sustainable built environment."

The Green Deal

The European Green Deal, established in December 2019, is the European Commission's programme to provide steps towards the green transition. The Deal aims to make Europe the first carbon-neutral continent and was followed by the Circular Economy Action Plan.

What has still to be agreed is what construction products are going to make the green transition possible and whether some building materials should be phased out.

Read More

CEMNET, 19 March 2021

https://www.cemnet.com/News/story/170480/the-call-for-greener-construction-products.html

EU considers plan to tightly regulate 1,4-dioxane

2021-03-20

The European Union is weighing a proposal to put 1,4-dioxane on the path toward strict regulation. The substance, a common laboratory reagent, is sometimes used to purify pharmaceutical ingredients. It's also an impurity in consumer and commercial products and a widespread water contaminant that is difficult to remove. The chemical is considered a likely human carcinogen and does not readily break down in the environment. A March 2 proposal from Germany would deem 1,4-dioxane a "substance of very high concern" under the EU's Registration, Evaluation, Authorisation, and Restriction of Chemicals (REACH) law because of the compound's

The chemical is considered a likely human carcinogen and does not readily break down in the environment.

potential to harm human health and the environment. If the EU finalizes the proposal, 1,4-dioxane would be placed on the EU government's list of candidates for strict regulation. According to the proposal, companies in the European Economic Area—EU states plus Iceland, Liechtenstein, and Norway—make or import more than 1,000 metric tons of 1,4-dioxane per year. That amount does not include any 1,4-dioxane exported from the area or the presence of the substance as an impurity.

Read More

Chemical & Engineering News, 20 March 2021

https://cen.acs.org/policy/chemical-regulation/EU-considers-plan-tightly-regulate/99/i10

INTERNATIONAL

Regulations for offshore drilling operations

2021-03-19

The oil and gas industry in Nigeria has always tried to meet the challenges of providing environmental protection. Admittedly, the exploitation of oil and gas reserves has not been without some ecological side effects including oil spills, and air and water pollution.

Drilling fluids and drill cuttings are the largest waste streams generated in global drilling operations. Regulations ensure minimal damage is done to the environment and protect marine life offshore.

These protections are not limited to Nigeria; most oil and gas countries have similar legislation and regulations to protect the environment. There are also regional legislations like OSPAR, Helsinki, Barcelona and Kuwait, and international groups such as the International Finance Corporation and the World Bank Group also has the Environmental, Health & Safety Guidelines for Offshore Oil & Gas Development. All these are efforts aimed at protecting the environment along with workers health and safety.

The Department of Petroleum Resources (DPR) is the regulator of the oil and gas industry in Nigeria. The Environmental Guidelines and Standards for the Petroleum Industry in Nigeria (EGASPIN) outlines environmental and safety standards that must be complied with by oil operators.

The DPR evaluates and monitors the discharges into the environment from exploration, production, terminal operations, hydrocarbon processing, oil

CHEMWATCH
Bulletin Board
Regulatory Update
APR. 02, 2021

Drilling fluids and drill cuttings are the largest waste streams generated in global drilling operations.

transportation, and marketing operations. Since 1991, the EGASPIN has been updated and revised to be at par with international best practices and advancements in drilling waste management technology, including zero discharge for inland and offshore shallow waters. This includes water less than 12 nautical miles distance from shoreline and in water depth of less than 200 feet.

In these zero-discharge zones, discharge is prohibited of whole and spent drilling fluid, drill cuttings, deck drainage, and well treatment waste. Discharges are permitted where the distance from shoreline is greater than 12 nautical miles or the water depth greater than 200 feet under certain conditions.

Water-based drilling fluids and cuttings discharge is allowed if the fluid and cuttings pass the sheen test and discharge is approved by DPR. For synthetic-based drilling fluid cuttings, the oil on cuttings (OOC) must be treated to less than 5 per cent before discharge. Low toxic, mineral-oil-based cuttings may be discharged if treated to less than 1 per cent OOC.

How Nigeria compares with Africa

Some of the newer oil producing countries in West Africa do not have regulations. In those countries, operator discretion and corporate global standards drive the present practices. Ghana – Environmental Protection Agency (EPA) is Ghana's regulatory authority. Offshore Oil & Gas Development in Ghana Guidelines for Environmental Assessment and Management, issued in 2012, outlines the regulation for the country. Non-aqueous drilling fluid cuttings shall not be discharged to sea in water depths less than 500 m. Group III non-aqueous drilling fluid with polycyclic aromatic hydrocarbons (PAHs) level than 0.001% and total aromatic content less than 0.5 per cent is preferred for use at water depth beyond 500m. The discharge limit is 2 per cent oil on cuttings. Group II non-aqueous drilling fluid discharge limit is 1 per cent oil on cuttings at water depths beyond 500m. Group I non-aqueous drilling fluid is prohibited in regulated areas. Cameroon, Equatorial Guinea, Ivory Coast, Liberia, Benin, Togo, Senegal, Mauritania, Mozambique, Tanzania & Namibia have no set or clear environmental regulations for oilfield discharge. Operator discretion drives the present practices, which is stipulated in their Environmental Impact Assessment.

Read More

This Day, 19 March 2021

https://www.thisdaylive.com/index.php/2021/03/19/regulations-for-offshore-drilling-operations/

Sustainability or spin? Greenwashing and the law

2021-03-19

LSE law graduate and future trainee Matthew Unsworth takes a look at how competition authorities are responding to misleading eco claims

What is 'greenwashing'?

The essence of 'greenwashing' is making an untruthful or misleading statement about how eco-friendly a product or service is. Companies are unlikely to tell outright lies but they might make claims which are quite subtly deceptive. Imagine, for example, a new appliance which is said to be more energy efficient than its rivals, with no mention of the fact that it uses more water too. Or an aerosol which is advertised as free from chlorofluorocarbons (CFCs), even though it would be illegal to use these chemicals anyway. In each scenario, a consumer is likely to believe, erroneously, that the product in question is better for the environment than alternatives.

The essence of 'greenwashing' is making an untruthful or misleading statement about how eco-friendly a product or service is.

Greenwashing is not a recent phenomenon; it has existed in some form since at least the 1980s. However, there are signs that the problem has become especially acute. In January, the International Consumer Protection and Enforcement Network investigated almost 500 websites making product sustainability claims and found that in 40% of cases there was a risk of consumers being misled. This is of real concern when UK shoppers alone spend over £41 billion on sustainable goods each year and there has been a global shift towards greener purchasing decisions amid the COVID-19 pandemic.

The legal position

There is no specific anti-greenwashing legislation in the UK. Having said this, many misleading environmental claims will fall foul of the restrictions contained in the Consumer Protection from Unfair Trading Regulations 2008. In particular, instances of greenwashing are likely to contravene Regulation 5, which prohibits false and misleading commercial practices, or Regulation 6, which prohibits commercial practices serving to hide or obfuscate material information. It is worth bearing in mind that a deceptive eco-claim will only constitute an offence under either regulation if it causes or is likely to cause consumers to enter into a transaction when they would not otherwise have done so. The situation is broadly similar in the EU, under Articles 6 and 7 of the Unfair Commercial Practices Directive 2005, in the US, under §5 of the Federal Trade Commission Act 1914, and in Australia, under Section 18 of the Competition and Consumer Act 2010.

Alternatively, in some circumstances, it might be possible to bring a claim for fraudulent misrepresentation against an alleged greenwasher. There are precedents for this on both sides of the Atlantic. In the Californian case of *DeWind v Glenmore Wind Farm*, a developer was sued for having overstated the energy potential of a wind farm site, which, according to the claimant, gave the impression that the project was economically viable when this was not true. The claim was ultimately dismissed. Misrepresentation is also the basis for a class action brought against Volkswagen in the UK relating to the "dieselgate" scandal. The car manufacturer is alleged to have programmed diesel vehicles to artificially lower their nitrogen oxide output to cheat emissions tests. As well as an apparent breach of air pollution laws, this practice is said to have led buyers to believe they were getting a cleaner car than was in fact the case. Lawyers at Slater & Gordon, Leigh Day and Freshfields are all advising on the claim, which a Law Society report predicts will pave the way for further greenwashing class actions over the next 30 years.

Read More

Legal Cheek, 19 March 2021

https://www.legalcheek.com/lc-journal-posts/sustainability-or-spin-greenwashing-and-the-law/

UNEP finds more than half of all countries have binding lead limits or are drafting laws

2021-03-18

An update published by the UN Environment Programme (UNEP) highlights national efforts to limit and eliminate lead paint. No level of lead exposure is considered safe, and even relatively low exposure levels can cause serious and irreversible neurological damage. The 2020 'Update on the Global Status of Legal Limits on Lead in Paint' reports that, as of 31 December 2020, 79 countries (41% of all countries) had legally binding controls to limit the production, import, and sale of lead paints. Another 13% (26 countries) were in the process of drafting laws.

No level of lead exposure is considered safe, and even relatively low exposure levels can cause serious and irreversible neurological damage.

Regulatory Update

APR. 02, 2021

In 2020: Colombia, Lebanon, and Viet Nam established new lead paint laws; China updated an existing law; and the World Health Organization (WHO) updated the status of Ecuador, Pakistan, and Qatar in its database to reflect existing laws.

The update notes that lead can permanently damage the brain and nervous system, resulting in decreased IQ and increased behavioral problems. It can also cause anemia, increase the risk of kidney damage and hypertension, and impair reproductive functions. Young children and pregnant women are especially vulnerable. The negative impacts on children's developing brains also have significant economic costs, including health care costs, productivity losses, and intellectual disability. While the cost of removing existing decorative lead paint from surfaces in homes, schools and other buildings can be substantial, the economic cost is low for eliminating the use of lead compounds in new decorative paints.

Read More

SDG, 18 March 2021

http://sdg.iisd.org/news/unep-finds-more-than-half-of-all-countries-have-binding-lead-limits-or-are-drafting-laws/

CHEMWATCH
Bulletin Board

REACH Update

APR. 02, 2021

Restrictions under new chemical regime accounted for first time

2021-03-23

Government has laid out plans for restriction work that will be carried out in the first year of UK REACH

The Government has today (23 March) set out the first restrictions to be initiated under its new chemical regulation system, UK REACH, to tackle risks posed by chemicals.

The launch of the UK REACH programme includes plans to initiate the restriction process on lead ammunition which is used widely in the shooting industry and causes harm to the environment, wildlife and people.

Certain harmful substances that can be found in tattoo inks and permanent make-up could also be restricted. The ink in tattoos can sometimes contain substances that can cause health effects, most commonly skin reactions, such as irritation or sensitisation. The substances this restriction proposal will consider includes, but is not limited to, substances that can cause cancer, are dangerous to reproduction, skin sensitisers and irritants.

Certain harmful substances that can be found in tattoo inks and permanent make-up could also be restricted.

A restriction will be introduced if evidence shows an unacceptable risk to human health and the environment, and after a public consultation. The review of the evidence will be conducted by the Health & Safety Executive (HSE), with support from the Environment Agency (EA). They will investigate the risk of per- and polyfluoroalkyl substances (PFAS) and consider how best to manage any identified risks.

PFAS are a group of over 9,000 different chemicals, some of which are already banned or highly restricted. In industry, these substances are used as stain repellents, coatings and fire-fighting foams. The chemicals in PFAS are extremely persistent in the environment; the substances can accumulate in animals and can also be toxic this means PFAS are of growing concern for both human health and environmental reasons.

Environment Minister Rebecca Pow said:

The plans announced today are just the first step in a wider programme of work we are able to pursue under the new independent chemicals framework UK REACH.

We will continue to review what further measures we can explore to safeguard human health and the environment based on robust science and the best available evidence.

Based on the commitment to having control of our own laws, the UK established its own independent chemicals regulatory framework from 1 January 2021. UK REACH allows Great Britain to make decisions on the regulation of chemicals that are based on the best available scientific evidence, ensuring that chemicals remain safely used and managed.

Read More

www.gov.uk, 23 March 2021

https://www.gov.uk/government/news/restrictions-under-new-chemical-regime-announced-for-first-time

Plans announced to phase out lead ammunition in bid to protect wildlife

2021-03-23

The Government is considering a ban of lead ammunition to protect wildlife and nature as part of new plans under UK REACH

- Government sets out the restriction work to be carried out in the first year of UK REACH, the UK's new chemical regime
- Evidence shows lead ammunition harms the environment, wildlife and people
- Consultation will seek public's views on restriction proposals

Lead ammunition could be phased out under government plans to help protect wildlife and nature, Environment Minister Rebecca Pow announced today [23 March].

A large volume of lead ammunition is discharged every year over the countryside, causing harm to the environment, wildlife and people. The government is now considering a ban under the UK's new chemical regulation system – UK REACH– and has requested an official review of the evidence to begin today with a public consultation in due course.

Research by the Wildfowl and Wetlands Trust shows that between 50,000 to 100,000 wildfowl die in the UK each year due ingesting lead from used pellets. Despite being highly toxic, wildfowl often mistake the pellets for food. A further 200,000 to 400,000 birds suffer welfare or health impacts, and animals that predate on wildfowl can also suffer.

A large volume of lead ammunition is discharged every year over the countryside, causing harm to the environment, wildlife and people.

CHEMWATCH
Bulletin Board
REACH Update
APR. 02, 2021

Lead ammunition can also find its way into the wider environment and the food chain, posing a risk to people if they eat contaminated game birds. Studies have also found that lead poisoning caused lowered immune systems in wild birds, potentially aiding the spread of diseases such as avian influenza (bird flu).

Environment Minister Rebecca Pow said:

Addressing the impacts of lead ammunition will mark a significant step forward in helping to protect wildlife, people, and the environment.

This is a welcome development for our new chemicals framework, and will help ensure a sustainable relationship between shooting and conservation.

The announcement today has been welcomed by environmental organisations.

Dr Julia Newth, Ecosystem Health & Social Dimensions Manager at the Wildfowl and Wetlands Trust (WWT), said:

Conservationists, including WWT, shooting organisations and game meat retailers have recognised the toxic risks from lead ammunition to people and the environment. Regulation of its use in all shooting, wherever this may happen, is very much needed as soon as possible to protect human and animal health and to enable us to move towards a greener and safer future.

Shooting organisations are also supportive of transitioning away from the use of lead ammunition and are working with government to bring this about.

The Environment Agency, together with the Health and Safety Executive, will now start a two-year process to review the evidence, conduct a public consultation and propose options for restrictions.

Now we have left the EU we are able to make our own laws. UK REACH allows decisions to be made on the regulation of chemicals based on the best available scientific evidence, ensuring chemicals remain safely used and managed.

Notes to editors:

- The use of lead ammunition in England is restricted by the Environmental Protection (Restriction on the use of Lead Ammunition) (England) Regulations 1999. (Similar existing regulations apply in

REACH Update

APR. 02, 2021

Wales with different definitions adopted in Scotland and Northern Ireland), These Regulations prohibit the use of lead ammunition on all foreshores in England, in or over specified SSSIs (predominately wetlands) and for the shooting of all ducks and geese, coot and moorhen. The plans announced today will consider phasing out the use of lead ammunition across all environments across England, Scotland and Wales.

- The Government is also initiating a restriction on substances with certain hazards in tattoo inks and permanent make-up.

Read More

www.gov.uk, 23 March 2021

https://www.gov.uk/government/news/plans-announced-to-phase-out-lead-ammunition-in-bid-to-protect-wildlife

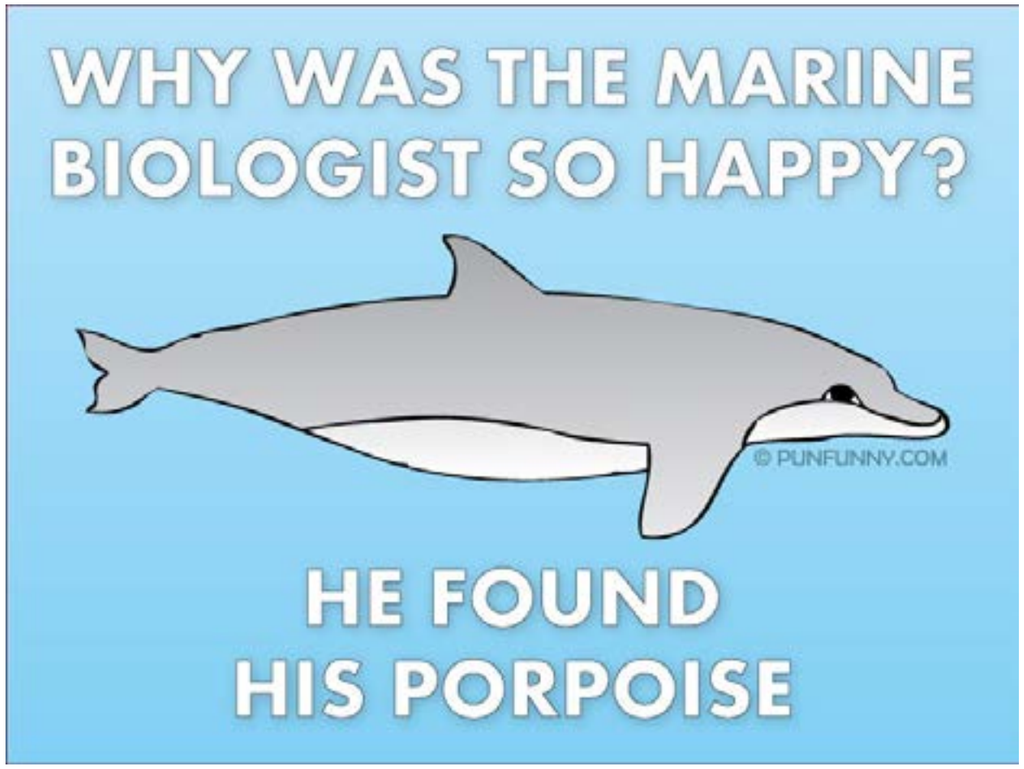
CHEMWATCH
Bulletin Board

Janet's Corner

APR. 02, 2021

Purpose

2021-04-02



https://www.coolpun.com/topic/marine+biology#&gid=1&pid=2

Cobalt

2021-04-02

Cobalt is a chemical element with symbol Co and atomic number 27. [1] It is a hard ferromagnetic, silver-white, lustrous, brittle element. It is a member of group VIII of the periodic table. Like iron, it can be magnetised. Cobalt is similar to iron and nickel in its physical properties. The element is active chemically, forming many compounds. Cobalt is stable in air and unaffected by water, but is slowly attacked by dilute acids. [2] It will burn when exposed to heat and the fumes may be hazardous. Small amounts of cobalt are found in most rocks, soil, water, plants, and animals. It is a component of vitamin B-12, which is required for good health. [3]

USES [2,3]

Cobalt is used in many alloys (superalloys for parts in gas turbine aircraft engines, corrosion resistant alloys, high-speed steels, cemented carbides), in magnets and magnetic recording media, as catalysts for the petroleum and chemical industries, as drying agents for paints and inks. Cobalt blue is an important part of artists' palette and is used by craft workers in porcelain, pottery, stained glass, tiles and enamel jewellery. The radioactive isotope, cobalt-60, is used in medical treatment and also to irradiate food, in order to preserve the food and protect the consumer. Cobalt is also used to make artificial body parts such as hip and knee joints.

SOURCES OF EMISSION & ROUTES OF EXPOSURE

Sources of Emission [3]

- Industry sources: Cobalt is mainly emitted from sources where it is used in the production of steel and other alloys. It may be emitted to air, land or water from these sources. Automotive repair shops may be significant emitters (to air) of cobalt. It will also be emitted to air, land and water during the mining or refining of nickel, copper, silver, lead and iron.
- Diffuse sources: Cobalt may be emitted to air, land or water from the manufacture, use or disposal of paints and varnishes. It may also be emitted to air, land or water from the manufacture, use or disposal of ceramic, inks, and enamels.
- Natural sources: Cobalt is found in soil, dust, seawater, volcanic emissions, and smoke from forest and bush fires.

Cobalt is a chemical element with symbol Co and atomic number 27.

CHEMWATCH
Bulletin Board
Hazard Alert
APR. 02, 2021

- Transport sources: Small amounts of cobalt have been found in motor vehicle exhaust.
- Consumer products: Consumer products containing cobalt and its compounds include: vitamin B-12, animal feeds and fertilisers, paints, varnish, enamels and ceramics. It is in metals used at high temperatures (e.g. some car parts).

Routes of Exposure [4,5]

- Exposure to low levels of cobalt can occur by breathing air, eating food, or drinking water. Consumption of food and drinking water are the largest sources of exposure to cobalt for the general population.
- Working in industries that make or use cutting or grinding tools; mine, smelt, refine, or process cobalt metal or ores; or that produce cobalt alloys or use cobalt.
- The general population is rarely exposed to radioactive cobalt unless a person is undergoing radiation therapy. However, workers at nuclear facilities, irradiation facilities, or nuclear waste storage sites may be exposed to radiation from these sources.
- Exposure to cobalt metal fume and dust can occur through inhalation, ingestion, and eye or skin contact.

HEALTH EFFECTS [6]

Acute Effects

Acute exposure to high levels of cobalt by inhalation in humans and animals results in respiratory effects, such as a significant decrease in ventilatory function, congestion, oedema, and haemorrhage of the lung. Acute animal tests in rats have shown cobalt to have extreme toxicity from inhalation exposure, and moderate to high toxicity from oral exposure.

Chronic Effects

Cobalt is an essential element in humans and animals as a constituent of vitamin B12. Cobalt has also been used as a treatment for anaemia, because it stimulates red blood cell production. Chronic exposure to cobalt by inhalation in humans results in effects on the respiratory system, such as respiratory irritation, wheezing, asthma, decreased lung function, pneumonia, and fibrosis. Other effects noted in humans from inhalation exposure to cobalt include cardiac effects, such as functional effects on the ventricles and enlargement of the heart, congestion of the liver, kidneys, and conjunctiva, and immunological effects that

include cobalt sensitisation, which can precipitate an asthmatic attack in sensitised individuals. Cardiovascular effects (cardiomyopathy) were observed in people who consumed large amounts of beer over several years time containing cobalt sulphate as a foam stabiliser. The effects were characterised by cardiogenic shock, sinus tachycardia, left ventricular failure, and enlarged hearts. Gastrointestinal effects (nausea, vomiting, and diarrhoea), effects on the blood, liver injury, and allergic dermatitis have also been reported in humans from oral exposure to cobalt. Animal studies have reported respiratory, cardiovascular, and central nervous system (CNS) effects, decreased body weight, necrosis of the thymus, and effects on the blood, liver, and kidneys from inhalation exposure to cobalt. EPA has not established a Reference Concentration (RfC) or a Reference Dose (RfD) for cobalt.

Reproductive/Developmental Effects

No information is available on the reproductive or developmental effects of cobalt in humans via inhalation exposure. In one oral study, no developmental effects on human foetuses were observed following treatment of pregnant women with cobalt chloride. Animal studies, via inhalation exposure, have reported testicular atrophy, a decrease in sperm motility, and a significant increase in the length of the oestrus cycle, while oral studies have reported stunted growth and decreased survival of newborn pups. These effects on the offspring occurred at levels that also caused maternal toxicity.

Cancer Risk

Limited data are available on the carcinogenic effects of cobalt. In one study on workers that refined and processed cobalt and sodium, an increase in deaths due to lung cancer was found for workers exposed only to cobalt. However, when this study was controlled for date of birth, age at death, and smoking habits, the difference in deaths due to lung cancer was found to not be statistically significant. In another study assessing the correlation between cancer deaths and trace metals in water supplies in the United States, no correlation was found between cancer mortality and the level of cobalt in the water. In a study by the National Toxicology Program (NTP), cobalt sulphate heptahydrate exposure via inhalation resulted in increased incidences of alveolar/bronchiolar tumours in rats and mice. In an animal study, inhalation of cobalt over a lifetime did not increase the incidence of tumours in hamsters. Cobalt, via direct injection under the muscles or skin, has been reported to cause tumours at the injection site in animals. EPA has not classified cobalt for carcinogenicity.

CHEMWATCH
Bulletin Board
Hazard Alert
APR. 02, 2021

SAFETY [5,7]

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.
- Serious Skin Contact: Wash with a disinfectant soap and cover the contaminated skin with an anti-bacterial cream. Seek medical attention.
- Inhalation: Allow the victim to rest in a well-ventilated area. Seek immediate medical attention.
- Serious Inhalation: Evacuate the victim to a safe area as soon as possible. Loosen tight clothing such as a collar, tie, belt or waistband. If breathing is difficult, administer oxygen. If the victim is not breathing, perform mouth-to-mouth resuscitation. Seek medical attention.
- Ingestion: DO NOT induce vomiting. Loosen tight clothing such as a collar, tie, belt or waistband. If the victim is not breathing, perform mouth-to-mouth resuscitation. Seek immediate medical attention.

Exposure Controls & Personal Protection

Engineering Controls

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 Protection

The following personal protective equipment is recommended when handling cobalt:

- 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 [3,5,6]

United States

- OSHA: he current Occupational Safety and Health Administration (OSHA) permissible exposure limit (PEL) for cobalt metal, dust, and fume (as Co) is 0.1 milligram per cubic metre (mg/m^3) of air as an 8-hour time-weighted average (TWA) concentration [29 CFR 1910.1000, Table Z-1].
- NIOSH: The National Institute for Occupational Safety and Health (NIOSH) has established a recommended exposure limit (REL) for cobalt metal, dust, and fume of 0.05 mg/m^3 as a TWA for up to a 10-hour workday and a 40-hour workweek [NIOSH 1992].
- ACGIH: The American Conference of Governmental Industrial Hygienists (ACGIH) has assigned cobalt, elemental, and inorganic compounds (as Co) a threshold limit value (TLV) of 0.02 mg/m^3 as a TWA for a normal 8-hour workday and a 40-hour workweek. The ACGIH also lists these substances as animal carcinogens (A3 substances) [ACGIH 1994, p. 17].
- The California Environmental Protection Agency (CalEPA) has established a chronic reference exposure level of 0.000005 milligrams per cubic metre (mg/m^3) for cobalt based on respiratory effects in rats and mice.
- ATSDR has established an intermediate inhalation minimal risk level (MRL) of 0.00003 mg/m^3 based on respiratory effects in rats.

CHEMWATCH
Bulletin Board
Hazard Alert
APR. 02, 2021

Australia

Safe Work Australia:

- For cobalt, an eight-hour TWA exposure limit of 0.05 mg/m^3 has been set
- For cobalt carbonyl (as cobalt), an eight-hour TWA exposure limit of 0.1 mg/m^3 has been set
- For cobalt hydrocarbonyl (as cobalt), an eight-hour TWA exposure limit of 0.1 mg/m^3 has been set

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Transportation of highly toxic chemicals is completely prohibited in Yangtze River Basin

2021-03-04

Yangtze River Protection Law of the People's Republic of China (hereinafter referred to as Protection Law) has been implemented from 1 Mar. 2021.

The Protection Law consists of nine chapters, including the General Provisions, Planning and Control, Resources Protection, Water Pollution Prevention and Control, Eco-environmental Modification, Green Development, Security and Supervision, Legal Liability and Supplementary Provisions, with a total of 96 articles.

The Yangtze River Basin under the Protection Law refers to the catchment area formed by main stream, tributaries and lakes of the Yangtze River, involving dozens of provinces, autonomous regions and related county-level divisions, including Jiangxi Province, Anhui Province, Jiangsu Province, Shanghai, Guangdong Province, Zhejiang Province, etc.

In accordance with Item 2, Article 51 of the Protection Law, the transportation of highly toxic chemicals and other hazardous chemicals that cannot be transported in inland waterways under national standards are prohibited in Yangtze River.

Based on Regulations on Safe Management of Hazardous Chemicals and Inventory of Hazardous Chemicals Prohibited in Inland Waterways, prohibited chemicals include:

1.Chemicals that are marked as highly toxic in Catalog of Hazardous Chemicals (2015 version);

2. Chemicals that meet the definition of highly toxic chemicals in Catalog of Hazardous Chemicals (2015 version);

3. 228 hazardous chemicals listed in Inventory of Hazardous Chemicals Prohibited in Inland Waterways (2019 revision) that are completely prohibited to transport in inland waterways, either in package or in bulk; other 85 hazardous chemicals in Inventory of Hazardous Chemicals Prohibited in Inland Waterways (2019 revision) are not allowed to be transported in bulk, yet can still be transported in package (such as steel cylinders, TANK, portable tank and containers);

In terms of mixtures:

In accordance with Item 2, Article 51 of the Protection Law, the transportation of highly toxic chemicals and other hazardous chemicals that cannot be transported in inland waterways under national standards are prohibited in Yangtze River.

1) Mixtures that are classified as highly toxic under GB 30000.18-2013 are prohibited from transportation;

2) In accordance with the screening principles under Inventory of Hazardous Chemicals Prohibited in Inland Waterways (2019 revision), mixtures that containing substances prohibited from transportation meeting one of the following circumstances cannot be transported:

- Unstable explosives;
- Containing ammonium chlorate (CAS: 10192-29-7), perchloric acid (CAS: 10192-29-7) with concentration higher than 72%, methyl nitrite (CAS:624-91-9), zinc ammonium nitrite (CAS:63885-01-8), nitric acid ammonium salt (CAS: 6484-52-2) containing combustible ≤0.2% which is easy to self-heat and sufficient to trigger its decomposition;
- Classified as Aquatic Acute 1(H400) or Aquatic Chronic 1 (H410);

Enterprises that violate the above mentioned requirements will be imposed a fine of not less than 200,000 Yuan but not more than 2 million Yuan; in severe cases, enterprises may be ordered to suspend business for rectification or relevant licenses may be revoked.

Related enterprises must pay attention that Shanghai Maritime Safety Administration has clearly declared that from 1 Mar. 2021, highly toxic chemicals as well as other hazardous chemicals that are prohibited from transportation in inland waterways are not allowed to sail in or transit in Shanghai section of the Yangtze River. Meanwhile, docks located in the Shanghai section of Yangtze River, including docks within the administrative area of Pudong Maritime Safety Administration, Chongming Maritime Safety Administration, Wusong Maritime Safety Administration and Baoshan Maritime Safety Administration.

Related enterprises may check whether their substances are prohibited from transportation in Yangtze River through our free APCISS system.

If you have any needs or questions, please contact us at service@cirs-reach.com.

cirs-reach.com, 4 March 2021

https://website

New drugs that block a brain chemical are game changers for some migraine sufferers

2021-03-22

Hayley Gudgin of Sammamish, Wash., got her first migraine in 1991 when she was a 19-year-old nursing student.

"I was convinced I was having a brain hemorrhage," she says. "There was no way anything could be that painful and not be really serious."

She retreated to her bed and woke up feeling better the next day. But it wasn't long until another migraine hit. And another. Taking a pill that combines caffeine with the pain relievers acetaminophen and codeine made life manageable until she got pregnant and had to stop taking her medication. After her son was born, the migraines came back. She started taking the drugs again, but they didn't work and actually made her attacks worse.

By the time Gudgin gave birth to her second son in 1997, she was having about 15 attacks a month. Her symptoms worsened over time and included severe pain, nausea, sensitivity to light, swollen hands, difficulty speaking, vomiting and diarrhea so intense she often wound up dehydrated in the emergency room.

"It hit me [that] I had to do something when I was vomiting in the toilet, and my 3-year-old came and pulled my hair back," she says. "It was no way to live — and not just because of the pain. You go to sleep every night not knowing how you're going to wake up. You make plans knowing you might have to cancel them."

A headache specialist prescribed several preventive medicines, but each caused side effects for Gudgin, including weight gain and kidney stones. Then, in 2018, Gudgin read about a new type of treatment for frequent migraine sufferers. Her neurologist agreed it was worth a try. After much wrangling with her insurance company — the drug is costly, and she had to prove that two other drugs had failed to help her — she got approval to take it.

In August 2018, Gudgin received her first monthly injection of erenumab, sold as Aimovig. By the end of September, she was down to one or two attacks a month. "And the migraines I do get are usually gone within six hours. I don't have to go to the ER or lie in a dark room all day," she says. "It's just been life changing."

She started taking the drugs again, but they didn't work and actually made her attacks worse.

CHEMWATCH
Bulletin Board
Gossip
APR. 02, 2021

Gudgin injects the drug into her leg once a month using a device similar to an EpiPen. Erenumab is one of four monoclonal antibodies, manufactured proteins that can bind to substances in the body, that have been approved since 2018 by the U.S. Food and Drug Administration to prevent migraines. The antibodies inhibit the action of a neurotransmitter called calcitonin gene-related peptide, or CGRP, either by changing the peptide's shape or attaching to its receptors in the brain.

The drugs have changed the game for some migraine sufferers. Roughly half of people who took one of the four drugs in clinical trials saw at least a 50 percent reduction in monthly migraines, says neurologist David Dodick of the Mayo Clinic in Phoenix, who reported the findings at a Migraine Trust International Symposium in October. About a third of patients had a 75 percent drop in migraine days.

The CGRP-blockers appear to be an improvement over existing preventive treatments, which were developed for other disorders. The newer drugs were designed specifically to target one of the mechanisms that researchers think leads to the painful episodes.

Doctors are embracing the new drugs because they can work better and generally have much fewer side effects than other options. "It's really beneficial for improving quality of life in our patients with migraines. [The new drugs] don't cause weight gain, sleepiness, brain fog," says neurologist Nina Riggins, a headache specialist at the University of California, San Francisco.

And the options for blocking CGRP are expanding. Rimegepant, or Nurtec, is one of several drugs known as gepants that bind to the CGRP receptor. The drug, an oral tablet rather than a shot, was approved as a treatment for acute migraine in February 2020. When taken every other day, rimegepant appears to also offer some benefit as a preventive, as reported January 2 in the Lancet.

Nothing typical

Migraine is the third most common disorder in the world, according to the World Health Organization. Migraines or severe headaches affect more than 15 percent of U.S. adults, striking women twice as often as men, the U.S. Centers for Disease Control and Prevention reports. In all, more than 39 million Americans get migraine attacks, which can last four to 72 hours.

A common pain

Based on U.S. household interviews in 2018, about 1 in 5 women and 1 in 10 men reported having a migraine or severe headache in the previous three months.

Along with the most common symptom — severe throbbing pain in the head — patients can experience sensitivity to light, smells and sound; dizziness; vomiting; numbness; and visual disturbances such as blind spots and tunnel vision.

"Migraine is probably more than one disease," says neurologist Richard Lipton of Albert Einstein College of Medicine in the Bronx, N.Y. "There are more than 40 identified genes that contribute to the risk of migraine. What that means is that there are multiple pathways that lead to migraine, and as a consequence of that, migraine is not a one-size-fits-all condition."

Although many genes have been identified as playing a role, researchers have not pinpointed the exact mechanisms involved with migraine. The long-held notion of blood vessel dilation being to blame has even fallen out of favor, says Amaal Starling, a neurologist at the Mayo Clinic in Scottsdale, Ariz.

"We know pain is caused by … abnormal activity in multiple parts of the brain, including the trigeminal nerve, trigeminal nucleus caudalis in the brain stem, and the pain networks," Starling says. This leads to migraine-related pain in the head, face and neck.

Some theories suggest that migraine occurs — and a cascade starts — when nerve cells in the brain get overexcited and stimulate the trigeminal nerve, which controls movement of the jaw muscle and sensations of touch, pain and temperature in the face. The trigger can be hormonal changes, stress, food, smells, sounds, a visual stimulus or some combination. The first step in the cascade releases CGRP in the brain, which causes transmission of pain signals.

The pain signals trigger an additional release of CGRP and other peptides. These molecules tell the brain to increase the dilation of blood vessels, releasing toxic chemicals. This is why, at least for some people, CGRP may be a big part of the problem.

The CGRP cascade

Migraines involve a series of events in the brain that is still not fully understood, but involves activation of the trigeminal nerve and release of a peptide called CGRP, causing pain in the head, face and jaw, plus other symptoms. Researchers have devised three new approaches that help

CHEMWATCH
Bulletin Board
Gossip
APR. 02, 2021

some patients. All block the action of CGRP: monoclonal antibodies (green Ys on image at right) that either block CGRP's receptor or grab hold of CGRP itself appear to prevent migraines. Other drugs (dark gray oval on image at right) that block the receptor can treat a migraine that's already started.

No easy fix

Treating chronic migraine is often a two-pronged approach: Try to prevent migraine attacks by managing the underlying cause, and stop attacks when they strike.

Part of a long-lasting problem with chronic migraine is that drugs available for prevention were developed for other diseases, such as hypertension, depression and epilepsy. For example, doctors realized that patients with high blood pressure who also had migraines reported fewer migraines after taking beta-blockers. The medicine slows down the heart by blocking the effect of adrenaline, a hormone that speeds up circulation. Similar stories led to the use of anticonvulsants, antidepressants, antianxiety medications, narcotics and antihistamines.

None of these drugs are without side effects, and they are ineffective for 40 to 50 percent of chronic migraine patients, according to a 2017 analysis of insurance claims data by Dodick and colleagues in Cephalalgia. Within six months of starting four commonly used migraine prevention drugs, 75 percent of patients had stopped using them. The researchers assume, based on other studies, that the main reasons for stopping were side effects and lack of efficacy.

Side effects include weight gain, nausea, brain fog, drowsiness, speech disturbance and lack of concentration. And sometimes the treatments themselves can bring on headaches. "Most of the acute treatments that we use for migraine, if they're taken too often, cause medication overuse headaches," Lipton says.

Preventing migraine

People diagnosed with chronic migraine, which means they get a migraine more than 15 days each month, are prescribed preventive drugs that work in various ways in combination with lifestyle changes, including getting more sleep, avoiding certain foods and lowering stress levels.

Focus on one pathway

Researchers realized about 20 years ago that CGRP plays a role in migraine. The peptide helps nerve cells communicate with each other. "[CGRP] is very heavily represented in the pathways that are involved in migraine," Lipton says.

In one study, researchers measured CGRP levels in the blood and found higher levels in people who had migraines than in people who did not. And among those who experienced migraines, CGRP blood levels went up as migraines came on. In a separate study, when an induced migraine attack was effectively treated, CGRP blood levels came down, says Deborah Friedman, a neuro-ophthalmologist at University of Texas Southwestern Medical Center in Dallas.

The work led to the creation of the four monoclonal antibodies approved for preventing migraines. One of them, erenumab, the drug that's helping Gudgin, mimics the shape of CGRP, binding to the CGRP nerve receptor so the CGRP has no place to attach when it arrives at a nerve cell. The other three drugs — galcanezumab (Emgality), fremanezumab (Ajovy) and eptinezumab (Vyepti) — attach to CGRP itself, changing its shape so it can't fit into the receptor. All four drugs are given as monthly or quarterly injections or intravenous infusions.

A step forward

Four approved monoclonal antibodies that work by attaching to CGRP and changing its shape or blocking its receptor showed an edge over a placebo in separate late-phase clinical trials to prevent episodic migraine. Response rate was defined as the percentage of patients with at least a 50 percent reduction in the number of migraine days per month.

These monoclonal antibodies help some patients and produce fewer side effects than existing treatments. In a 2019 survey of nearly 600 people taking galcanezumab to prevent migraines, conducted by the drug's maker, Indianapolis-based Eli Lilly, nearly 80 percent reported their migraine as "better" overall since starting the medication. In a study funded by eptinezumab's manufacturer, H. Lundbeck A/S in Copenhagen, more than 80 percent of about 700 patients reported they had a 50 percent or greater drop in migraine days in at least one four-week interval, and about one-third of patients taking intravenous eptinezumab saw that same drop over the entire 24-week study.

Only 20.5 percent of patients taking a placebo saw the same drop in migraine days, as reported last October in the Journal of Headache and Pain.

CHEMWATCH
Bulletin Board
Gossip
APR. 02, 2021

The gepants go after the same pathway, but can be taken orally because they are small molecules. Gepants are prescribed on an as-needed basis to stop acute migraines. Recent studies suggest they may have preventive benefits too, according to an April 2020 report in Headache.

Gepants have been studied since 2004, but earlier versions caused liver problems, so they never made it to market. In 2019 and 2020, the FDA approved two formulations — ubrogepant, or Ubrelvy, and rimegepant, or Nurtec. Overall, the gepants appear to stop migraine pain within two hours in about 20 percent of patients and do not bring on the overuse headaches that are common with other acute treatments.

Two additional gepants, atogepant and zavegepant, are still in patient trials. Atogepant is being evaluated as a preventive, while zavegepant is being looked at as an acute medication.

Lipton and colleagues reported in the Lancet on January 2 the results of a Phase II/III prevention study of rimegepant, funded by Biohaven Pharmaceuticals of New Haven, Conn. Of 348 participants who took the drug every day, 49 percent experienced a 50 percent or greater reduction in moderate to severe migraine days each month. But the placebo group did almost as well, with a 41 percent reduction.

Stopping an acute migraine

Once a migraine attack occurs, patients have over-the-counter and prescription options to try.

The need for new ideas

Clearly, this variety of CGRP inhibitors don't work for everyone. And they cause side effects for some people, including constipation, increased risk for upper respiratory tract infections and injection-site pain.

Amy Chesney, a retired software engineer who lives in Bossier City, La., started getting migraines in 1992, tried three different CGRP drugs and found that they made her depressed and didn't do anything for her migraines.

There's also some concern about long-term effects from CGRP monoclonal antibodies, since CGRP exists in the peripheral nervous system as well as the brain. For instance, CGRP causes blood vessels to dilate in a variety of systems including the intestines.

Doctors say this is why constipation is one of the drugs' most common side effects. CGRP is also involved in hair follicles, and some patients have

reported hair loss. And CGRP is important to blood vessel health, which is why researchers say it will be important to complete long-term studies to look for cardiac issues, although so far none have surfaced.

Finally, the drugs are expensive and, as Gudgin discovered, insurance companies can make patients and doctors jump through hoops before covering the cost, says Matthew Robbins, a neurologist at Weill Cornell Medicine and New York-Presbyterian Hospital in New York City.

When erenumab received FDA approval, its manufacturers, Novartis of Basel, Switzerland, and Amgen of Thousand Oaks, Calif., set a price of $6,900 per year for the drug. "Generally, you can't just prescribe them straight away. [Patients] have to either not tolerate established medications or [show] that they do not work first," Robbins says.

It took two denials and three months before Gudgin's insurance company would approve payment. First, she had to prove that she had tried cheaper preventive medications. Then she had to confirm that she got migraines frequently enough to classify her disease as chronic.

Gudgin says that although her insurance company finally paid for her treatment, she does have a rough time at the beginning of the year when her $4,000 deductible has not yet been met. However, it's worth it for her, she says, and she would pay out of pocket if she had to. "I'm not stuck in a darkened room. I have a life again. You can't put a price on that."

sciencenews.org, 22 March 2021

https://www.sciencenews.org

Humans are rapidly losing the ability to procreate, scientist warns

2021-03-29

An environmental medicine professor is sounding the alarm on humanity's rapidly declining fertility rates — and she says chemicals in plastics are largely to blame.

Shanna Swan, professor of environmental medicine and public health at Mount Sinai's Icahn School of Medicine in New York City, helped complete a major study in 2017 that discovered sperm count amongst men in Western countries has dropped by more than 50 percent over the past four decades, according to The Guardian. Last month, she released her book Count Down that dives into how and why humans are losing their ability to procreate.

That represents a steep sperm count decline of 53.4% in men in western countries such as Australia, New Zealand, North America, and Europe.

CHEMWATCH
Bulletin Board
Gossip
APR. 02, 2021

"People are recognizing we have a reproductive health crisis, but they say it's because of delayed childbearing, choice or lifestyle – it can't be chemical," Swan said to the Guardian. "I want people to recognize it can. I am not saying other factors aren't involved. But I am saying chemicals play a major causal role."

In the 2017 study published in Human Reproduction Update, researchers discovered that sperm concentration fell from 99 million per ml in 1973 to 47.1 million per ml in 2011. That represents a steep sperm count decline of 53.4% in men in western countries such as Australia, New Zealand, North America, and Europe.

According to Swan, one of the primary drivers are chemicals that "interfere with or mimic the body's sex hormones."

"Phthalates, used to make plastic soft and flexible, are of paramount concern," Swan said. "They are in everybody and we are probably primarily exposed through food as we use soft plastic in food manufacture, processing and packaging."

She continued, "They lower testosterone and so have the strongest influences on the male side, for example diminishing sperm count, though they are bad for women, too, shown to decrease libido and increase risk of early puberty, premature ovarian failure, miscarriage and premature birth."

Swan says that the rate of fertility decline isn't just an odd quirk that can be easily solved with reproductive therapies like in-vitro fertilization. It actually poses an existential threat to humanity. In fact, she projects the world is on track to be completely infertile by 2045.

"The current state of reproductive affairs can't continue much longer without threatening human survival," Swan writes in Count Down.

Though this situation seems dire (and it is), there is some hope. She says that we need the chemical industry to develop new non-hormonally active chemicals for domestic use. Also, those who plan to have children should be wary of the plastics they bring into their home such as Teflon, BPA, and phthalates.

Otherwise, Children of Men might look more like a documentary than a fictional movie one day

futurism.com, 29 March 2021

https://www.futurism.com

Millions of dead jellyfish are washing up around the world. 'The blob' could be to blame

2021-03-25

Like a tourist on a cruise ship, the by-the-wind sailor jellyfish (Velella velella) spends its days drifting aimlessly through the open sea, gorging itself on an endless buffet of complementary morsels.

The jelly straddles the ocean's surface with a rigid sail poking just above the water and an array of purple tentacles dangling just underneath. As the sail catches wind, the jelly floats from place to place, capturing tiny fish and plankton wherever it roams. Thriving Velella colonies can include millions of individuals, all just partying and chowing down together in the open water. Life is good.

Until, that is, the wind blows a colony of sailor jellies onto shore.PLAY SOUND

Every year, on beaches around the world, colonies of sailor jellies become stranded by the thousands. There, they dry up and die, becoming a "crunchy carpet" of dehydrated corpses covering the sand, Julia Parrish, a University of Washington professor and co-author of a new study on mass Velella strandings, said in a statement.

Sailor jelly strandings are common when seasonal winds change course, but some — like a 2006 event on the west coast of New Zealand — are on another level entirely, with the jellyfish corpses numbering not in the thousands, but in the millions. Why? What force of nature makes some Velella strandings so much larger than others?

Parrish and her colleagues wanted to find out. So, in their new study (published March 18 in the journal Marine Ecology Progress Series) they delved into 20 years of Velella observations reported along the west coast of the United States.

The observations came from a program called the Coastal Observation and Seabird Survey Team, also known as COASST, which trains citizen scientists to search their local beaches for marine birds that have washed ashore, plus any other unusual animal sightings. COASST's network covers hundreds of beaches stretching from northern California to the Arctic Circle, according to the group's website — and, of course, some members have had run-ins with Velella.

The researchers found nearly 500 reports of Velella strandings in the COASST database, sighted on nearly 300 beaches. According to these

Every year, on beaches around the world, colonies of sailor jellies become stranded by the thousands.

CHEMWATCH
Bulletin Board
Gossip
APR. 02, 2021

reports, the most massive die-offs by far occurred during spring months from 2015 to 2019. During those years, dead jellyfish littered more than 620 miles (1,000 kilometers) of continuous coastline, the researchers found.

Those jellyfish die-offs also coincided with a massive marine heat wave known as "the blob." Beginning in 2013, surface waters off the Pacific coast began heating up to levels never recorded before, Live Science previously reported. The intense warming continued through 2016, tampering with every level of the marine food chain and resulting in mass die-offs of seabirds, baleen whales, sea lions and other creatures. According to the new study, it's likely that the blob drove the mass die-offs of by-the-wind sailor jellyfish reported during those years.

The catch is, those warming ocean waters may have actually been good for the jellies, the researchers said. As the blob increased ocean surface temperatures, certain fish (such as northern anchovies) benefited from longer spawning seasons, providing more food for Velella jellies to gobble up earlier in the year. This may have caused jellyfish populations to spike before seasonal wind changes blew the jellies ashore in the spring.

In other words, the blob may have helped Velella jellies thrive off the Pacific coast, leading to much larger stranding events those years. The sailor jellies could therefore become climate change "winners" as global warming is predicted to increase the frequency of marine heat waves, the researchers wrote. But their success will come at the expense of other, less fortunate creatures — and a whole mess of jellyfish carcasses on our coasts.

"A changing climate creates new winners and losers in every ecosystem," Parrish said in the statement. "What's scary is that we're actually documenting that change."

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"It can influence the mom's health later. And it's a vulnerable period of development for the fetus, so it can have childhood and lifelong consequences."

More than 50 new environmental chemicals detected in people

2021-03-23

Researchers have detected more than 50 new environmental chemicals lurking in people's bodies, the vast majority of which are little known or unknown compounds.

These chemicals — which have never been observed in people before — were discovered in a study of pregnant women and their newborns.

The findings are concerning given that very little is known about these chemicals and their potential health effects, researchers from the new study say. What's more, pregnant women and their newborns are a particularly vulnerable population.

"We are very concerned about these exposures that occur during pregnancy because it's such a vulnerable period of development," said study senior author Tracey Woodruff, director of the Program on Reproductive Health and the Environment (PRHE) and the Environmental Research and Translation for Health (EaRTH) Center, both at University of California San Francisco. "It can influence the mom's health later. And it's a vulnerable period of development for the fetus, so it can have childhood and lifelong consequences."

Of these newly detected chemicals, two were perfluoroalkyl and polyfluoroalkyl substances, or PFAS. These chemicals, used in consumer products such as nonstick cookware and pizza boxes, stay in the human body for a long time and can accumulate, according to the Environmental Protection Agency (EPA). Ten of the newly detected substances were plasticizers, or chemicals used in the production of plastics. For example, one of the detected plasticizers, a group of chemicals called phthalates, are often found in fast-food packaging and have been associated with adverse health effects. Two of the newly detected chemicals are used in cosmetics; one in pesticides.

But most — 37 — of these newly detected chemicals are ones that researchers have little to no information on, the authors wrote in the study, published Tuesday (March 16) in the journal Environmental Science & Technology.

Mysterious chemicals

Despite pregnancy being a vulnerable period of development, there's been a lack of data on chemicals that mothers and fetuses are potentially

CHEMWATCH
Bulletin Board
Gossip
APR. 02, 2021

exposed to, due in part to a lack of methods for detecting those chemicals, Woodruff told Live Science. Current methods for monitoring human exposure to chemicals typically involve screening for only a few hundred of some 8,000 chemicals produced or imported into the U.S. every year, the authors wrote in the study.

For this study, the researchers recruited 30 expectant women seeking prenatal and delivery care at the Zuckerberg San Francisco General Hospital and UCSF Mission Bay Medical Center. Blood samples were collected from the mother during labor and delivery and from the newborn's umbilical cord (cord blood) just after birth.

The researchers then analyzed the blood samples using a relatively new technique called high-resolution mass spectrometry that involves determining the different masses of compounds to identify them. In this way, they were able to take snapshots of nearly all the chemicals present in blood samples from mothers and their newborn infants, said study co-author Dimitri Abrahamsson, a postdoctoral fellow at PRHE. "That allowed us in the end to find evidence for some chemicals that appear to not have been previously reported in people," he added.

The researchers identified 109 chemicals present in both the maternal and cord blood samples, including 55 that had never been found in people before. Others detected in the samples, such as phthalates, have previously been found in humans before and have been linked to adverse health effects, such as reproductive problems. The researchers also detected the two most-studied PFAS, known as PFOA and PFOS, in the maternal and newborn samples. PFAS and PFOA have been shown to cause developmental, liver, kidney, and immunological problems in laboratory animals and have also been linked to numerous health problems in human epidemiological studies, according to the EPA.

The researchers found traces of such chemicals in both the mothers and the babies, Woodruff said. "So that's a very important feature of this, because it shows that these exposures are also occurring in the womb," Woodruff said.

The umbilical cord, which connects the placenta to the fetus, is the conduit through which oxygen, and other nutrients pass between the mother and the fetus. If a chemical is present in the cord blood, the fetus has been exposed to it, Woodruff said. More research is needed to determine whether these particular chemicals are also present in fetal tissues and at what levels; however, previous studies have found that chemicals detected in cord blood also show up in fetal tissue, Woodruff said.

Because so little is known about these newly detected chemicals, including where the mothers may have been exposed to them, it's not clear what the potential health effects of them may be, the researchers told Live Science. This should signal not a sense of uncertainty but "alarm," Abrahamsson said. "We're being exposed to chemicals that we have very little information about. And these chemicals could potentially have harmful health effects that we don't know and can't predict," he said.

The researchers can determine whether these chemicals are present in the maternal and cord blood, but they can't tell at what levels, Woodruff said. For that reason, the researchers cannot say whether the chemicals detected are dangerous at the levels at which they are present in mothers and babies.

But that doesn't necessarily mean there's no reason to worry about adverse health effects from chemical exposures, Woodruff added. "We already know from other studies that pregnant women are exposed to chemicals, many of them at levels that have been associated with adverse health effects," such as exposure to phthalates being linked with problems with male reproductive development, she said. "These [newly detected] chemicals are in addition to chemicals we know are linked to adverse health outcomes."

In the future, Woodruff said, the researchers plan to study the toxicities of these newly detected chemicals in the human body and to learn how the chemicals affect various tissues with the long-term goal of using the information to prevent adverse health outcomes and disease. The researchers also need to confirm the identities of the newfound chemicals by comparing them, again using mass spectrometry, to "analytical standards," or pure samples of each chemical, the researchers said.

For consumers, the researchers have put together some tips on how to avoid exposure to substances that can be harmful to reproductive health, including cleaning with non-toxic products, using less plastics and avoiding canned foods.

PLAY SOUND

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CHEMWATCH
Bulletin Board
Gossip
APR. 02, 2021

Popular food preservation may be toxic to the immune system

2021-03-25

A newly published study warns that a preservative found in hundreds of readily available processed foods, including popular snacks, may be toxic to the immune system. The findings were published in the International Journal of Environmental Research and Public Health and involved data from the EPA's Toxicity Forecaster ("ToxCast").

The study comes from researchers with the Environmental Working Group, which used ToxCast to evaluate the potential impact popular food additives may have on health. In addition, the team also evaluated the effect of PFAS, which are known as 'forever chemicals' — and, sadly, they're found in packagings like fast food wrappers and processing equipment.

The researchers found that commonly used food preservative tert-butylhydroquinone (TBHQ) may be toxic to the immune system. The findings were observed both in high-throughput in-vitro toxicology testing and animal tests. This is particularly concerning given how many foods feature TBHQ, including nearly 1,250 'popular processed foods,' according to the study.

The researchers found that commonly used food preservative tert-butylhydroquinone (TBHQ) may be toxic to the immune system.

In addition, the researchers note that PFAS forever chemicals can make their way from packaging and food wrappers to the food itself — and that's a problem, as these chemicals are also linked to a suppressed immune system. Among other things, the impact on the immune system can make vaccines less effective.

The study's lead author Olga Naidenko, PhD, explained:

The pandemic has focused public and scientific attention on environmental factors that can impact the immune system. Before the pandemic, chemicals that may harm the immune system's defense against infection or cancer did not receive sufficient attention from public health agencies. To protect public health, this must change.

slashgear.com, 25 March 2021

https://www.slashgear.com

WWII-era stimulant drug discovered in weight loss supplements

2021-03-24

An experimental stimulant drug from the World War II era is showing up in weight loss and sports supplements sold today, according to a new study.

The stimulant, known as phenpromethamine, was last sold as a nasal inhaler called Vonedrine in the 1940s and 1950s, but it has since been withdrawn from the market and has never been approved for oral use, according to the study, published Tuesday (March 23) in the journal Clinical Toxicology. It's also banned from competitive sports by the World Anti-Doping Agency. The new study appears to be the first to confirm the presence of phenpromethamine in supplements, the authors said.

In addition to phenpromethamine, the study identified eight other prohibited stimulants in sports and weight loss supplements, which were often found mixed together in various combinations to create "cocktails" of stimulant drugs that have never been studied in people, the authors said.

"This is really surprising," study lead author Dr. Pieter Cohen, a general internist at the Cambridge Health Alliance and an associate professor of medicine at Harvard Medical School, told Live Science. "Finding nine different experimental prohibited stimulants at the same time was really quite shocking." The authors found as many as four different stimulants in a single supplement.

The risks of consuming these combinations of stimulants is unknown, and these stimulants are not always listed on the product labels, the authors noted.

"The FDA should warn consumers about the presence of cocktails of experimental stimulants in weight loss and sports supplements and take immediate effective action to remove these stimulants from the market," the authors wrote in the study.

Prohibited stimulants

The researchers began their study looking not for phenpromethamine, but for a different stimulant called deterenol. Studies from Europe had found that supplements containing deterenol together with other stimulants were linked with harmful effects in people, including nausea, vomiting, chest pain, cardiac arrest and even sudden death. (Deterenol has never been approved for use in the U.S. and in 2004, the FDA ruled that the stimulant was not permitted in dietary supplements.)

CHEMWATCH
Bulletin Board
Gossip
APR. 02, 2021

For the study, they analyzed 17 brands of supplements sold in the U.S. that were labeled as containing deterenol or a synonym for the drug. These products were usually marketed as weight loss supplements or sport supplements. (A full list of these supplement brands can be found in the study.)

The researchers found deterenol in 13 of the 17 supplements. The next most commonly detected stimulant was phenpromethamine, present in four of the 17 brands.

Very little data exists on the safety of phenpromethamine. When it was used in the 1940s and 1950s, it was available only as a nasal spray, Cohen said. The effects of taking the drug orally, which is how people would consume it today in a supplement, are unknown. "If you have it concentrated and take it in a pill form, it could have totally different effects," Cohen said.

Phenpromethamine is not the first WWII-era stimulant to show up in dietary supplements. In 2004, after the FDA banned the stimulant ephedra from dietary supplements, manufacturers started adding other experimental stimulants, including 1,3-DMAA, which was previously marketed in 1948 as a nasal inhaler, the authors said. The FDA has since banned 1,3-DMAA from supplements and has issued warnings that it may increase the risk of heart problems.

"As soon as the FDA warns about a stimulant, new ones, close variants of them tend to appear," Cohen said.

So far, the FDA has not issued warnings to consumers about phenpromethamine, according to the study. What's more, scientists at the FDA recently detected deterenol in supplements, publishing their findings in the journal Drug Testing and Analysis in September 2020. But even after this discovery, the agency didn't issue a warning, despite the supplement being prohibited by the agency, Cohen said.

"There's no question that the FDA should have acted as soon as they determined [deterenol] was present," Cohen said. "They should be immediately warning consumers about deterenol; they should be communicating with manufacturers that any supplement containing the stimulant needs to be removed."

Although the FDA may not have warned about deterenol, the agency has warned about weight loss supplements in general. On its website, the FDA says it has "identified an emerging trend" of dietary supplements that

contain hidden and potentially harmful active ingredients. "Consumers may unknowingly take products laced with varying quantities of approved prescription drug ingredients, controlled substances, and untested and unstudied pharmaceutically active ingredients," the agency says.

Of the nine stimulants found in the new study, seven — including 1,3-DMAA — have previously been the subject of FDA warnings due to their presence in supplements. This finding agrees with that of a 2018 study by Cohen and colleagues that found that some dietary supplements still contain experimental stimulants years after those stimulants were prohibited by the FDA, Live Science previously reported.

Knowing whether a dietary supplement contains a prohibited stimulant can be difficult because manufacturers may not list the drug on the label, or they may use a synonym for the drug, Cohen said.

But in general, Cohen advises consumers to avoid two categories of dietary supplements — those labeled to say they will help you lose weight and those labeled as pre-workout or muscle-building supplements. (The latter category excludes protein powders, which generally contain amino acids and are not something to worry about, Cohen said.) These categories of supplements cannot be considered safe until two things happen: "We reform the law so the FDA has more enforcement authority; and the FDA begins to effectively enforce the law," Cohen said.

In a statement provided to Live Science, the FDA said it is reviewing the new study. "The FDA is dedicated to advancing our strategic priorities for dietary supplements: safety, product integrity, and informed decision-making. We appreciate studies like this for raising awareness and bringing needed attention to these matters," the statement said.

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https://www.livesciene.com

Are California oil companies complying with the law? Even regulators often don't know

2021-03-22

On a breezy February afternoon at the ragged edge of rapidly gentrifying downtown Los Angeles, hipsters walk toy dogs along Pico Boulevard. Around the corner on 14th Street, an actor strikes poses for a photo shoot against murals of sunflowers, diamonds and inspirational sayings. The aging, yellow brick residential Portsmouth Hotel sits among knockoff watch dealers here, while a block away, a giant construction crane hoists materials skyward for new luxury apartments.

"People live in here with fear. ... They worry something's gonna happen, an explosion or something, and we're not gonna have a chance," said Gregorio Villegas, the longtime building manager.

Below ground is another story. Tucked out of sight, oil wells run thousands of feet deep, tapping thick crude from one of California's many urban oil fields. And in the fall of 2019, investigators with the state's oil agency flagged trouble.

Nasco Petroleum was injecting huge amounts of water into well bores above the legal pressure limits, aiming to push more crude out of the aging downtown field. Similarly intense pressure led to a major oil spill in 2006, after a nearby well bore operated by Nasco's predecessor ruptured. Hot crude and oily waste bubbled up from underground, filled an apartment building basement, oozed out of manhole covers and buckled sidewalks. More than 130 low-income tenants were evacuated.

The pressure wasn't the investigators' only concern. They also noted that a number of "bad" wells had been left unfixed for years, with missing cement seals. The wells, investigators wrote in a report to a manager, posed "immediate" risks to drinking water aquifers. They urged supervisors at the California Geologic Energy Management Division, or CalGEM, to take the strongest possible enforcement actions: order Nasco to cease well operations, suspend approvals of the company's project or both.

No one ever did. While the agency said in a statement that it has taken less stringent measures, like mandating that Nasco lower injection pressure, it declined to provide evidence that the company had complied. Officials acknowledged they remain concerned about potential threats to drinking water, though they said they had no proof of contamination. In January, they said they would address the problems but declined to provide specifics.

"Respectfully, we do not comment on ongoing enforcement actions or investigations in order to preserve their integrity," spokesman Don Drysdale said in an email.

Today, three of the problematic wells are listed as active on CalGEM's website. Less than 100 feet from Nasco's oil operations, low-income residents of the Portsmouth Hotel said they've endured decades of problems from the site, including the ground trembling at all hours, fumes that cause headaches and nausea, and equipment catching fire.

"People live in here with fear. ... They worry something's gonna happen, an explosion or something, and we're not gonna have a chance," said Gregorio Villegas, the longtime building manager.

A Nasco employee said its wells are operating with no problems. The owner did not respond to requests for comment. Emergency phone numbers on the site's front entrance are disconnected, and no one responded to knocking on gates.

While California has long sought to maximize oil and gas production, it has recently tried to pair that goal with environmental stewardship. The state's elected leaders have approved dozens of new staff to better oversee the oil industry and last year changed CalGEM's mission to prioritize public health and the environment during fossil fuel production. Since 2018, CalGEM officials have pledged to sharply increase the number of enforcement orders they issue — their toughest regulatory hammer. "We've been very aggressive in terms of our enforcement," Gov. Gavin Newsom said last year.

But an investigation by The Desert Sun and ProPublica has found that enforcement is still lax, and in many cases, the state doesn't know if companies are complying.

Between 2018 and 2020, CalGEM issued 66 enforcement orders. Of those, just 11 have been complied with, while the vast majority remain outstanding, according to agency records and responses. (The news organizations identified an additional 55 orders going back to 2015, but officials said they could not confirm whether companies had complied with orders before 2018, when CalGEM created an enforcement team.)

CalGEM in recent years gained the authority to fine delinquent firms up to $25,000 per day. However, The Desert Sun and ProPublica found that the agency has imposed few fines above $5,000 and has yet to collect one above $35,000. In 2020, CalGEM said it issued $191,669 in civil penalties and collected zero. Many companies continue to violate California's oil and gas rules with impunity.

According to CalGEM documents the news organizations obtained through public records requests, errant firms have left leaking wells, tanks, sump ponds and other problems across the state, posing threats to public health and wildlife. Photos and inspection reports for several orders show rusted, corroded or oil-coated equipment. Others show holes in netting around sump ponds meant to keep out wildlife and birds attracted by the shiny, sticky pools. At one Central Valley site, inspectors documented

CHEMWATCH
Bulletin Board
Gossip
APR. 02, 2021

unreported "spills of oil" on five separate dates, and they found wastewater being funneled through unlined dirt channels, raising concerns about groundwater contamination. At the edge of the wildfire-prone Los Padres National Forest northwest of Los Angeles, an oil company failed to maintain emergency roads to idle well sites.

In response to questions, CalGEM head Uduak-Joe Ntuk and spokespeople defended the agency's performance, saying the top priority is protecting the public and the environment. But its own budget requests state that the agency does not have enough employees to "prosecute enforcement actions in a timely manner" or to "adequately protect the health and safety of the citizens of the state."

"There is currently a substantial backlog" of staff requests, representing a significant "gap between what CalGEM can and should enforce and what it has the staff to enforce," managers wrote in a January budget request. In fiscal year 2019, for example, the agency issued 35 orders — well short of the 87 it said were requested by staff. In fiscal year 2020, the numbers were even lower, with just 19 orders issued; CalGEM had projected staff would request 138, but the agency declined to provide the final count.

Ntuk, who was appointed by Newsom in November 2019, said cases can take years to develop to guarantee they will withstand legal appeals, and the COVID-19 pandemic had curtailed access to the courts, slowing the process. In the Nasco case, Ntuk said he was not aware that agency inspectors had requested he issue an order.

Still, he said, "We do need to aggressively enforce our statutes and regulations, and I believe we do."

Some key lawmakers are fed up.

State Sen. Henry Stern, D-Los Angeles, who sits on the Natural Resources and Water Committee, is now calling for an oversight hearing based, in part, on The Desert Sun and ProPublica's findings. He said they are also weighing potential legislation to tighten CalGEM's enforcement and to make more oil and gas documents public.

"If the agency is either unable or unwilling to do the job, then the Legislature is going to have to force them to do it," Stern said. "Oil and gas workers and the communities who live near these sites have the right to know where there are idled or abandoned wells or other equipment that might be leaking or otherwise dangerous. We need to know which sites

have not been properly monitored, where faulty records exist and where operators have defied state orders without being fined or shut down."

A "Useless" Record-keeping System

The problems are not new. In 2011, a scathing federal audit of CalGEM found shoddy documentation and lax regulation led to failures to protect underground sources of drinking water, like the issues identified in downtown Los Angeles at the Nasco site. In response, in 2015, state officials drew up a "renewal plan," which they said would prioritize "California's public safety and environmental health."

A key piece of the initiative was transitioning from paper files to electronic record-keeping. Officials in 2015 began developing an online system called WellSTAR, or Well Statewide Tracking and Reporting System. The Legislature authorized $52 million for the project. But costs rose year after year, and in one request to lawmakers, CalGEM vowed that if another increase were approved, the agency would guarantee the system contained an enforcement database. By December 2019, the agency had spent $78.8 million, according to a California Department of Technology project review.

Today, CalGEM still has no centralized enforcement database, Ntuk acknowledged. While it has posted some orders on its website, the public has no ready way to know if they've been complied with. After additional requests for information from The Desert Sun and ProPublica, the agency said it would begin compiling enforcement efforts in one place.

Texas, another top oil producer, has a public database of all inspections and enforcement actions, which cost about $105,000 to launch, said a spokesman for the state's Railroad Commission, which oversees oil enforcement. It is updated weekly. Environmentalists and social justice advocates say California should be able to do better.

"You just have to think in the 21st century in the state that has Google, if we can't figure out a way to do that, something's wrong," said Dan Jacobson, state director of Environment California, a group that has monitored the oil industry for years.

Some praise WellSTAR and related mapping systems, saying they allow agency staff and companies to quickly input applications, production numbers and other data. Members of the public can do precise searches of well locations and find out when wells were dug. But enforcement records on WellSTAR are kept private.

CHEMWATCH
Bulletin Board
Gossip
APR. 02, 2021

"WellSTAR, for all its fancy bells and whistles, is 99% useless," said Michael Salman, a retired UCLA historian who served as a beta tester of the system for CalGEM. "What if you're a fire department captain or chief, or zoning official for a city or county tasked with monitoring and regulating oil wells in your jurisdiction, and you need to know what's going on?"

Ntuk defended the online system. "WellSTAR is not a failure," he said, noting that in addition to production data, the public and companies now have access to well permits and historical records.

But the lack of enforcement information leaves 2.1 million Californians living within a mile of active oil wells in the dark, with little to no way of knowing if dangers exist from the facilities or if problems are ever rectified. Many oil wells sit in low-income, nonwhite neighborhoods with less political clout, elected officials and experts note.

Compounding the issue, hundreds of pages of documents have vanished from public view on the agency's website in the past year, such as the Nasco reports. Officials said they had to remove them to comply with a law on making information available to people with disabilities but didn't explain why the records were not restored.

Stern said he and fellow legislators wanted public access to all agency documents restored.

CalGEM said it has hired a community engagement director and begun a "Transformation Plan" aimed at improving communication and restoring public confidence. Officials there also said the public can file records requests to get answers about enforcement and read the annual reports the agency submits to the Legislature.

It has yet to complete its 2019 annual report. It has also failed to give state legislators and the public legally required updates on programs related to idle wells, underground injection and fracking. CalGEM declined to comment on why the reports had been delayed. "They're pending," a senior official said.

A Fight to Collect Fines

CalGEM has also struggled to impose financial penalties on errant companies.

For years, the agency could only fine a company $25,000 total, no matter how severe a violation. That changed in September 2016, after the huge Aliso Canyon methane gas blowout in Porter Ranch, an upper-middle-

class Los Angeles County neighborhood. Lawmakers enabled CalGEM to impose fines of up to $25,000 per day.

CalGEM's largest penalty ever, a $12.5 million fine against HVI Cat Canyon in 2017, faltered in the courts in part because the agency failed to provide missing paperwork. Negotiations led to a $2 million settlement, but the company is now in bankruptcy, and no payments have been made to date.

Similarly, after news reports about a massive Central California oil spill in 2019, CalGEM again tried to use its new penalty powers. The agency issued an order levying a $2.7 million fine on Chevron, alleging that the firm had failed to prevent or stop numerous spills and moved spilling oil through an unlined dirt channel, creating a significant risk to human health and the environment. While such spills can spontaneously erupt and create deadly sinkholes, the oil company promptly appealed the order. A company official later said Chevron does not believe the spills at issue posed a threat to human health. A year and a half after CalGEM issued the order, the case remains unresolved, in settlement talks. A Chevron spokeswoman said the company had no further comment.

In its own budget requests this year, CalGEM says more staff is needed to get the job done, in part to help enforce a variety of new state laws that expand the agency's oversight responsibilities. (CalGEM is funded entirely out of per-barrel production fees levied on oil companies.) It says it wants to hire specialists in property records, bonding and other areas to ensure enforcement orders can withstand appeals. Lawmakers are set to evaluate that argument in the coming months as they weigh what to approve in Newsom's proposed 2021-22 state budget.

State Sen. Monique Limon, D-Santa Barbara, agreed the agency must be fully staffed, but she said it's currently failing in one of its key duties. "While CalGEM has made strides ... they still lack serious enforcement," she said. She added that the agency must "provide the oversight required to protect the environment and health of Californians."

But industry officials and even some environmentalists note CalGEM has made nearly identical budget requests for a decade, and it has received funding for more than 120 new staff members since 2010, including six slots to create its first-ever enforcement unit three years ago.

"They have more resources than ever before even as production is falling," said Rock Zierman, CEO of the California Independent Petroleum Association.

CHEMWATCH
Bulletin Board
Gossip
APR. 02, 2021

For many environmentalists, whatever CalGEM might do to improve enforcement is too little too late. The state's oil industry has been drying up for decades, and some companies have been fleeing the state or founding stand-alone units that can declare bankruptcy if necessary. Last year, for the first time in a century, the agency issued more permits to shut down wells than to drill new ones. Officials estimate there are more than 100,000 inactive wells statewide — which a 2020 study predicted could become a $9 billion problem for state taxpayers.

More than half of the orders issued by CalGEM since Newsom took office in 2019 have been for not paying idle well fees. In their current plea to the Legislature for more staff, agency officials say they want to improve compliance with idle well laws. But to do so, they propose decreasing their enforcement actions, to instead "proactively engage with operators at risk of non-compliance."

"CalGEM is trying, but they're still far from being a gem of an agency," said Bill Allayaud, California director of government affairs for the Environmental Working Group, who first sounded alarms about the agency in 2011. "I mean what the heck? It's been a decade and none of these problems should exist."

propublica.org, 22 March 2021

https://www.propublica.org

85% of COVID-19 long-haulers have multiple brain-related symptoms

2021-03-25

Many COVID-19 "long haulers" experience at least four lingering neurological symptoms, such as brain fog, headache and the loss of sense of smell or taste, even if they were never hospitalized for their initial illness, according to a new study.

For the study, published Tuesday (March 23) in the journal Annals of Clinical and Translational Neurology, the researchers analyzed information from 100 COVID-19 long haulers from 21 states. These patients were seen via telehealth or in person at the Neuro COVID-19 Clinic at Northwestern Memorial Hospital in Chicago from May to November 2020. None of the patients had been hospitalized when they initially fell ill with COVID-19-like symptoms, and all had experienced persistent symptoms for more than six weeks. On average, patients were seen four to five months after their initial illness.

On average, patients were seen four to five months after their initial illness.

Half of the participants had previously tested positive for COVID-19, while the other half had tested negative but had symptoms consistent with COVID-19. The authors note that early in the pandemic, getting a COVID-19 test was difficult for patients who didn't require hospitalization, and these patients may have cleared the infection by the time they were tested. PLAY SOUND

Overall, 85% of participants reported at least four neurological symptoms. The most common symptom was "brain fog" or trouble thinking, reported by 81% of participants; followed by headaches, reported by 68%; and numbness or tingling, reported by 60% of participants. More than half reported problems with their sense of taste or smell; 47% reported dizziness; 30% reported blurred vision; and 29% reported ringing in the ears.

Other common, but not neurological, symptoms included fatigue, depression and anxiety, insomnia and gastrointestinal symptoms.

In many patients, their symptoms fluctuated, or came and went, for months. When they were asked how much they felt they had recovered to their pre-COVID-19 level, on average, patients said they felt only 64% recovered after about five months.

"Our study indicates that 'long COVID-19' is an important emerging entity requiring multidisciplinary expertise and care," the authors wrote in their paper. It's unclear how many people have long COVID, but some studies suggest that about 30% of people with COVID-19 experience lingering symptoms up to nine months after their diagnosis, Live Science previously reported.

"Although we don't know the exact number of people who are affected by long COVID,

probably millions of people in the U.S. are affected by this syndrome, and this is impacting their quality of life and cognitive function," study senior author Dr. Igor Koralnik, chief of Neuro-infectious Diseases and Global Neurology at Northwestern Medicine, said in a news conference.

More studies are needed to determine the causes of long COVID-19 and to help researchers find appropriate treatments for the condition, the authors said.

Interestingly, more than 40% of participants reported experiencing depression and anxiety prior to their COVID-19 diagnosis, suggesting this may be a risk factor for long COVID, the authors said. What's more, 16%

CHEMWATCH
Bulletin Board
Gossip
APR. 02, 2021

reported having an autoimmune disease before their COVID-19 diagnosis, which is twice as high as the prevalence of autoimmune disorders in the general population, and it suggests that an autoimmune mechanism may play a role in long COVID, they said.

About 70% of participants were women, which matches the sex ratio seen in some other autoimmune disorders, such as rheumatoid arthritis, which affects three times more women than men, the authors said.

The authors note that their study was small and the majority of patients were white, and so the finding may not apply to the general population. It's also possible that some patients who tested negative for COVID-19 were not infected with the virus. The researchers are studying ways to improve COVID-19 diagnosis for those who were previously infected; for example, they are studying how certain immune cells react to the coronavirus's proteins, which may help identify those who were previously infected.

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https://www.livescience.com

Amazon 'river monster' turns up dead in Florida

2021-03-24

The rotting body of a dead Amazon "river monster" recently washed ashore in Florida, raising concerns about whether this gigantic predatory fish has joined the Sunshine State's ever-growing list of invasive species, according to news sources.

But although it might thrive in Florida's warm waters, this fish, known as the arapaima (Arapaima gigas) — a sizable creature that can grow to be 10 feet (3 meters) long and up to 440 lbs. (200 kilograms), according to a 2019 study in the journal PLOS One — the odds are stacked against it, at least for now, said Solomon David, an aquatic ecologist at Nicholls State University in Louisiana who wasn't involved with the recent arapaima sighting.

That's because these fish have some very particular quirks: They breed only in specific areas, spend valuable time and energy caring for their young, and don't reach sexual maturity until they're about 5 feet (1.5 m) long and at least 3 to 5 years old, David told Live Science. Moreover, it would take

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many individuals to have a sustainable population in Florida, and so far, just one dead arapaima has been found.

In this case, the arapaima was likely an exotic pet in a person's private aquarium that either got too big for its tank and was illegally released into the wild or died in captivity and was dumped into the river, David said. "We don't even know if this thing was alive when it was dumped, if it was dumped in there," David told Live Science.

PLAY SOUND

The remains of the arapaima were found in Cape Coral's Jaycee Park on the banks of the Caloosahatchee River, which empties into the Gulf of Mexico in western Florida, the South Florida Sun Sentinel reported in early March. The normally greenish fish, which sports a reddish tail, had already turned white from decay, photos show. But though it wasn't the full 10 feet long, it was definitely an arapaima, the Florida Fish and Wildlife Conservation Commission told the Sun Sentinel.

This fish, also known as the pirarucu or paiche, used to be plentiful in parts of the Amazon River, but the species is now threatened in many places along its native habitat, David said. The arapaima is part of the bony tongue group, a slew of heavy-bodied tropical river fish whose tongues are studded with teeth and whose bodies are covered with large, mosaic-like scales that are hard, like armor, according to Encyclopedia Britannica. These scales are so tough, even piranhas can't bite through them — but that's just luck, as the arapaima evolved long before piranhas even existed, David said.

The arapaima is prized for its meat, and not just in rural regions along the river, where the fish's relatively boneless meat, once salted, can be stored without refrigeration, according to Miami Patch. In fact, Whole Foods Market sold commercially farmed arapaima, the grocery store chain said in a 2016 blog post. But wild arapaimas are threatened largely by overfishing, and it doesn't help that the species, one of the largest freshwater fish in the world, is relatively easy to spot. It's an obligate air breather, meaning it has to come to the water's surface every 5 to 15 minutes to gulp in air, according to a 2009 study in the Journal of Applied Ichthyology.

Arapaimas evolved this breathing tactic because the Amazon has low oxygen levels. (Warm water holds less oxygen than cold water does.) Arapaimas don't have lungs but rather special tissue in their swim bladders that processes oxygen, Lesley de Souza, a conservationist who specializes in neotropical fishes at the Field Museum in Chicago, told mongabay.com.

CHEMWATCH
Bulletin Board
Gossip
APR. 02, 2021

Invested parents

Unlike many fish that never meet their young, arapaimas are doting parents. During the Amazon's rainy season, usually from December to May, the river floods into neighboring floodplains. It's there, on the flooded plains, that arapaimas dig shallow nests where the females can lay eggs for the males to fertilize. Both parents guard the nest from predators, and they continue to care for the young once the eggs hatch just nine days later, according to a 2017 study in the journal PLOS One.

Both parents release a milk substance from their heads, known as "arapaima milk," that is fed to the offspring, according to the study. In addition, the dads are devoted caregivers.

"The male provides an intensive parental care which can last up to three months, guiding the offspring above its darkened head into zooplankton-rich areas for feeding," according to the 2017 study. The female tends to swim around the male and young at a distance — it's not clear why, but perhaps to look out for predators or food — and usually leaves her "family" after about a month, after which she might reproduce with other males, according to the study.

Parental care is a key reason arapaimas are likely not taking over Florida waters, as young arapaimas are "not very tough fish when they're small," David said. But if these fish make it to adulthood, they can live at least 15 to 20 years, according to the 2019 PLOS One study.

Granted, even though the odds are stacked against this fish in Florida, the arapaima could overcome these hurdles — perhaps they could find nesting areas on Florida's coast, raise their young, wait until they were big and old enough to reproduce and then repeat the cycle, establishing a viable population. If that were to happen, these voracious eaters would likely make a dent in populations of both invasive and native species of fish and small invertebrates that live in the vicinity, David said. However, these fish are so big, and take so long to mature, that it would likely be possible for the Florida Fish and Wildlife Conservation Commission to track down and remove them, he noted.

"We should be on the lookout — there's nothing wrong with being vigilant," David said. "But again, going from the fish to fearmongering is not the greatest way to learn about these fish," he added, noting all the negative media coverage these fish are getting.

Some outlets, including CBS and even the fishing magazine "Field & Stream," called the Amazonian fish "ugly."

"As somebody who is sort of a champion for the 'ugly' fish, I think we need to get away from that," David said. "I think they're really cool and amazing-looking fish. Just look at those red scales."

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CHEMWATCH
Bulletin Board

Weight lifters' brains reveal one unexpected side effect of steroids

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IF A SCIENTIST SCANNED YOUR BRAIN, what do you think it would show? If you've ever taken steroids, the answer may not be what you expect.

Androgenic anabolic steroids — the kinds of drugs athletes, weight lifters, and even recreational exercisers may take in the hopes of building lean muscle mass and improving their athletic performance — have been linked to a plethora of health risks, including diminished testosterone production, psychiatric issues, and cardiovascular problems. But there's more.

Now, a study published this week in Biological Psychiatry: Cognitive Neuroscience and Neuroimaging reveals powerful evidence that long-term use of these drugs can accelerate brain aging to the extent that your brain looks demonstrably older than your biological age on brain scans.

HERE'S THE BACKGROUND — That steroids harm health isn't a new idea, but these drugs' effects on the brain and cognitive abilities are "understudied," according to this paper's authors. This study is the largest of its kind to date, but as Astrid Bjørnebekk, the study's lead author and leader of Oslo University Hospital's Anabolic Androgenic Steroid Research Group, tells Inverse, "there are few studies that have looked into AAS [anabolic androgenic steroid] use and brain aging, so there is a lot to be learned."

High doses of certain common anabolic steroids appear to have toxic effects on animal brain cells and even lead to cell death. And some of the better-studied health impacts of steroid use, such as cardiovascular problems, hypogonadism, and insulin sensitivity, are connected to cognitive impairment later in life.

Studies that have looked directly at the brains of anabolic steroid users suggest these drugs may be linked to psychiatric and cognitive issues, reduced connectivity in some parts of the brain, and changes to brain volume and density in certain regions.

Cognitive testing of long-term steroid users has also revealed problems with pattern recognition, difficulty establishing the relationships between objects, cognitive processing speed, memory, executive function, and problem-solving abilities. "All these findings are in the same direction and

High doses of certain common anabolic steroids appear to have toxic effects on animal brain cells and even lead to cell death.

suggest long-term consequences on brain health," along with the new study's results, says Bjørnebekk.

WHAT THEY FOUND — Among the androgenic anabolic steroid users included in this study, those who had used steroids for more than 10 years and met the criteria for being "dependent" on these substances, their MRI brain scans revealed a worrying trend: Their brains looked older than their true biological age.

To come to this conclusion, the researchers first trained machine-learning algorithms to guess the "brain age" of participants using a dataset composed of the brain scans of almost 2,000 healthy males of different ages. Then, they ran the brain scans of each of the 130 male weight lifters who used anabolic steroids long-term and the 99 male weight lifters who had not used steroids through the computer model to predict their brain age.

The difference between the predicted age based on the brain scan and the individual's actual age was deemed the "brain age gap."

The "brain age gap" was larger for long-term, dependent steroid users than non-users. And the longer the weight lifters had used steroids, the bigger the gap — in other words, the aging process seemed to accelerate with extended use of steroids.

The researchers controlled for confounding factors like cognitive ability and depression. They found that while steroid users were more likely to be prescribed psychiatric medication like antidepressants, this didn't affect accelerated brain aging findings.

WHY IT MATTERS — As the brain ages, some areas change in thickness, volume, and surface area — an older-looking brain is associated with cognitive impairment, mortality, and a host of other problems.

Unfortunately, the study doesn't pinpoint if one steroid is worse than another, and as Bjørnebekk says, "We do not know the exact practical effects yet," but she hopes to study these next. Weight lifters and other athletes may use a combination or a variety of androgenic anabolic steroids, making it difficult to single out the culprit for cognitive risks. Not to mention, it's hard to recruit study participants who are engaging in drug use that could put their professional — and personal — lives at risk to delve further into the link.

In general, drug use and addiction are also associated with older-looking brains. On the other hand, in one study, brains appear "younger" than

CHEMWATCH
Bulletin Board
Curiosities
APR. 02, 2021

biological age among people who are more educated and take regular exercise. Notably, in this study, the brains of steroid users who quit did not differ much from the healthy participants in the control group, suggesting that recovery is possible.

Apart from serving as a warning to those considering taking anabolic steroids, the findings of this study strengthen the case that long-term anabolic steroid use really does lead to measurable cognitive changes. Healthcare providers may be able to use these findings to prevent and treat steroid use.

inverse.com, 28 March 2021

https://www.inverse.com

Cause of mysterious bald eagle deaths found after 25 years

2021-03-26

A mysterious neurodegenerative disease has been killing bald eagles and other animals at lakes across the United States. And after 25 years of sleuthing, researchers have finally figured out its cause.

The disease, known as vacuolar myelinopathy (VM), was first discovered in 1994 when a large number of bald eagle carcasses were found near DeGray Lake in Arkansas. VM attacks the brains of infected animals, causing problems with motor functions and eventually leading to a "gruesome death," according to researchers.

"When the birds are really sick, they just look really drunk, they stumble around and fall down," co-author Susan Wilde, an aquatic scientist at the University of Georgia who has been studying VM since 2001, told Live Science. "But it gets even worse, they get paralyzed, blinded and can have tremors and seizures before eventually succumbing to the disease."

Initially, scientists had no idea how the eagles acquired the disease. Scientists eventually identified an invasive plant and later a particular species of cyanobacteria that seemed to be responsible, but the exact mechanisms behind VM continued to elude detection.PLAY SOUND

Now, a new study has uncovered the culprit: a neurotoxin called aetokthonotoxin that is produced under certain circumstances by the cyanobacteria living on the invasive plants.

"But it gets even worse, they get paralyzed, blinded and can have tremors and seizures before eventually succumbing to the disease."

"A toxin produced by cyanobacteria that colonize a highly invasive plant, which has the capacity to affect diverse animal phyla, should not be underestimated in its potential impact on our environment," lead author Steffen Breinlinger, a doctoral student at Martin Luther University Halle-Wittenberg in Germany, told Live Science.

What is VM?

Since it was first discovered in 1994, VM has spread quickly throughout lakes in the U.S.

"We have found it in nine states from Virginia to Texas," Wilde said. "But I don't think we understand just how many places this might be occurring."

A wide range of lake species also seem to be impacted by the disease — fish, frogs, snails, salamanders, turtles and snakes, as well as smaller birds like, coots, owls and waterfowl.

However, bald eagles (Haliaeetus leucocephalus) are one of the most affected species because they feed on all of these other infected animals, Wilde said.

"We know it's at least 130 eagles that have died testing VM-positive," Wilde said. "But the recovery rate of dead bodies is probably around 10 or 12%, so it's probably at least 10 times that number."

Researchers test for VM by performing a necropsy immediately after the animal's death. Lesions and damage to the brain are the only physical evidence of the disease and can only be properly identified during a short window of time after death. This makes tracking the disease and estimating deaths even harder, Wilde said.

Spreading across the U.S.

Early on, scientists discovered that VM was found only in lakes where an invasive plant species, Hydrilla verticillata, was also found. The Hydrilla, which is native to Central Africa, was first found in the U.S. in 1960 in Florida and has since become one of the most successful invasive plant species in history, according to invasive.org.

It only takes a few fragments of the Hydrilla plant or some of its tubers — structures created by plants to store nutrients that can also be used in asexual reproduction — to be introduced into a lake before it takes over and becomes almost impossible to remove, Wilde said.

CHEMWATCH
Bulletin Board
Curiosities
APR. 02, 2021

However, scientists soon realized that not all lakes where Hydrilla grows were linked to VM, so something else must have been causing the disease.

In 2015, a new study by Wilde and colleagues identified a species of cyanobacteria (Aetokthonos hydrillicola) that was found on Hydrilla in lakes where VM was occurring in animals. But the exact cause of the disease still remained a mystery because the team couldn't explain how the bacteria were causing VM.

Solving the mystery

In the new study, Wilde sent samples of the cyanobacteria to Breinlinger and other researchers in Germany, who attempted to grow cultures of the bacteria and see what toxins they produced.

To their surprise, the German team found that cyanobacteria grown in regular cultures did not produce any toxin and seemed to disprove Wilde's theory that they were responsible for VM. However, when grown on cultures that included bromide, the plants produced a toxin that researchers now think causes VM. The toxin is called aetokthonotoxin, which translates to "poison that kills the eagle."

Exactly why the cyanobacteria produce the toxin and why they only do so in the presence of bromide is still unknown.

Bromide does occur naturally in lakes in small doses, but it is also introduced by humans in the form of herbicides (ironically used to control the spread of Hydrilla), as well as chemical run-off from both flame retardants and pollution from coal-powered power stations, Breinlinger said.

"It was only this discovery that made us aware that VM is also spreading due to anthropogenic influence," Breinlinger said.

Next steps

It is highly unlikely that VM will ever be eradicated from U.S. lakes, but now that scientists better understand the toxin responsible for it, they can figure out ways to control the spread and manage the disease, Wilde said.

"If we control the bromide in the reservoirs, Hydrilla will not accumulate in it and ultimately Aetokthonos [the cyanobacteria] will be stripped of its weapon," Breinlinger said. "Without bromide, it simply cannot produce the toxin in the first place."

However, it is equally important that researchers are able to locate all the places where VM is prevalent, and Wilde believes citizen scientists could play a crucial role.

"Citizens that recognize what Hydrilla looks like and when a bird is acting really strange could be huge," Wilde said. "We've just got to keep an eye out for it and keep it under control."

The researchers are also planning to do further research on how the new toxin affects small mammals, such as mice, to see just how dangerous it could be in humans.

"There is actually some of the toxin in the tissues that waterfowl hunters would consume," Wilde said. "It seems even more important to get to the point where we ask whether or not humans would have some health effects if we consume [the toxin]."

The new study was published online March 25 in the journal Science.

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Why is sleep important? We ask neuroscientists, doctors, and NASA

2021-03-27

Sleep. Everyone does it, and some of us do it better (and for longer) than others, but why do humans sleep? In short, why is sleep important for us? It seems like such a basic question to ask, but as it turns out, the answer is far from basic. In fact, experts still don't really know how to answer this question entirely, but they are discovering more about the importance of sleep with each passing year.

Type the word 'sleep' into Google and you will be served an endless sea of articles discussing why sleep is important for humans – and plenty more articles lamenting how difficult it is to get to sleep (and stay asleep) at times. Common questions include, 'How can I sleep instantly?' and 'How many hours of sleep do you need?' As a species, we are obsessed with slumber numbers: how much, how fast, and where does age come into it? And it isn't just Google being asked why sleep is important – doctors are regularly grilled, usually by folk at their wits' end over back-to-back cycles of poor sleep.

CHEMWATCH
Bulletin Board
Curiosities
APR. 02, 2021

That's worth remembering too: one size does not fit all when it comes to sleep.

For some, good sleep is elusive, and cruelly, any sleep expert will tell you that the more a person struggles to get some shut-eye, and the more effort they put into trying to sleep, the more they struggle. And on the cycle goes. But understanding the importance of sleep and how to let it happen (because we can't make it happen), the sooner you'll return to what feels like healthy snoozing for you. That's worth remembering too: one size does not fit all when it comes to sleep. Yes there are healthy averages, but you know what feels right for you.

WHY DO HUMANS NEED SLEEP?

The average person spends nearly a third of their life asleep, and if we keep skipping on quality sleep, the outcome won't be good. Consistent poor sleep damages the body, and total, prolonged sleep deprivation can be fatal. Dr Lindsay Browning, neuroscientist, chartered psychologist and author of Navigating Sleeplessness points to a very rare genetic brain disorder associated with lack of sleep which can be fatal: "Without sleep we [eventually] die. There's a condition called Fatal Familial Insomnia, where people stop being able to sleep and the only outcome of that is death."

While such examples are extreme, they show that sleep is important. However, from an evolutionary perspective sleep makes no sense. Dr Browning explains it best: "When we sleep, we are completely vulnerable. We are at risk to predators and the environment around us. From that perspective sleep is a very risky thing to do, so it must have huge benefits that outweigh those huge risks of death." We have to admit, thinking about sleep from this perspective is new to us, but it's certainly thought-provoking.

NASA has also spent a long time thinking about sleep, why we need it, and how to get it. For more than 50 years, NASA's Human Research Program (HRP) has been studying what happens to the human body in space, and one ongoing element of that research is sleep. Chiefly, how to ensure astronauts get quality sleep in space, and what the repercussions are if they don't.

Dr. Erin E. Flynn-Evans, previously an instructor in Medicine in the Division of Sleep Medicine at Brigham and Women's Hospital and Harvard Medical School, now leads the NASA Ames Research Center Fatigue Countermeasures Laboratory. Who better for us to ask the big question, why do humans need sleep? "This is a very challenging question!" says Dr Flynn-Evans. "Humans need sleep for a variety of reasons. Sleep impacts, and is impacted by, nearly all other aspects of human physiology.

"Sleep enables physical recuperation of the body, encodes memories, enhances learning, suppresses metabolism, restores cognitive function, and may even help the brain clear waste products.

"At NASA, we care about all these benefits, but one of the biggest reasons we study sleep is to ensure that astronauts are able to perform at an optimal level during missions including to the moon and Mars." While most of us aren't ever likely to set foot on the moon or Mars anytime soon, if NASA recognizes the vital importance of sleep, then the rest of us should too.

WHY IS SLEEP IMPORTANT TO OUR HEALTH?

For something we're supposed to do naturally, sleep sounds complex. But what can science tell us about what happens to our brain and body while we're asleep? Dr Katherine Green, MD, is the Medical Director of the UCHealth Sleep Medicine Clinic, and she will also soon be talking about all-things-sleep in the new women's health podcast evrē. She helps us shed some light on how sleep affects the brain: "Key processes involved in learning and memory happen only during sleep, and sleep is an integral part of memory consolidation and learning and retaining new things," says Dr Green.

"There are vital roles in regulating mood and appetite that depend on your circadian rhythm and the cycle of wake and sleep. Recent studies have shown that during sleep, there are vital 'housekeeping'-like processes that occur to clear toxins and by-products from the brain that build up during periods of wakefulness."

This is something Dr Browning spoke to us about too: "We know that when you sleep, your brain physically spring-cleans itself of amyloid plaques, which are sticky protein substances that build up and cause Alzheimer's. If you aren't sleeping enough, your brain has to prioritize what it really needs to do in a shorter period of time because you are having less sleep."

In an article titled The Sleep Deprived Brain, the Dana Foundation shared how, "A new study now shows that just one night of sleep deprivation results in the accumulation in the brain of a protein implicated in Alzheimer's." So much for your brain 'switching off' during sleep, huh?

The UCSF Weill Institute for Neurosciences is home to researchers and physicians studying some of the most complex challenges in the human brain. Dr Louis Ptacek is a professor at the Department of Neurology there, and when we pressed him for an answer on why sleep is important to

CHEMWATCH
Bulletin Board
Curiosities
APR. 02, 2021

humans, he told us straight: "We really don't know. It's clearly important for 'restoration'. Probably eliminating some 'waste' that has accumulated during the day. What we know for certain is that chronic sleep deprivation leads to increased risk of many diseases. So getting enough sleep is important."

Dr Browning backs this up: "So much research consistently shows that getting enough good-quality sleep is associated with diminished risk of depression and anxiety. You also have a decreased risk of getting certain types of cancer, of getting dementia, of obesity, and strokes. Your immune system benefits if you sleep well, as does your memory and your ability to make decisions."

THE HEALTH BENEFITS OF SLEEP

As mentioned throughout this article, the benefits of regular, healthy sleep are tenfold, and some of the most common are:

IF SLEEP IS SO IMPORTANT, WHY DON'T WE TALK MORE ABOUT IT?

While there are still question marks over its precise function, and exactly what happens to us during sleep, we are now understanding that healthy sleep is just as (arguably, if not more) important as getting regular exercise and eating a healthy, balanced diet.

But even then, it's tempting to cut down on sleep in favor of doing something else a little more, well, exciting or productive. That could be getting up at 5am to hit the yoga studio, or going to bed late to nail a massive work assignment that's giving us anxiety. Or heck, just staying up way past our bedtime to kick back and watch a movie. Yet if we don't prioritize sleep, all of those things will be harder or less enjoyable.

As part of her work teaching Cognitive Behavioral Therapy for Insomnia (CBT-I) at Trouble Sleeping, Dr Browning has met with a lot of sleep-deprived people who sacrifice sleep to make gains in other areas of life.

Some folks see sleep as an inconvenience that gets in the way of a busy, fulfilling life, while others don't necessarily understand the importance of sleep because they can't see the direct effects of getting good sleep in the way they do when lifting weights or writing a novel, for example. Muscles get bigger and words mount up on a page after a while, but how do we directly see and measure the benefits of sleep over a longer period of time?

"With sleep, some of it is direct – your immune system is compromised after just one night of poor sleep," Dr Browning points out. "But if people don't understand the benefits of getting good sleep, they naturally won't prioritize it and will do other things. That does make sense, but that's also why it's vital to educate people that sleep is important and to prioritize it just as you would healthy eating and exercise."

In other words, while we are inundated with information on the importance of getting regular exercise, or eating at least five portions of fruit and veg a day, when it comes to discussing the role of sleep, it doesn't get nearly as much air-time. Dr Browning wants people to think about sleep in the same way they think about the benefits of regular exercise and a balanced diet: "I want people to think that if they prioritize sleep, they're benefiting themselves just as they do when choosing to eat more fruits and vegetables and choosing to exercise.

"We need to do all of these things to be healthy, and not sacrifice one for the other. What pains me is when people get up two hours early to go to the gym before work, but they might not be going to bed two hours earlier. So those people are sacrificing sleep and doing damage to themselves." Hats off to those who adjust the time they go to bed to accommodate getting up earlier.

Before we explore further, it's important not to get hung up on the concept of 'good sleep' because healthy sleep for you will be different to healthy sleep for the next person. This is why you shouldn't panic, because poor sleep is, for the majority of people, something that can be addressed by a doctor or sleep expert. It also pays to keep some perspective – a crumby night's sleep here and there is not the end of the world.

This preoccupation with achieving correct sleep, also called Orthosomnia, is something Dr Browning has experience of dealing with, "My work is helping people who are struggling to sleep, and so often their struggles are fueled by, 'Well, I read that if I don't sleep for seven to nine hours I'm going to get cancer. And then of course that person doesn't sleep well because they're stressed out of their mind about their sleep.

"I deeply believe that sleep is important," she continues, "but I really want to balance that with making sure that people don't obsess about sleep because that can be damaging."

EXPERT TIPS FOR BETTER SLEEP

CHEMWATCH
Bulletin Board
Curiosities
APR. 02, 2021

So we know sleep is important, but we also know obsessing over it won't help us sleep any better, so what do the experts recommend? In short, how can we enjoy better sleep and deal with any pesky sleep problems we might be facing right now?

Dr Carmen Salvaterra, MD, is a renowned pulmonologist and practitioner of sleep medicine at Johns Hopkins Community Physicians Pulmonology and Sleep Medicine. Her go-to tips for better sleep include:

- Follow a bedtime routine
- Maintain a wake and sleep schedule
- Dim lights in the evening
- Avoid electronics one to two hours before bedtime
- Do not eat two hours before bedtime
- Use darkening shades in your bedroom
- Do not perform any other activities in bed, such as watching TV

Pay attention to what you are drinking and eating too, especially if you're consuming caffeine after midday – the half-life of caffeine varies widely between people, but it can last around five hours or longer, so if you're having it late afternoon, it could still be in your body close to bedtime. "Caffeinated products such as coffee and caffeinated sodas, along with dark chocolate, energy pills and drinks hamper our sleep," says Dr Salvaterra. "We should not consume these close to bedtime."

And if you think a nightcap would help, then you're right and wrong: "Alcohol helps us fall asleep, but leads to night awakenings and therefore restless and poor quality sleep, especially in the early morning hours, as it interrupts our REM sleep," says Dr Salvaterra.

Some people talk about 'initiating sleep', but sleep isn't something you can make happen by sheer will. "Not even the best sleepers in the world can make themselves sleep at any moment," explains Dr Browning. "What you can do is make your environment ripe for sleep, so that sleep is much more likely to happen. And then you just let sleep happen."

Things that can stop us from sleeping include – no surprises here – a busy, racing mind. Now, our brains can't be stopped from thinking completely, but there are things we can do, including practicing good sleep hygiene, to feel more at ease in this type of situation. "You have to accept that your

mind is thinking for a reason; your brain is having those thoughts because they're important," says Dr Browning. "So rather than trying to suppress them, or take a sleeping pill to knock you out, deal with those thoughts and issues during the day time.

"You could try expressive writing, or keeping a journal or gratitude diary. Something like that will help your brain get out all those thoughts so you won't be thinking about them at night." Firing up a meditation app may also help you to relax and breathe properly.

One of the biggest sleep myths is that older people don't need anywhere near the average recommended amount of sleep for adults (roughly seven to nine hours). Every person needs regular, healthy sleep. However, Dr Green points out, our sleep needs and sleep patterns definitely change as we age. "Young kids are mostly 'advanced' in their circadian rhythms (up very early in the morning), whereas, by adolescence we become 'delayed' (night owls). As we age, the total amount of sleep that is necessary does decrease, and older adults tend to get less 'deep' or slow wave sleep as they age. Most adults still need a minimum of seven hours of sleep at night (whereas kids need much more).

"Our circadian rhythm also tends to change as we age (thus where the idea of the 'early bird special' comes from – older adults tend to have a circadian rhythm that is shifted earlier, meaning earlier bedtime and earlier wake time)."

NOW, WHAT DO WE KNOW ABOUT POOR SLEEP?

We asked Dr Salvaterra, of Johns Hopkins Community Physicians Pulmonology and Sleep Medicine, what the impact would be on our physical and mental health if we didn't get enough quality sleep on a consistent basis. She replied, "Various health conditions associated with poor sleep include mood disorders, cardiac arrhythmias, and memory impairment. Even dementia has been associated, along with stroke if there is lack of oxygen to the brain in people with sleep apnea."

For Dr Salvaterra, the importance of sleep is perhaps best answered by looking at the effects of sleep deprivation or poor sleep: "When we are deprived of sleep the brain function is impacted as memory is affected, with inability to pay attention at tasks and loss of creativity."

As Medical Director of the UCHealth Sleep Medicine Clinic, Dr Green has also encountered a lot of people with varying sleep issues, and is well-placed to talk about the effects of poor sleep. "Health benefits of sleep are

CHEMWATCH
Bulletin Board
Curiosities
APR. 02, 2021

very wide reaching – studies show that getting insufficient sleep increases your risk of high blood pressure, cardiovascular disease, metabolic disorders such as diabetes and obesity, and also increase the risk of anxiety and depression. We know that poor sleep impacts cognition, learning and memory, focus and attention, and also impacts driving and work safety."

Sleep also has links to fertility, with irregular sleep cycles potentially causing issues when it comes to baby-making. "Circadian rhythm and the hormones that regulate sleep and wakefulness also trigger the release of the daily hormones that regulate both ovulation and the process of sperm maturation," explains Dr Green. "So if your sleep cycle and sleep habits are not regular, there may be dysfunction in the timing or regularity of those hormones being released, and this can lead to menstrual irregularity or a prolonged period of trying to conceive unsuccessfully."

THE EFFECTS OF SLEEP DEPRIVATION ON MENTAL HEALTH

As you'd expect, there's interplay between sleep and mental health too, though to what extent doctors don't yet know. "Chronic sleep deprivation leads to increased risk of many health problems, and that includes mental health," says Dr Ptacek of the UCSF Weill Institute for Neurosciences. "Again, we don't understand the molecular details of this but are using our studies in familial sleep traits to begin to address this question."

You probably aren't imagining it, either: you do feel more emotional when you're not sleeping well. As Dr Salvaterra points out, when we are sleep deprived "our emotions are also impacted, as mood disorders and emotional instability has been noted in people who are deprived of restful sleep".

What about people who are dealing with anxiety or depression? How do those mental health conditions affect sleep? "People who have depression tend to either sleep a lot less or a lot longer," says Dr Browning. "They may sleep a lot less because of anxiety and worries, but people with depression can also sleep a lot more because they are basically escaping life. So they'll be sleeping for long periods, often throughout the day, which then messes up their sleep at night."

IF SLEEP IS SO IMPORTANT, SHOULD WE WORRY IF WE HAVE SHORT-TERM SLEEP LOSS?

When we ask ourselves the question 'why is sleep important?', it's easy to become aware of our own sleep, whether it's any good, whether we're getting enough, and how normal is it to wake up in the middle of the

night anyway? Is it our fault for not buying the best mattress for your favorite sleep position? It's easy to panic, but that's possibly one of the most counter-productive things you can do for better sleep.

"Short-term sleep loss is something we are able to deal with," Dr Browning assures us. "We can recover from it. And if it wasn't, every new parent on the planet would be absolutely screwed. Everyone has periods of sleep loss, but when that loss becomes the norm that's when problems build up. So if you're consistently not sleeping, you are doing longer-term damage that you won't be able to undo."

Remember when you were young (or maybe you still are) and felt as though you could work all day, party all night, and not have a care about getting much sleep? Us too, but it turns out being awake for very long periods at a time without sleeping isn't so clever.

In fact, when we asked UCHealth's Dr Green what would happen to a healthy person if they didn't sleep for 24 hours, this is what she said: "Being sleep deprived even for a short period of time has profound effects, particularly on mood, driving and work safety, and focus and attention.

"There are studies showing that after 20 hours awake drowsy drivers are impaired on reaction time testing equivalent with a 0.08% blood alcohol content, and that after 24 hours awake, that impairment is equivalent to a BAC of 0.1%."

However, if you think a long, luxurious lie-in at the weekends will help you catch up on sleep then you may want to reconsider. "Maintaining the same bedtimes and wake-times (yes even on weekends!) is one of the healthiest things you can do for your sleep habits overall," advises Dr Green. "Keeping a regular schedule of sleep helps keep your circadian rhythm normal and better regulates all the other processes (appetite, fertility hormones, energy level, etc) that depend on that 24-hour cycle in your body.

"'Catch-up' sleep can make it difficult to fall asleep at night as it pushes your circadian rhythm out of alignment, so it may feel like a great idea on a Saturday morning, but for some people it can really make Sunday night and Monday morning much more difficult.

"Setting a regular wake-time and sleep-time also ensures you are prioritizing sleep in your day and schedule, to make sure you are allowing yourself at least seven hours of sleep each night."

IS THERE SUCH A THING AS TOO MUCH SLEEP?

CHEMWATCH
Bulletin Board
Curiosities
APR. 02, 2021

As it turns out, yes, and there are negative health outcomes attached to this too. "However," cautions Dr Browning, "it's important to point out that we don't know whether it's the fact you are sleeping too much that causes the health issues, or whether you're having health issues that are then causing you to sleep too much. For example, if you're going through cancer or if you have a chronic illness… Our immune system is boosted during sleep, so if you are sick, you need more sleep. Therefore, if you're sick, that can cause you to sleep more." Dr Browning also shares another reason why people might sleep too much: "Some people who sleep a lot are people with sleep apnea."

Sleep apnea is a serious condition where you stop breathing during the night, and according to the American Sleep Apnea Association, it is estimated that around 22 million Americans suffer from it.

"People with sleep apnea repeatedly stop breathing throughout the night, and this can happen hundreds of times in the night. So their sleep is being continually disrupted. They'll sleep for seven, eight, nine, ten hours, and think they've slept for that long, but they'll wake up and still feel exhausted. And that's because they aren't sleeping properly when they are asleep."

If you went to Dr Browning's clinic and said you can sleep for ten hours a night and still sleep for longer yet you never feel refreshed after sleep, she will tell you something doesn't add up. "If you can't get the rest you need within that time period, something isn't right, and often it's sleep apnea. When people have treatment for sleep apnea, they go back to having a more normal amount of sleep, which is usually between seven and nine hours, because they're actually resting properly."

Bottom line is, if you're sleeping too much, think about why this might be the case and speak to a doctor as soon as you can, to see if there is something going on with you while you're asleep.

THE KEY TAKEAWAYS ON WHY SLEEP IS IMPORTANT

As we have heard from various experts throughout this article, getting enough sleep is essential to maintaining optimal health and wellbeing. Good sleep is beneficial for our physical and mental health, and can help us feel energized, creative, focused and productive in our day to day experiences.

Creating a manageable bedtime routine that you can stick to each night is important for helping you to relax and fall into a space where sleep

is more likely. This includes optimizing your bedroom for sleep, such as tidying away clutter, boosting your in-bed comfort with a good pillow for sleeping, or dimming the lights or playing around with smart color lighting for sleep.

We should prioritize snoozing more, but it isn't something to obsess over. Also remember that some of us naturally need more or less sleep than others, and that the average 'seven to nine hours' for adults is not set in stone. You know your sleep needs better than anyone, and you also know what helps you drift off more easily too. So prioritize your sleep, enjoy every minute of it, but don't stress over it. Good sleep is your ally for better health, so if you feel you aren't getting it right now, speak to a doctor or sleep expert because there is help available to you.

toptenreviews.com, 27 March 2021

https://website

Can microbes save us from PFAS?

2021-03-21

For 3 decades starting in the 1940s, General Electric dumped solvents from its manufacturing facilities into New York's Hudson River, contaminating it with polychlorinated biphenyls (PCBs). Scientists worried about how best to clean up the pollutants. "At that time, they thought PCBs were completely nonbiodegradable," says Lawrence P. Wackett, a biochemist at the University of Minnesota Twin Cities who consulted for the company in the late 1980s.

But analysis of sediment cores extracted from the river throughout the 1980s showed that the PCBs were slowly losing their chlorine atoms and turning into benign hydrocarbons. Later, scientists determined that the transformation was performed by microbes (Science 1987, DOI: 10.1126/science.236.4802.709).

Now, researchers are hoping microbes could do the same for per- and polyfluoroalkyl substances (PFAS), also known as forever chemicals. Used in personal care products as well as firefighting foam, stain-repellent coatings, and membranes for chlor-alkali production, PFAS have strong carbon-fluorine bonds that make them difficult to degrade. PFAS have become a high-profile contaminant, polluting areas near manufacturing facilities that make or use them and military sites like air bases. Researchers are still trying to fully understand the health effects of PFAS

PFAS have become a high-profile contaminant, polluting areas near manufacturing facilities that make or use them and military sites like air bases.

CHEMWATCH
Bulletin Board
Curiosities
APR. 02, 2021

but have determined that some are carcinogenic and toxic to multiple systems.

Traditionally, to treat contaminated water, remediators first concentrate the PFAS, typically via an activated carbon filter, and then incinerate the saturated filters at high temperatures. Biological remediation could be more cost effective for low levels of PFAS in large volumes of contaminated material. So far, no organism has been found that can completely defluorinate PFAS, but researchers have no reason to believe that microbes couldn't eventually do the job. "Never say never in terms of what they can't handle," Wackett says.

The US Department of Defense's Strategic Environmental Research and Development Program (SERDP) has funded extensive research into the chemical and physical remediation of PFAS. In 2018, SERDP launched a call for research proposals exploring the biodegradation of PFAS and awarded $2.75 million to five projects beginning last year.

However, other scientists, like Rolf U. Halden, an environmental engineer at Arizona State University, worry that investigating bioremediation of PFAS distracts from the real work of having to dial back on their use. Halden is "very, very skeptical" that a microbe could be practically deployed to remediate PFAS. "I think that this will only delay the actual hard question that we have to answer: How much [PFAS] is too much, and how do we get to a healthy use of these very useful materials?" he says.

MICROBIAL INFALLIBILITY

In his 1951 textbook, The Chemical Activities of Bacteria, British microbiologist Ernest Gale put forward the microbial infallibility hypothesis—that if there is energy to be gained from a compound, a microorganism will figure out how to extract it and create a niche for itself. After the Deepwater Horizon explosion and oil spill, for example, scientists found that microbes eventually ate most of the energy-rich hydrocarbon compounds that spilled into the Gulf of Mexico, resolving part of the problem naturally.

Halogenated compounds such as PCBs contain much less energy than hydrocarbons, but microbes can still use them (Biochem. J. 2020, DOI: 10.1042/BCJ20190720). In the Hudson River, Dehalococcoides bacteria living in oxygen-poor environments in the sediment transfer electrons to the PCBs, reducing them and kicking out chloride ions, Wackett explains.

In fact, Dehalococcoides are obligate dehalogenators, Halden says, meaning they can survive only by dumping their electrons on halogenated organic compounds. But there are significant differences between PFAS and their chlorinated counterparts, he says. To start, carbon-fluorine bonds are much stronger and harder to break than carbon-chlorine bonds.

More importantly, microbes evolved along with thousands of naturally occurring chlorinated compounds, so when bacteria like Dehalococcoides encounter human-made chlorinated pollutants like PCBs or trichloroethylene (TCE), they don't see those pollutants as completely foreign. "These organisms existed before we created TCE," Halden says. But naturally occurring fluorinated compounds are rare; only fluoroacetate is well studied in plants, and it contains just one fluorine atom. PFAS, in contrast, especially the perfluorinated ones, are swathed in fluorine atoms. "That renders the chemicals almost bulletproof," Halden says.

PFAS are so recalcitrant that one of the five SERDP-funded projects investigating biological methods to destroy PFAS instead demonstrated that previously reported chemical degradation methods don't work. Pedro J. J. Alvarez, an environmental engineer at Rice University, had been working with bacteria that can produce copious amounts of superoxide outside their cells. Alvarez read that superoxide generated by decomposing hydrogen peroxide could break down perfluorooctanoic acid (PFOA), one of the most common PFAS found in the environment (Environ. Sci. Technol. Lett. 2014, DOI: 10.1021/ez4000862), so he proposed that superoxide-generating bacteria could perhaps degrade PFAS. He and his colleagues found, however, that superoxide generated chemically or enzymatically could not break down PFOA (Environ. Sci. Technol. Lett. 2020, DOI: 10.1021/acs.estlett.0c00505). When Alvarez and his team dug deeper, they found that another heavily investigated substance for PFOA degradation, hydroxyl radicals, could not do the job either (Chemosphere 2020, DOI: 10.1016/j.chemosphere.2020.125883).

But Alvarez is not discouraged. "If it's going to fail, let's fail fast so that we do not waste time on this," he says. That way, the research community can move on and try other approaches. His team's recent work on using the superoxide-generating bacteria to dechlorinate TCE has shown outstanding results, Alvarez says. The bacteria are effective even when oxygen, which could compete with TCE as an electron acceptor, is present. Because TCE is a common cocontaminant with PFAS, Alvarez thinks the superoxide-generating bacteria could still prove useful by eliminating

CHEMWATCH
Bulletin Board
Curiosities
APR. 02, 2021

other pollutants that may interfere with remediation processes that target PFAS.

And Alvarez believes in the microbial infallibility hypothesis—that a microbe will find a way to use even tough compounds like PFAS. "I am certain that it can happen," he says.

A POINT OF WEAKNESS

A key factor for how easily a microbe can break down a fluorinated compound is if the molecule contains a spot vulnerable to attack, such as a carbon-hydrogen bond, says Jinxia Liu, an environmental engineer at McGill University. Liu has been investigating the biotransformation of polyfluorinated compounds called fluorotelomers for over a decade. Fluorotelomers such as 6:2 fluorotelomer sulfonic acid, which is used in firefighting foams, contain such a spot that is susceptible to microbial action.

Aerobic Gordonia bacteria perform a well-known transformation on fluorotelomers: they consume the sulfonated part, leaving a highly persistent, perfluorinated carboxylic acid. Liu has observed perfluorinated biotransformation products that are one or two carbons shorter, though, suggesting that Gordonia is also capable of chopping up the fluorinated tail one carbon at a time. "In theory, we can completely defluorinate a fluorotelomer," says Liu, whose calculations show that the process is energetically favorable. But Liu's team observed that the removal usually stops after two cycles. The researchers are working to figure out why the defluorination stops and how to push the microbes to repeat the removal until all the fluorine atoms are gone.

In perfluorinated molecules, moieties like a double bond could serve as the necessary point of weakness. Yujie Men of the University of California, Riverside, incubated KB1, a commercially available microbial culture that is used for dechlorination and that includes Dehalococcoides bacteria, with lactate and a variety of perfluorinated molecules. The lactate provides electrons for the microbes, while the PFAS act as electron acceptors. The microbes degraded 100% of one unsaturated perfluorinated molecule—(E)-perfluoro(4-methylpent-2-enoic acid)—after 130 days and more than 90% of another—4,5,5,5-tetrafluoro-4-(trifluoromethyl)-2-pentenoic acid—after 70 days, compared with none of the saturated perfluorinated compounds (Environ. Sci. Technol. 2020, DOI: 10.1021/acs.est.0c04483).

Men's team has identified intermediates suggesting that two initial reactions—with opposite effects—compete during the biotransformation

process. The microbes could be replacing fluorine atoms on the double-bonded carbons with hydrogen, thereby making the molecule more vulnerable to additional defluorination. Or they could be adding two hydrogen atoms across the double bond, creating a saturated compound that is more resistant to defluorination. Men is working to identify the specific bacteria responsible for the reactions and the enzymes involved. "There is a way to direct them as long as we know which microorganism and which enzymes are carrying out the defluorination reaction and the hydrogenation reaction," she says.

As for PFOA and perfluorooctane sulfonic acid (PFOS), which contain no weak spots, a bacterium native to the wetlands of New Jersey may be able to defluorinate them (Environ. Sci. Technol. 2019, DOI: 10.1021/acs.est.9b04047). Peter Jaffé and his group at Princeton University have been studying A6, a strain of the microbe Acidimicrobium, since 2005. This microbe performs a reaction called Feammox, in which it transfers electrons from ammonium ions to iron(III) ions in acidic soil.

Jaffé's team sequenced A6's genome and noticed it had genes coding for dehalogenases. "Some of them were quite novel," Jaffé says. The team then decided to see what happens when A6 is given only PFAS as its sole source of carbon. Over 100 days of incubation with either PFOA or PFOS, the researchers found a steady disappearance of up to 60% of the compounds, with an accompanying rise in dissolved organic carbon and fluoride ions.

Jaffé is now collaborating with the University of Minnesota's Wackett to decipher the mechanisms behind A6's defluorinating power. Wackett is using a combination of computational and experimental techniques to narrow down the enzymes and the genes that could be responsible.

PRACTICALITY

In the laboratory, researchers can create ideal conditions for microbes to feed on PFAS or even force them to do it. Deploying microbes out in the environment for in situ remediation, however, presents significant challenges. Halden notes that Jaffé's and Men's studies used high concentrations of PFAS. But in the real-world environment, even though PFAS are present in some places at levels dangerous to people's health, they still exist only at parts-per-billion concentrations.

Worse, there are many other goodies in the environment for microbes to feast on, and it is hard to control what they choose. Men has witnessed microbes in the commercial KB1 culture turn from consuming PFAS to eating an alternative like TCE when it is present. "It's very difficult because

CHEMWATCH
Bulletin Board
Curiosities
APR. 02, 2021

it's like you're asking someone to eat grass rather than normal food," Men says.

Whether microbial action can be exploited cost-effectively will also depend on the contaminated site, Alvarez says. A key parameter is how quickly water will carry PFAS at a particular site to another place: if the migration is slow, remediators can get away with a slow microbial degradation process. "But if the rate of migration is fast, then you better look for a more aggressive, faster solution to protect public health," he says.

A more feasible option is ex situ remediation, in which the contaminated material is pumped away and treated in an isolated bioreactor under controllable conditions. In a treatment facility, biological remediation can also be paired with chemical remediation. Bruce E. Rittmann, an environmental engineer at Arizona State University, is taking such a two-step approach.

"Our strategy is based on the understanding that we aren't going to be able to directly biodegrade these PFAS," he says. "We need to start the job for the microorganisms."

In Rittmann's strategy, PFAS first go through a hydrogenation reaction with a palladium catalyst, which replaces some of the fluorine atoms with hydrogen. Then, the partially defluorinated material is fed to a diverse group of microbes that finish the defluorination job. Rittmann has successfully demonstrated the steps individually and is now working to link them in a two-stage setup. The group is also investigating various research questions, such as how much defluorination is required in the first step and what the biotransformation products are.

McGill's Liu is collaborating with microbiologist Nancy N. Perreault of Canada's National Research Council to explore microbial biodegradation of PFOS after it first receives photochemical treatment that partially defluorinates it.

Currently, the microbes being studied for PFAS degradation grow too slowly, and their defluorination performances are not good enough for any practical remedy for environmental contamination of PFAS, Men says. Nevertheless, at the risk of sounding too optimistic, Men says she is hopeful that microbes will eventually rise to the challenge: "Bacteria have really huge potential, and they evolve very fast."

Whether or not microbes are ever able to conquer PFAS, most researchers agree that the use of PFAS should be restricted without delay. Despite voluntary phaseouts and even international bans on a few PFAS, some 1,400 PFAS are still being used in about 200 applications, spanning almost every industry. Some applications, such as medical equipment and chlor-alkali membranes, might justify the use of PFAS. But PFAS may not be required for other products—like artificial turf, guitar strings, or children's rain jackets. "We have to look deeper into what's really necessary and what is not," Liu says.

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https://www.cen.acs.org

Prime numbers protect Brood X cicadas from everything but zombie fungus

2021-03-27

After spending 17 years underground, trillions of cicadas will emerge this spring to creak out their ear-splitting mating songs and litter tree trunks with their eerie molted skin.

It's weird enough that Brood X, as this enormous influx of cicadas is known, somehow manages to emerge all at the same time after nearly two decades beneath the soil. What's even weirder is that the cicadas may use math to protect themselves from predators — well, most predators. No matter what these cicadas do, they're still susceptible to a fungus that turns them into zombies with disintegrating butts.

If this seems like a lot, well … it is. It turns out that the emergence of cicadas expected this May is a story encompassing evolution, math and some seriously gross parasites.

There are numerous species of cicada, all with life cycles that occur partly underground and partly aboveground. Some species emerge every year, others every few years. But then there are seven species of true weirdos: Periodical cicadas, all of which have either 13-year or 17-year emergence patterns. These periodical cicadas are a beloved species of entomologists and mathematicians alike, because it may be no coincidence that both 13 and 17 are prime numbers.

Bug math

The periodical cicadas are categorized in broods labeled by Roman numerals, based on where they emerge and how long their life cycles are.

No matter what these cicadas do, they're still susceptible to a fungus that turns them into zombies with disintegrating butts.

CHEMWATCH
Bulletin Board
Curiosities
APR. 02, 2021

Some occur in relatively small regions. Brood I, for example, comes out in Virginia and West Virginia every 17 years.

The brood set to emerge this year, though, is a biggie. Brood X, also known as the "Great Eastern Brood," last emerged in 2004. Members of this brood inhabit the District of Columbia and 15 states: Delaware, Georgia, Illinois, Indiana, Kentucky, Maryland, Michigan, New Jersey, New York, North Carolina, Ohio, Pennsylvania, Tennessee, Virginia and West Virginia.

The periodical cicada life cycle starts in the trees. Parents lay eggs in tree branches. The young hatch, then "kind of commando down and burrow down to the roots," said Joe Ballenger, an entomologist and doctoral student at the University of Wyoming. There, they feed on tree sap "until basically they're old enough to drive."

Bizarrely, the broodlings develop underground at different rates, Ballenger told Live Science. If a person were to dig for cicada nymphs a decade after the brood went underground, they'd find nymphs of various sizes and different stages of development. By year 16, though, all of the cicada nymphs would be at the same stage. Somehow — and no one knows how — the fastest developers know to wait, and the slowest catch up.

At year 17, things get exciting. When the soil warms to 64 degrees Fahrenheit (17.8 degrees Celsius), the cicadas burrow out of the earth, molt and then careen around, looking for mates. The result is spectacular: molted carapaces stuck to everything, screeching calls filling the air, clumsily flying bugs running directly into innocent passersby. As a child in Iowa, Ballenger once saw a deer covered in cicadas simply because the insects were everywhere and not particularly picky about where they perched.

The overwhelming number of cicadas emerging at once is protective. It's a strategy called predator satiation. Basically, birds and other predators can scarf down as many cicadas as they want, and it really won't matter; there are so many that the insects will still be able to reproduce in huge numbers.

A long recurrence interval may also stymy predators. For instance, the oldest robins in the wild are typically around 5 or 6 years old. That means that a 17-year cicada emergence is something a robin grandma might regale her grandchicks about, but those grandchicks may live and die without seeing such a feast.

In other words, the cicada windfalls are so rare that the robins can't really evolve to take advantage of them. The same is true for other predators, including some predatory wasps that capture cicadas, paralyze them and lay their eggs inside them. The wasps produce only so many eggs, Ballenger told Live Science, and the cicada emergences are so unusual that the wasps can't simply evolve to produce more eggs those years.

But the 13- and 17-year recurrence of cicada emergences may be an even savvier strategy. Both 13 and 17 are prime numbers, meaning they're divisible only by 1 and themselves. This means that emergences rarely overlap with predator population cycles that occur in shorter intervals. For example, if cicadas emerged every 10 years, they'd be susceptible to predators whose population boomed on a cycle of one, two, five or 10 years. If they came out every 12 years, they'd be a tasty snack for any predator on a cycle of one, two, three, four, six or 12 years. Thirteen years, though? Only one and 13. The same goes for a 17-year cycle.

Glenn Webb, a biological mathematician at Vanderbilt University in Tennessee, has done mathematical modeling that suggests that if periodical cicadas didn't use prime-number cycles, they'd drop dramatically in numbers or go extinct. In a 2001 paper in the journal Discrete & Continuous Dynamical Systems, Webb compared survival in cycles ranging from 10 to 18 years. Thirteen- and 17-year cycles performed best, yielding a stable population. The other cycle options led to declines, and 10-, 12- and 18-year cycles led to dramatic population losses or even extinction.

Not everyone agrees that these models are correct, Webb told Live Science, but by his math, predator cycles occurring every two to three years seem to make a big difference in cicada survival.

"It's a controversy," he said. "And I don't know when it will be settled, because it's not easy to conduct experiments or collect data."

Outwitting humans, falling to fungi PLAY SOUND

The challenge is that periodical cicadas' long life cycles don't mesh with human scientists' lives very well. Most doctoral students are in their late 20s or 30s by the time they finish their programs, and many must go on to work in someone else's lab as postdoctoral researchers. A cicada-loving entomologist might be 40 years old by the time they get to set up their own research program in periodical cicada studies. Let's say a 40-year-old researcher studies their first Brood X emergence this year. They'll be 57 the next time the bugs come around so they can collect their second round of

CHEMWATCH
Bulletin Board
Curiosities
APR. 02, 2021

data and then … drat, 74 and likely well into retirement. It's not a schedule that works well in the publish-or-perish model of academia.

Thus, many cicada studies are unfunded side projects, Ballenger said. "The fact that we can't know a lot about them creates a lot of mystery," he said.

So maybe cicadas use prime numbers to protect themselves, or maybe they don't. But there's one predator that they definitely don't outwit with math: a group of fungi called Massospora.

Massospora are truly creepy. Resting spores from the fungi infect cicadas as they burrow out of the soil in early spring. Infected cicadas look normal at first, but the fungus soon colonizes their back ends, turning it into a mass of spores (thus the name). The cicadas don't die, though, said Brian Lovett, a postdoctoral researcher at West Virginia University who studies insect-destroying fungi. Instead, they keep moving around, dropping new spores wherever they go.

"We'll describe them in our lab as flying saltshakers of death," Lovett told Live Science.

The fungus doses the infected cicadas with an amphetamine called cathinone, which is also found in the khat plant. This compound is probably made by the fungus itself (though the researchers aren't sure if the fungus might induce the cicadas to make the substance) and seems to keep the insects alert enough to keep bopping around even as their back ends dissolve. The fungus also has a bizarre effect on male cicadas it infects: Instead of flying around and calling for mates, the male cicadas start acting like females, flicking their wings in a way that indicates they're receptive to an amorous male.

"Since the back half of the body has been infected with spores, instead of mating with the cicadas [the approaching males] get infected with the fungus," Lovett said.

It's possible the fungus produces a compound that switches on this female behavior, Lovett said. It's also possible that it's just a side effect of the male's reproductive organs disintegrating that also benefits the fungus.

Massospora don't only infect periodical cicadas; they also like annual cicadas. That means they're not dissuaded by 13- or 17-year cycles. These massive cicada population bumps are a boon to the fungi, Lovett said, and a significant proportion of the cicada population is probably infected by the end of the season. However, predator satiation still holds. There are so

many more cicadas than the spores could possibly infect before mating season is over that the overall cicada numbers remain strong.

Lovett and his colleagues are working on genetically sequencing Massospora species to understand how they're related and how they've co-evolved with their cicada hosts. They're also trying to figure out if and how the fungus produces the amphetamine and the behavioral changes in male cicadas. Because the fungi conveniently infect cicadas that emerge each year, it's easier to investigate these questions. Brood X, on the other hand, might hold on to its mysteries well into the future.

"I think the question will be of interest 100 years from now," Webb said.

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Wildfire smoke is particularly harmful to kids' respiratory health, study finds

2021-03-23

Wildfire smoke was associated with a far greater number of pediatric respiratory care visits than other sources of airborne fine particles, according to a new study, even when wildfires were less severe.

The study, published Tuesday in Pediatrics, examined more than 170,000 emergency and urgent care visits for respiratory concerns from 2011 to 2017 in the Rady Children's Hospital Network, which cares for around 90% of hospitalized children in San Diego County. The concerns included difficulty breathing, respiratory distress, wheezing, asthma, and cough. Researchers found that a 10-unit increase of airborne particles less than 2.5 micrometers wide — known as PM2.5 — from wildfire smoke was associated with a 30% spike in admissions, compared to 3.7% from non-smoke sources, such as traffic emissions.

"It's quite a big bit of a difference," said Rosana Aguilera, the study's lead author and a postdoctoral researcher in environmental health at the University of California, San Diego. "I don't know if I was expecting that high number."

"I don't know if I was expecting that high number."

Scientists have known for decades that airborne fine particles negatively affect children's respiratory health, in part because their lungs are still developing and they breathe at a faster rate than adults, which means kids

CHEMWATCH
Bulletin Board
Curiosities
APR. 02, 2021

can take in more polluted air. As climate change increases the frequency and severity of wildfires, Aguilera and her colleagues set out to find whether PM2.5, which can get deep into the lungs and may even enter the bloodstream, were more harmful to children when they came from wildfire smoke.

Airborne fine particles have been regulated by the Environmental Protection Agency since the 1970s, and this pollution is generally decreasing across the country, except for wildfire-prone Western states. The health effects of the smoke-derived particles also likely have a disproportionate impact on communities of color, who more often live in areas vulnerable to wildfires. If particulate matter from wildfires is more harmful than that from other sources, it could mean that policies like EPA limits on particulate levels are in need of revision, said Juan Aguilera, a postdoctoral scholar at the Sean N. Parker Center for Allergy and Asthma Research at Stanford University.

"As we learn more about certain effects and certain consequences, definitely there's room to improve some of the policy," said Aguilera, who is of no relation to Rosana Aguilera and was not involved in the study.

In addition to looking at emergency and urgent care visits in San Diego County, the study authors identified ZIP codes affected by wildfire smoke using satellite data from the National Oceanographic and Atmospheric Administration's Hazard Mapping System. They also used data from EPA stations monitoring fine particulate matter in these same areas.

Using environmental data from two different governmental agencies is an innovative approach, said Juan Aguilera, and is "very important when we consider exposure."

The results support another study, published this month in Nature, from Rosana Aguilera and her colleagues, who documented an increased association between respiratory hospitalizations and wildfire-associated particulates among residents in nearly 700 ZIP codes in Southern California over a 14-year period.

The wildfires that occurred during the study period of the Pediatrics paper were of relatively modest severity, leading the authors to conclude that wildfires do not have to be extreme to produce impacts in children's health. However, the 2020 wildfire season was one of the worst in modern history across California.

"With an increase in wildfires and the intensity and the frequency, there would be an associated increase in health burden," said Rosana Aguilera.

That burden will likely fall harder on some populations: A 2018 study found that majority Black, Hispanic, and Native American census tracts were about 50% more vulnerable to wildfires. In San Diego County, a third of the population is Hispanic or Latino.

Particulates from wildfires may also have long-term impacts, not only the acute ones the study tracked. Juan Aguilera's colleagues at Stanford recently published a study that shows high levels of fine particulate matter and other types of air pollution are associated with immune effects in children, though the study did not examine individual sources. Studies on exposure to wildfire smoke in Montana have documented reductions in lung capacity and even an increase in influenza cases following severe fire seasons.

In addition to potential policy changes, personal awareness and protective measures might help limit the effects of airborne fine particles from wildfire smoke. People can wear N95 masks, use indoor air filtration devices, and make sure "there's a proper control of the ventilation, so that smoke doesn't necessarily get indoors," said Juan Aguilera.

Rosana Aguilera noted that the study is not without limitations, such as the fact that children may attend school in — and spend a significant amount of time in — a different ZIP code from where they live. The satellite data the researchers used could, in some cases, misidentify areas with smoke pollution, the paper said. In addition, the findings are based on one California county and may not be generalizable to the whole state or other states.

The higher proportion of smoke-associated respiratory visits was most pronounced among children 5 and younger, who also comprised the majority of emergency visits. This association was not as high among youth ages 6-12 and largely absent among those 13-19. The study authors acknowledged that the comparatively low number of visits for older children makes the data difficult to interpret. Juan Aguilera said parents might be more likely to seek care for respiratory concerns in very young children, leading to an overrepresentation of the youngest age group and underrepresenting older children.

Even so, Rosana Aguilera said the study shows PM2.5 from wildfire smoke is a pressing children's health issue worth further study.

CHEMWATCH
Bulletin Board
Curiosities
APR. 02, 2021

"In some regions in the U.S. and in the world, there's a trend that this type of pollution will increase," she said.

statnews.com, 23 March 2021

https://www.statnews.com

A new black hole image reveals the behemoth's magnetic fields

2021-03-24

Astronomers have gotten their first glimpse of the magnetic fields tangled around a black hole.

The Event Horizon Telescope has unveiled the magnetism of the hot, glowing gas around the supermassive black hole at the heart of galaxy M87, researchers report in two studies published online March 24 in the Astrophysical Journal Letters. These magnetic fields are thought to play a crucial role in how the black hole scarfs down matter and launches powerful plasma jets thousands of light-years into space (SN: 3/29/19).

"We've known for decades that jets are in some sense powered by accretion onto supermassive black holes, and that the in-spiraling gas and the outflowing plasma are highly magnetized — but there was a lot of uncertainty in the exact details," says Eileen Meyer, an astrophysicist at the University of Maryland, Baltimore County not involved in the work. "The magnetic field structure of the plasma near the event horizon [of a black hole] is a completely new piece of information."

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The supermassive black hole inside M87 was the first black hole to get its picture taken (SN: 4/10/19). That image showed the black hole's shadow against its accretion disk — the bright eddy of superhot gas spiraling around the black hole's dark center. It was created using observations taken in April 2017 by a global network of observatories, which collectively form one virtual, Earth-sized radio dish called the Event Horizon Telescope (SN: 4/10/19).

Using data from 2017, scientists created the first real picture of the supermassive black hole at the center of galaxy M87. How? We explain.

The new analysis uses the same observations. But unlike the black hole's initial portrait, the new image accounts for the polarization of the light waves emitted by gas around the black hole. Polarization measures a light wave's orientation — whether it wiggles up and down, left and right or at an angle — and can be affected by the magnetic field where the light

originated. So, by mapping the polarization of light around the edge of M87's black hole, researchers were able to trace the structure of the underlying magnetic fields.

The team found evidence that some magnetic fields loop around the black hole along with the disk of material swirling into it. That's to be expected because "when gas is rotating, it's basically able to carry along the magnetic field with it," says Jason Dexter, an astrophysicist at the University of Colorado Boulder.

But, he says, "there's some interesting component of this magnetic field which is not just following the motion of the gas." At least some of the magnetic field lines are sticking up or down perpendicularly from the accretion disk, or pointing directly toward or away from the black hole, Dexter and colleagues found. These magnetic fields must be very strong to resist being dragged around by the whirl of infalling gas, he says.

Such strong magnetic fields may actually push back against some of the material spiraling in toward the black hole, helping it resist gravity's pull, says study coauthor Monika Mościbrodzka, an astrophysicist at Radboud University in Nijmegen, the Netherlands. Magnetic fields pointed up and down from the accretion disk could also help launch the black hole's plasma jets, by channeling material toward the black hole's poles and giving it a boost in speed, she says.

sciencenews.org, 24 March 2021

https://www.sciencenews.org

Why do hummingbirds 'hum'?

2021-03-30

Colorful hummingbirds get their name from the hum generated by their fast-moving wings as they hover; these tiny aerodynamic marvels have the fastest wingbeat of all birds, clocking in at around 70 strokes per second (more than 4,000 per minute).

But how exactly do their wings produce a humming noise? Researchers recently took a closer look at hummingbirds as the birds hovered and flew, to better understand what generated their signature sound.

The scientists created the first-ever 3D acoustic model of flying hummingbirds, combining video and audio recordings of the birds in motion with measurements of the forces generated by hummingbird wings as they oscillated. The team traced the humming sound to the

But how exactly do their wings produce a humming noise

CHEMWATCH
Bulletin Board
Curiosities
APR. 02, 2021

upstroke of hummingbird wingbeats, which provided the birds with an extra boost of lift — unlike the upstrokes in the wingbeats of other birds. PLAY SOUND

To capture all the elements of hummingbird flight, the researchers used sensitive pressure plates that measured the force of wingbeats, a dozen high-speed cameras, 2,176 microphones and six obliging Anna's hummingbirds (Calypte anna) that were each caught, filmed and released on the same day, according to a new study published March 16 in the journal eLife.

The captured birds were brought to a specially constructed flight enclosure at Stanford University. As the free-flying hummingbirds fluttered around the enclosure and sipped nectar from fake flowers, they were filmed by high-speed cameras that were linked to microphone arrays "to make the sound visible," said Rick Scholte, a researcher and CEO for Sorama, an offshoot of Eindhoven University of Technology in the Netherlands and the company that created this acoustic visualization system.

"Together they work a bit like a thermal camera that allows you to show a thermal image," said Scholte, co-author of a new study published March 16 in the journal eLife. "We make the sound visible in a 'heat map', which enables us to see the 3D sound field in detail, he said in a statement. This enabled the scientists to create a frame-by-frame map synching audio data to wing motion.

Another piece of the puzzle was the amount of aerodynamic force generated by the hummingbirds' wings during upstrokes and downstrokes, which the scientists measured using pressure plates, said lead study author Ben Hightower, a researcher who conducted these experiments when he was a doctoral candidate at Stanford's School of Engineering. Gravity is constantly pulling the hummingbirds down, but the force the birds generate from wing flaps to offset gravity's pull varies a little with every beat, Hightower explained.

"During the downstroke they're creating more lift, and then during the upstroke they're creating a little bit less lift," he said.

In most flying birds, the "whoosh" that you hear is the sound of their downstroke — the only wingbeat to generate lift. By comparison, hummingbird wings, which trace a "U" shape in the air as they flap, produce lift on both the downstroke and upstroke, the study authors found. At the speed that hummingbird wings move, these actions and

air pressure differences during wingbeats account for the hummingbirds' humming sound. Variability in the way air moves over feathers and the wing's overall shape add overtones and nuance to the sound. This make the hum sound pleasant to humans — unlike the more irritating whine of a mosquito or the buzzing of a fly, according to Scholte.

"A hummingbird wing is similar to a beautifully tuned instrument," Scholte said.

But how does the hum of fast-moving wings sound to a hummingbird? In some species of hummingbirds, males generate high-pitched mating calls by vibrating their tail feathers, the study authors wrote. Might the hum of hummingbird wings also serve as a form of communication? It's unknown how well the birds can hear the sound of humming while in flight, but it's possible that this might play a role in how the birds interact with each other, Hightower said.

"Hummingbirds are very territorial; if you've ever seen them around a feeder, they will fend off other hummingbirds. It'd be interesting to see if hummingbirds can use the hum to detect other hummingbirds in the area," he said.

Hummingbirds also dine on fruit flies — so, can fruit flies hear those humming wings, and can they thereby tell when a bird is nearby and about to strike?

"Those are two questions that stick out to me as interesting areas to look into," Hightower said.

Originally published on Live Science.

livescience.com, 30 March 2021

https://www.livescience.com

Study finds nowhere on Earth is safe from satellite pollution

2021-03-28

There appears to be nowhere left on Earth where astronomers can view the stars without light pollution from space junk and satellites, according to a new analysis. The study considered the tens of thousands of objects in orbit as of 2020—before an onslaught of thousands more satellites that companies plan to launch in the coming years.

"As space gets more crowded, the magnitude of this effect will only be more, not less."

CHEMWATCH
Bulletin Board
Curiosities
APR. 02, 2021

"It's a bit of an eye opener," says John Barentine, director of public policy at the International Dark-Sky Association, who helped author the study, accepted today in the Monthly Notices of the Royal Astronomical Society: Letters and posted online. "As space gets more crowded, the magnitude of this effect will only be more, not less."

Astronomers are already on edge about megaconstellations of satellites. Since 2019, SpaceX has launched more than 1000 Starlink communications satellites for a global internet service. Tens of thousands more are licensed to follow from SpaceX and other companies such as Amazon in the coming years.

So far, astronomers and advocacy groups like Barentine's have focused their worries on how the bright trails of individual satellites overhead disrupt naked-eye observers and swamp more sensitive astronomical observations. In response, SpaceX engineers have managed to dim their subsequent satellites to about one-quarter of the brightness of the first prototypes.

But Miroslav Kocifaj, an astronomer at the Slovak Academy of Sciences, had a different concern. He wondered whether the collective cloud of satellites and debris above Earth might scatter light back into the atmosphere more generally. Even if the individual objects aren't visible, could their presence add an additional background glow to the night sky in a way that would wash out the faintest reaches of the cosmos?

Kocifaj, Barentine, and their colleagues find that they do. Even at the darkest possible sites on Earth, the sky itself has a natural glow in the upper atmosphere from sources like ionized particles. But on top of that background glow, objects already in orbit may add about 10% more diffuse light, they estimate.

That calculation relies on several assumptions, starting with estimates of the number and size distribution of space objects in the mid-1990s, extrapolating the increasing crowdedness of space since then, and guessing how reflective these objects would be on average.

"I look forward to an independent confirmation of the result," says Pat Seitzer, an emeritus astronomer at the University of Michigan, Ann Arbor, who has modeled the brightness of individual satellites and is collaborating with SpaceX to dim future versions. He says the team's calculation seems reasonable, but he was surprised at the size of the effect.

In 1979, the International Astronomical Union suggested astronomical observatories should be built only where light pollution adds less than 10% more light over natural skyglow; the new study suggests nowhere on the planet meets those standards anymore.

The human eye can detect contrast differences that small, but Barentine says most stargazers won't notice. But it could matter to astronomers searching for faint, sprawling objects on the sky such as dim galaxies, which astronomers are studying for clues to the physics of galaxy formation and the nature of dark matter. In order for those faint galaxies to stand out from the sky's airglow, astronomers already needed long exposures on the biggest telescopes in the darkest sites available.

What matters most for this kind of research is not just the amount of added background glow, but how it varies across the globe—neither of which has yet been actually measured, says Mireia Montes, an astronomer at the Space Telescope Science Institute. A variable airglow would be difficult to subtract out. But, "If it's uniform, it's OK," she says. "You just put more time in, and your images end up being more expensive."

sciencemag.org, 28 March 2021

https://www.sciencemag.org

Here's why humans chose particular groups of stars as constellations

2021-03-29

The Big Dipper's stars make up a conspicuous landmark in the sky of the Northern Hemisphere. Even novice stargazers can easily pick out the shape, part of the Ursa Major constellation. Now, scientists have shown that three factors can explain why certain groups of stars form such recognizable patterns.

To replicate how humans perceive the celestial sphere, a team of researchers considered how the eye might travel randomly across this night sky. Human eyes tend to move in discrete jumps, called saccades (SN: 10/31/11), from one point of interest to another. The team created a simulation that incorporated the distribution of lengths of those saccades, combined that with basic details of the night sky as seen from Earth — namely the apparent distances between neighboring stars and their brightnesses.

CHEMWATCH
Bulletin Board
Curiosities
APR. 02, 2021

The technique could reproduce individual constellations, such as Dorado, the dolphinfish. And when used to map the whole sky, the simulation generated groupings of stars that tended to align with the 88 modern constellations recognized by the International Astronomical Union, Sophia David and colleagues reported March 18 at an online meeting of the American Physical Society.

"Ancient people from various cultures connected similar groupings of stars independently of each other," said David, a high school student at Friends' Central School in Wynnewood, Penn., who worked with network scientists at the University of Pennsylvania. "And this indicates that there are some fundamental aspects of human learning … that influence the ways in which we organize information."

sciencenews.org, 29 March 2021

https://www.sciencenews.org

Now, scientists have shown that three factors can explain why certain groups of stars form such recognizable patterns.

CHEMWATCH

Bulletin Board

Technical Notes

APR. 02, 2021

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

CHEMICAL EFFECTS

Metal Toxicity and Speciation: A Review

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