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Regulatory Update

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ASIA PACIFIC

Australia publishes guidance for categorising chemicals in toys

2021-06-17

The Australian government has published guidance for manufacturers and importers of industrial chemicals used in children's toys or care products, to help categorise the substances before they are introduced to the country's market.

Under the Australian Industrial Chemicals Introduction Scheme (AICIS), companies placing these chemicals on the market for the first time must identify them as one of:

- **listed introduction** – already in Australia's inventory;
- **exempted introduction** – considered very low risk to both human health and the environment and permitted on the market;
- **reported introduction** – considered low risk to human health or the environment but must be registered with the AICIS and a pre-introduction report submitted; or
- **assessed introduction** – considered a medium to high risk to human health or the environment and must be assessed before being introduced.

And, in a 31 May circular, the AICIS issued guidance to help manufacturers and importers of toys to do this.

And, in a 31 May circular, the AICIS issued guidance to help manufacturers and importers of toys to do this.

It is designed to be read in conjunction with the online categorisation guide, updated on 28 May. It is aimed at:

- importers and manufacturers of industrial chemicals used to make toys; and
- importers of toys that are designed to "release a liquid containing chemicals".

The placing of an industrial chemical on the Australian market for end use in children's toys or care products is classified as a 'specified class of introduction'. This means it is subject to additional – or different – requirements relating to hazard information, reporting or recordkeeping, depending on its categorisation.

The AICIS said it has an increased level of concern for introducing chemicals in these products because youngsters may be more vulnerable

to potentially hazardous chemicals, especially because they often put items in their mouth.

According to the guidance:

- a children's toy is an object for a child to play with;
- a children's care product is a product intended to facilitate:
- sleep, relaxation or hygiene;
- feeding; and sucking.

Read More

Chemical Watch, 17 June 2021

https://chemicalwatch.com/283340/australia-publishes-guidance-for-categorising-chemicals-in-toys

The dark side of not being green

2021-06-14

Last week the Climate Change Commission released its carbon reduction roadmap for New Zealand.

It's clear that to meet our Paris Accord target of zero net emissions by 2050, business operations, consumer behaviour and government regulation will change.

Many want to stick with the status quo of a modern world completely dependent on fossil fuels. But this comes at a high cost.

The cost is risking extreme weather that our modern world has never seen, with knock-on effects expected to include massive forest fires, sea level change and ecosystem destruction around the world.

Read More

Stuff NZ, 14 June 2021

https://i.stuff.co.nz/business/opinion-analysis/125426945/the-dark-side-of-not-being-green

Review summarizes microplastic exposures to humans

2021-06-24

In a review published on June 19, 2021, in the *Journal of Food Science,* Mengke Jin and co-authors from *Dalian University of Technology*, China,

Many want to stick with the status quo of a modern world completely dependent on fossil fuels. But this comes at a high cost.

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summarize human exposure concentrations to microplastics via food and beverage consumption.

The authors reviewed 108 publications available on Web of Science up to the year 2021 and extracted information on the occurrence, source, and characterization of microplastics found in fish, bivalves, salt, drinking water, beverages, packaged food, honey, sugar, fruit and vegetables, chicken, and canned sardines (FPF reported here, here, and here). According to the literature analysis, detected microplastic levels in previous studies were, for instance, 0-11 particles/gram bivalves and 0-14 particles/kg salt while particle concentrations in one liter of tap and bottled water were 0-61 and 0-6292, respectively. In the article, the scientists attributed the large concentration differences to the locally varying microplastic pollution. The sources of microplastic contamination in aquatic food products, drinking water, and salt were summarized to be contaminated marine and freshwater (FPF reported), whereas the microplastics in plastic packaged food can stem from the packaging itself as well as the procedure of opening it. The article also reports on the capability of microplastics to penetrate different plant parts resulting in fruit and vegetable contamination. According to the authors, the amount of microplastic intake by an individual largely depends on eating habits, diet, and the country and region in which they live.

Read More

Food Packaging Forum, 24 June 2021

https://www.foodpackagingforum.org/news/review-summarizes-microplastic-exposures-to-humans

AMERICA

EPA to collect PFAS manufacturing data

2021-06-16

On June 10, 2021, the U.S. Environmental Protection Agency's (EPA) announced three actions demonstrating its commitment to help reduce the potential risks to the public from per- and polyfluoroalkyl substances (PFAS). RELEASE

Those actions included issuing a proposed rule that is designed to gather comprehensive data on more than 1,000 PFAS manufactured in the United States, withdrawing guidance that altered EPA's July 2020 Significant New

The proposed deadline for reporting PFAS data to EPA is one year after the effective date of the final rule.

Use Rule (SNUR) restricting certain long-chain PFAS, and publishing a final rule that officially incorporates three additional PFAS into the Toxics Release Inventory (TRI). Each action is summarized briefly below.

Proposed Rule to Require Reporting on PFAS Manufactured in the United States

The proposed rule would require all manufacturers (including importers) of PFAS in any year since 2011 to report information related to chemical identity, categories of use, volumes manufactured and processed, byproducts, environmental and health effects, worker exposure, and disposal.

The proposal would assist EPA to better understand the sources and quantities of PFAS manufactured in the United States and support the agency's PFAS research, monitoring, and regulatory efforts. Once finalized, this rule would be the first targeted effort under the Toxic Substances Control Act (TSCA) to collect information on the manufacture of PFAS and would provide EPA with the most comprehensive dataset of PFAS manufactured in the United States. The proposed deadline for reporting PFAS data to EPA is one year after the effective date of the final rule.

EPA will accept public comments on the proposed rule for 60 days following publication in the federal register via docket EPA-HQ-OPPT-2020-0549 at www.regulations.gov. PROPOSAL

Withdrawing Compliance Guide on PFAS SNUR

Consistent with President Biden's Executive Orders and other directives, including those on environmental justice, scientific integrity, and regulatory review, EPA withdrew compliance guidance that it believed weakened the July 2020 Significant New Use Rule (SNUR) which, among other things, prohibits companies from importing certain long-chain PFAS as part of a "surface coating" on articles without prior EPA review and approval. Articles that could contain these PFAS as part of a surface coating include, automotive parts, carpet, furniture, and electronic components.

The compliance guide was issued in January 2021 in the last days of the Trump Administration and limited what would be considered a "surface coating" subject to the SNUR. EPA removed the January 2021 compliance guide from the its website, and it is no longer in effect. No new guidance is expected to be issued.

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Read More

JD Supra, 16 June 2021

https://www.jdsupra.com/legalnews/epa-to-collect-pfas-manufacturing-data-6749969/

More than half of makeup products sold in US contain toxic chemicals, study suggests

2021-06-16

More than half the cosmetics sold in the United States and Canada are awash with a toxic industrial compound associated with serious health conditions, including cancer and reduced birth weight, according to a new study.

Researchers at the University of Notre Dame tested more than 230 commonly used cosmetics and found that 56% of foundations and eye products, 48% of lip products and 47% of mascaras contained fluorine - an indicator of PFAS, so-called "forever chemicals" that are used in nonstick frying pans, rugs and countless other consumer products.

Some of the highest PFAS levels were found in waterproof mascara (82%) and long-lasting lipstick (62%), according to the study published Tuesday in the journal Environmental Science & Technology Letters. Twenty-nine products with higher fluorine concentrations were tested further and found to contain between four and 13 specific PFAS chemicals, the study found. Only one item listed PFAS, or perfluoroalkyl and polyfluoroalkyl substances, as an ingredient on the label.

Read More

ABC News, 16 June 2021

https://abc7news.com/health/study-half-of-us-cosmetics-contain-toxic-chemicals/10796942/

Some of the highest PFAS levels were found in waterproof mascara (82%) and long-lasting lipstick (62%), according to the study published Tuesday in the journal Environmental Science & Technology Letters.

MPRA issues interim order to regulate certain UV radiation-emitting and ozone-generating devices under the Pest Control Products Act

2021-06-14

On June 7, 2021, Health Canada's Pest Management Regulatory Agency (PMRA) **announced** the issuance of its **Interim Order Respecting Ultraviolet Radiation-emitting Devices and Ozone-generating**

Devices under the Pest Control Products Act (Interim Order), setting forth new requirements for certain devices claiming to control, destroy, make inactive, or reduce the level of bacteria, viruses, and other micro-organisms that are human pathogens. PMRA also issued an "**Explanatory Note**" and a **Questions and Answers** document regarding the Interim Order.

PMRA states that it issued the Interim Order following the increased sale of ultraviolet (UV) radiation-emitting and ozone-generating devices such as lights and wands in Canada since the COVID-19 pandemic. These devices are marketed to kill bacteria and viruses, including SARS-CoV-2, the virus that causes COVID-19. According to PMRA, it has not received enough evidence to confirm that UV radiation-emitting and ozone-generating devices are safe for users and the public, or that they are effective.

Thus, PMRA is now requiring that companies register certain UV radiation-emitting devices and ozone-generating devices before they may be sold or used in Canada. In its Explanatory Note, PMRA states:

By bringing certain UV and ozone-generating devices under the [*Pest Control Products Act* (PCPA)], they need to be registered or otherwise authorized in order to be on the Canadian market. An application to register a pest control product must be submitted to Health Canada in the form and manner directed by the Minister and must include any information and other material that is required by the *Pest Control Products Regulations* to accompany the application. Applications to register devices consist of a number of information and data requirements, including a cover letter stating the purpose of the application, an application and fee estimate forms, the proposed English and French product labels, as well as data to support the safety and efficacy of the device. A registration will be granted under the PCPA if the Minister considers that the health and environmental risks and the value of the device are acceptable after any required assessments.

The Interim Order clarifies that certain UV radiation-emitting devices and ozone-generating devices claiming to kill bacteria and viruses are not subject to the regulatory requirements of the PCPA and its Regulations. These include:

- Devices that are manufactured, represented, distributed, or used to control, destroy, or inactivate viruses, bacteria, or other micro-organisms that are human pathogens for use in swimming pools, spas, or wastewater treatment systems;

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- Devices that meet the definition of "device" in Section 2 of the Food and Drugs Act and are classified as a Class II, III, or IV medical device under the **Medical Devices Regulations**; and
- UV radiation-emitting devices that satisfy the following conditions:
- The device is certified by a standards development organization accredited by the Standards Council of Canada as meeting the applicable Canadian electrical safety requirements;
- The certification mark of the standards development organization appears on the label of the device;
- Any efficacy claim that is made in respect of the device is only a claim of supplemental sanitization;
- No express or implied reference to prevention, treatment, or mitigation of disease is made in respect of the device;
- The device has at least one of the following mechanisms:
- A mechanism that locks the device during operation, or
- A mechanism that automatically shuts off the device if it is opened during operation; and
- The UV lamp is fully shielded or enclosed in the device in a manner that prevents access to it by users of the device and prevents exposure to UV radiation.

For UV radiation-emitting devices that satisfy these conditions, there are additional labeling requirements for the display panels and operating manual.

Read More

Pesticide Law and Policy Blog, 14 June 2021

http://pesticideblog.lawbc.com/entry/pmra-issues-interim-order-to-regulate-certain-uv-radiation-emitting-and-ozo

State-by-state regulation of PFAS substances in drinking water

2021-06-10

Summary

In the absence of an enforceable federal per- and polyfluoroalkyl substances ("PFAS") drinking water standard, many states have embarked on the process of regulating PFAS compounds in drinking water. The result is a patchwork of regulations and standards of varying stringency

The result is a patchwork of regulations and standards of varying stringency which presents significant operational and compliance challenges to impacted industries.

which presents significant operational and compliance challenges to impacted industries. This client alert surveys the maximum contaminant levels ("MCLs"), as well as guidance and notification levels, for PFAS compounds – typically perfluorooctane sufonic acid ("PFOS") and perfluorooctanic acid ("PFOA") – in drinking water that have been enacted or proposed at the state level.

1. Federal Health Recommendations and Advisory

The United States Environmental Protection Agency ("EPA") has issued a Lifetime Drinking Water Health Advisory Level of 70 ppt for PFOS and PFOA. EPA's Health Advisory is non-enforceable and non-regulatory, but is intended to provide technical information to state agencies and other public health officials on health effects, analytical methodologies, and treatment technologies associated with drinking water PFAS contamination. Several states have adopted the EPA's recommended 70 ppt PFAS concentration limitation for drinking water.

2. State Regulations

President Biden's Environmental Justice Plan includes a commitment to set "enforceable limits for PFAS in the Safe Drinking Water Act," presumably for PFOA and PFOS, so the entire country may soon be subject to enforceable MCLs for at least those two PFAS compounds. However, until such federal action occurs (and potentially afterwards to the extent that states continue to enact more stringent standards), the regulatory landscape for PFAS compounds in drinking water will consist of an array of widely-varying state-promulgated standards and regulations. For example, one of the smallest allowable concentrations is currently 5.1 ppt (California; PFOA only), and one of the largest values is currently 400,000 ppt (Michigan; PFHxA only). The chart below illustrates the significance of the discrepancies between the regulatory levels for PFOA and/or PFOS.

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JD Supra, 10 June 2021

https://www.jdsupra.com/legalnews/state-by-state-regulation-of-pfas-9713957/

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EUROPE

Classification, labelling and packaging of chemicals

2021-06-14

Chemicals placed on the market in Great Britain (England, Scotland and Wales) are regulated by the GB Classification, Labelling and Packaging Regulation, known as GB CLP.

HSE is the GB CLP Agency and carries out certain CLP functions that were formerly undertaken by the European chemicals agency (ECHA).

Our CLP website contains guidance on how to comply with the GB CLP Regulation.

Read More

HSE, 14 June 2021

https://www.hse.gov.uk/

HSE is the GB CLP Agency and carries out certain CLP functions that were formerly undertaken by the European chemicals agency (ECHA).

Export and import of hazardous chemicals (GB PIC)

2021-06-14

The Great Britain Export and Import of Hazardous Chemicals Regulation (GB PIC) applies in England, Scotland and Wales.

Businesses exporting or importing PIC-listed chemicals from or to Great Britain are required to comply with the GB PIC regime.

Visit our website for more information on the GB PIC Regulation.

Read More

HSE, 14 June 2021

https://www.hse.gov.uk/

INTERNATIONAL

NAFDAC to register chemical products to boost economy

2021-06-20

National Agency for Food and Drug Administration and Control (NAFDAC) and chemical products manufacturers have agreed to explore the

international market to enhance foreign exchange earnings and catalyst for industrial growth.

Director General of NAFDAC, Prof Mojisola Adeyeye hinted during a virtual chemical manufacturers' stakeholders' meeting organized by the agency to sensitize, enlighten, and create awareness on the current trends in the regulation of the manufacture of chemicals with emphasis on the need to be listed as a Chemical Manufacturer in Nigeria.

She said the objective of the deliberations augur well with the current focus of the NAFDAC management to bring the Agency's regulatory activities in line with international best practices.

Adeyeye noted that Chemical Evaluation and Research Directorate has the mandate to safeguard public health by ensuring that only the right quality chemicals are manufactured, imported, exported, distributed, sold and used in Nigeria.

Adeyeye disclosed that the directorate has put in place effective regulations and guidelines for sound chemical management in Nigeria.

"This is achieved by ensuring proper utilization of chemicals in a manner that reduces risk to health and environment and advocating for use of chemicals that are less harmful and hazardous."

Resident Media Consultant to NAFDAC, Sayo Akintola, in a statement on Sunday in Lagos quoted Prof Adeyeye as saying that a portal has been created by the agency for registration of chemical products for effective quality control and strict adherence to international best practices.

Read More

Nigerian Tribune, 20 June 2021

https://tribuneonlineng.com/nafdac-to-register-chemical-products-to-boost-economy/

Study maps intentionally added substances in plastics

2021-06-22

Scientists investigate plastic monomers, additives, and processing aids for their chemical identity, use, and hazard classification; identify >10,000 chemicals; 24% categorized as substances of potential concern of which the majority is not currently subject to management measures; emphasize information gaps regarding substance properties and uses.

In total, the scientists identified 10,547 IAS that have a CAS number.

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An article published on June 21, 2021, in the peer-reviewed journal *Environmental Science & Technology*, reports on the chemical types, use patterns, hazard classifications, production volumes, and regulatory status of intentionally added substances (IAS) present in plastics. Helene Wiesinger and co-authors from *ETH Zürich*, Switzerland, reviewed 63 publicly available data sources from industry, science, and regulatory agencies on IAS, including monomers, additives, and processing aids, and they compiled the information into a database.

In total, the scientists identified 10,547 IAS that have a CAS number. The main reported uses of these substances are in packaging, textiles, and food-contact applications (more than 2,000 substances in each), toys (522 substances), and medical items (275 substances). The production volume of 4,000 compounds is ranked as 'high', since they exceed an annual production volume of 1,000 metric tons in the EU and/or the US. Based on the persistence, bioaccumulation, and toxicity criteria in the EU, the scientists categorized 24% of the identified chemicals as "substances of potential concern." They reported that more than half of these substances of concern are neither included in the Stockholm Convention nor in regulations from the US, EU, and Japan. Around 900 of these chemicals are, however, allowed in these countries for food-contact applications.

In the article, the authors also address the data and knowledge gaps they observed during their research: The substances used in plastics are often not transparently reported, hazard data of plastic chemicals is lacking or incomprehensively reported, and application information is missing. According to the scientists, transparent reporting of information along a product's value chain, centralized and comprehensive data compilation, and open accessibility are key factors to allow for better management of hazardous chemicals and guarantee the safety of plastics. Moreover, they emphasized that chemical regulations need to cover all hazardous substances and that harmonization of regulatory efforts between countries can help "to ensure global sound chemicals management." The authors believe that their database can support the transition to a safe circular plastic economy since it helps increase transparency and identify safer chemical alternatives that are currently missing on the market. Wiesinger and colleagues concluded that "concerted efforts from industry, civil society organizations, the scientific community, regulatory agencies, and other policymakers are urgently needed to ensure sustainable chemicals management in the future."

Read More

Food Packaging Forum, 22 June 2021

https://www.foodpackagingforum.org/news/study-maps-intentionally-added-substances-in-plastics

Highlights from June RAC and SEAC meetings

2021-06-16

The Committee for Risk Assessment (RAC) adopted its opinion supporting Germany's proposal to restrict PFHxA, its salts and related substances. A consultation on the draft opinion of the Committee for Socio-Economic Analysis (SEAC) on the same group of chemicals will start in early July.

Helsinki, 16 June 2021 – RAC agreed that there is an EU-wide risk for people and the environment from the use of PFHxA, its salts and related substances, which is currently not adequately controlled. PFHxA substances are very persistent and mobile and, therefore, contribute to increasing environmental pollution and human exposure. RAC considers that the proposed restriction would be effective in reducing emissions of PFHxA and the related risks.

RAC noted that there are various uncertainties in the information provided in the restriction proposal, particularly related to applicable use volumes and the associated emissions of PFHxA. It, however, concluded that the uncertainties do not change the overall conclusion and that a restriction is justified.

SEAC agreed its draft opinion on the costs and benefits of the proposal for society. As the available information was limited, SEAC could not conclude that the conditions of the proposed restriction are the most appropriate measure for addressing the identified risks, even considering the modifications proposed by SEAC. However, SEAC was able to reach a conclusion on whether the restriction was proportionate for certain uses where information on the socio-economic impacts was less uncertain.

A 60-day consultation of SEAC's draft opinion will start at the beginning of July. The consolidated opinion of both committees is expected to be ready by the end of 2021.

The committees also:

- adopted 11 opinions on applications for authorisation on 11 uses of octyl- and nonylphenol ethoxylates;
- discussed their opinions on restricting lead in outdoor shooting and fishing;
- discussed their opinions on restricting hazardous chemicals in single-use baby diapers.

In addition, RAC adopted an important opinion on the scientific evaluation of occupational exposure limits (OEL) for asbestos, as well as opinions

RAC considers that the proposed restriction would be effective in reducing emissions of PFHxA and the related risks.

on nine proposals for harmonised classification and labelling (CLH). The committee also continued its discussions at the request of the Executive Director of ECHA on the environmental properties of lead.

Lastly, the two committees agreed on the approach for evaluating review reports for authorisation.

Read More

ECHA, 16 June 2021

https://echa.europa.eu/-/highlights-from-june-rac-and-seac-meetings

Updating our language: why should not paint all nanoforms with the same brush

2021-05-31

One of the most important functions of language is the ability to describe reality in increasing degrees of precision. For example, what many of us would simply call "red" can be vermilion, carmine, crimson or scarlet to a painter. Similar levels of accuracy also exist for what most people would still simply call "nanomaterials". To continue with our colour metaphor, this helps us to identify red. But what if we need to be more precise than that?

The EU definition originally adopted in 2011 describes a nanomaterial as a material at the nanoscale i.e. smaller than 100 nanometres (to put this in context, our red blood cells typically measure 7-8 nanometres).

Just as an artist does not treat all shades of a colour the same way, assessing the behaviour of substances at the nanoscale requires a greater degree of precision than that allowed for by the term "nanomaterial" as defined by the EU. This is because talking about a specific "nanomaterial" only tells us about its elemental composition and size; however, at the nanoscale, that substance can adopt more than one different form (i.e. a nanoform), and, most importantly, those nanoforms can behave differently in terms of their physico-chemical properties. If we just call them all a nanomaterial, we're erasing those differences.

Why is this important? The EU REACH Regulation lays out the requirements that companies have to meet to lawfully place their chemicals on the market, including the registration of any substance produced, imported or used in a quantity above one tonne/year, as well as a Safety Data Sheet (SDS) which must be provided to every customer with the first delivery of a chemical. This way, the customer can prepare accordingly and put

If we just call them all a nanomaterial, we're erasing those differences.

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in place adequate worker protection procedures, as well as environment protection measures where needed.

Remember what we just said about different nanoforms of a chemical having different properties and behaviours? SDS are where those differences come into play. Let's take for example nanosilver, one of the most studied substances at the nanoscale, which is used in a variety of applications including medicine, textile, and cosmetics: to talk about nanosilver simply tells us that we're looking at the chemical element silver, at a size smaller than 100 nanometres. Nanosilver, however, comes in different nanoforms that have different properties. This means that, while one form of nanosilver can be used as an effective anti-microbial agent, another one may be used in tagging and imaging applications, and both will be associated with different (if any) toxicities: it seems obvious that we would not treat them in the same way.

To go back to our artistic metaphor, imagine you're a contemporary Rubens working on the portrait of Emperor Maximilian, and want to add some rich red velvet in the background; you know that different shades will create very different effects and that crimson will be much better than vermilion. Now imagine that your paint delivery arrives, and the can only says "Red". It could be crimson, it could be vermilion, it could be yet another shade. You're probably not going to risk ruining your work, so you'll decide to stay away from the colour red altogether and paint that background grey.

If we apply this to nanoforms, the impact can be damaging: if the language we use does not allow us to capture their differences in terms of hazard profiles, we risk ending up with a blanket approach that attributes to all nanoforms of a same substance the risk profile of the most hazardous of them, misleading us into avoiding or even banning them altogether. This in turn can hamper the development and use of novel materials, missing out on the opportunities they afford.

Read More

EUON, 31 May 2021

https://euon.echa.europa.eu/nanopinion/-/blogs/updating-our-language-why-we-should-not-paint-all-nanoforms-with-the-same-brush

Janet's Corner

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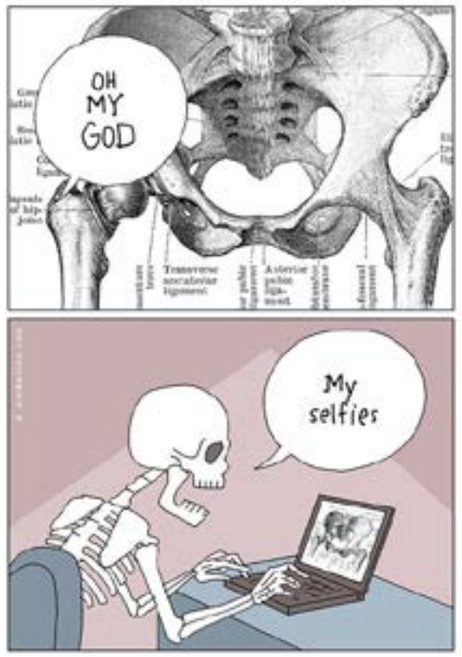
Nudes

2021-07-02



https://asapscience.tumblr.com/post/169492236981/httpwwwjimbentoncom

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Hazard Alert

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Chlordane

2021-07-02

Chlordane, is an organochlorine compound with the molecular formula $C_{10}H_6Cl_{8,}$ used as a pesticide in the United States from 1948 to 1988. It is sometimes referred to by the trade names Octachlor® and Velsicol 1068®. It is a thick liquid whose colour ranges from colourless to amber, depending on its purity. It may have no smell or a mild, irritating smell. Chlordane is not a single chemical, but is a mixture of many related chemicals, of which about 10 are major components. Some of the major components are trans-chlordane, cis-chlordane, beta-chlordene, heptachlor, and trans-nonachlor. Chlordane does not dissolve in water. Therefore, before it can be used as a spray, it must be placed in water with emulsifiers (soap-like substances), which results in a milky-looking mixture. [1,2]

USES [3,4]

Chlordane was used as a pesticide in the United States from 1948 to 1988. In 1988, all approved uses of chlordane in the United States were cancelled. From 1983 to 1988, chlordane's only approved use was to control termites in homes. The pesticide was applied underground around the foundation of homes. Before 1978, chlordane was also used as a pesticide on agricultural crops, lawns, and gardens and as a fumigating agent. In 1978, EPA cancelled the use of chlordane on food crops and phased out other above ground uses over the following 5 years. Chlordane still can be legally manufactured in the United States, but it can only be sold to or used by foreign countries. Although chlordane can be used to control fire ants in the United States, no products are currently registered for this use (5, 6).

Chlordane, is an organochlorine compound with the molecular formula C10H6Cl8, used as a pesticide in the United States from 1948 to 1988.

IN THE ENVIRONMENT [2]

When used as a pesticide on crops, on lawns and gardens, and to control termites in houses, chlordane enters the environment. In soil, it attaches strongly to particles in the upper layers of soil and is unlikely to enter into groundwater. It is not known whether chlordane breaks down in most soils. If breakdown occurs, it is very slow. Chlordane is known to remain in some soils for over 20 years. Persistence is greater in heavy, clayey or organic soil than in sandy soil. Most chlordane is lost from soil by evaporation. Evaporation is more rapid from light, sandy soils than from heavy soils. Half of the chlordane applied to the soil surface may evaporate in 2 to 3 days. Evaporation is much slower after chlordane penetrates

into the soil. In water, some chlordane attaches strongly to sediment and particles in the water column and some is lost by evaporation. It is not known whether much breakdown of chlordane occurs in water or in sediment. Chlordane breaks down in the atmosphere by reacting with light and with some chemicals in the atmosphere. However, it is sufficiently long lived that it may travel long distances and be deposited on land or in water far from its source. Chlordane or the chemicals that chlordane changes into accumulate in fish, birds, and mammals. Chlordane stays in the environment for many years and is still found in food, air, water, and soil. Chlordane is still commonly found in some form in the fat of fish, birds, mammals, and almost all humans.

SOURCES & ROUTES OF EXPOSURE

Sources of Exposure [3]

- Before 1988, exposure to chlordane may have occurred in the workplace; persons involved in the manufacture, formulation, or application of chlordane, such as farmers, lawn-care workers, and pest-control workers may have been exposed.
- Studies on chlordane levels in indoor air reported levels ranging from < 1 to 610,000 nanograms per cubic metre (ng/m^3).
- Currently, exposure to chlordane appears to be highest for those persons living in homes that were treated for termites with chlordane. Chlordane may be found in the air in these homes for many years after treatment.
- Additional exposure to chlordane may occur from digging in soil around the foundation of homes where chlordane was applied. Mean residue levels in soil around 30 homes treated with chlordane ranged from 22 to 2,540 parts per million (ppm).
- Exposure to chlordane may also occur from eating chlordane-contaminated food. Chlordane remains in the food supply today because much of the farmland in the United States was treated with chlordane in the 1960s and 1970s, and it remains in the soil for over 20 years.
- Chlordane has been listed as a pollutant of concern to EPA's Great Waters Program due to its persistence in the environment, potential to bioaccumulate, and toxicity to humans and the environment

Routes of Exposure [5]

The main routes of exposure to chlordane are:

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- inhalation
- skin absorption
- ingestion
- skin and/or eye contact

HEALTH EFFECTS [3]

Acute Effects

- Neurological effects, such as headache, dizziness, irritability, and convulsions, and effects on the blood have been seen from acute chlordane exposure in animals and humans.
- Chlordane is considered to have high acute toxicity based on short-term animal tests in rats.

Chronic Effects

- Chronic exposure of humans to chlordane by inhalation results primarily in effects on the nervous system.
- Animal studies have reported effects on the liver, kidney, blood, thyroid, and respiratory and nervous systems from chronic exposure to chlordane via inhalation.
- The Reference Concentration (RfC) for chlordane is 0.0007 milligrams per cubic metre (mg/m^3) based on liver effects in rats.
- The Reference Dose (RfD) for chlordane is 0.0005 milligrams per kilogram body weight per day (mg/kg/d) based on liver necrosis in mice.

Reproductive/Developmental Effects

- A study of women living in homes repeatedly treated for termites with chlordane revealed an increased incidence of ovarian and uterine disease, compared with a reference population. However, it is not possible to state whether these effects were solely due to chlordane or to other chemicals as well.
- An animal study reported biochemical and behavioural alterations mimicking male sex steroids, while another study reported alterations in reproductive behaviour, both in male rats exposed to chlordane.

Cancer Risk

- An occupational study investigating men with non-Hodgkin's lymphoma found that the odds of chlordane use as an insecticide were significantly greater among cases than among controls.

- Two other epidemiological studies did not find an association between chlordane exposure and leukaemia or multiple myeloma.
- Animal studies have reported liver cancer in mice and male rats exposed to chlordane via ingestion.
- EPA considers chlordane to be a probable human carcinogen and has classified it as a Group B2 carcinogen.

SAFETY [6]

First Aid Measure

- Inhalation: No specific intervention is indicated as the compound is not likely to be hazardous by inhalation. Remove victim to fresh air immediately. Keep affected person warm and at rest.
- Skin Contact: The compound is hazardous by skin contact. Remove contaminated clothing and shoes immediately. Wash affected area with mild soap or detergent for at least 15 minutes or until no evidence of chemical remains. In case of chemical burns, cover area with sterile, dry dressing. Bandage securely, but not too tightly. Get medical attention, immediately.
- Eye Contact: In case of contact, immediately flush eyes with plenty of water for at least 15 minutes. Eyelids may be lifted occasionally, until no evidence of chemical remains. Call a physician.
- Ingestion: The compound is toxic by ingestion. Do not use gastric lavage or emesis. Affected person must drink 100 fold of water or milk to dilute acid. Call a physician immediately.

Exposure Controls & Personal Protection

Engineering Controls

- Ventilation - Natural ventilation.
- Access to a safety shower and eyewash station

Personal Protective Equipment

The following personal protective equipment is recommended when handling chlordane:

- Respiratory Protection: None required.
- Protective Gloves: Are highly recommended.
- Eye Protection: Safety glasses with side shields are required.

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- Other Protective Equipment: Lab coat or other long – sleeved garment is required.

REGULATION [2,7]

United State

- EPA: The Environmental Protection Agency guidelines for drinking water suggest that no more than 60 ppb chlordane should be present in drinking water that children consume for no longer than 10 days. Drinking water should contain no more than 0.5 ppb for children or 2 ppb for adults if they drink the water for longer periods. All use of chlordane were cancelled on food crops, effective March 1978. Until 1988, EPA permitted chlordane use for termite control or dipping the roots or tops of nonfood plants. On April 14, 1988, however, EPA stopped all sales and commercial use of chlordane. Federal regulations limit the amount of chlordane that factories can release into wastewater. The EPA requires industry to report releases or spills of 1 pound or more. A temporary guideline of the National Research Council indicated that 0.005 mg/m^3 should be the maximum amount allowed in the air of military housing.
- FDA: The Food and Drug Administration has established that the levels of chlordane and its breakdown products in most fruits and vegetables should not be greater than 300 ppb and in animal fat and fish should not be greater than 100 ppb.
- OSHA: The Occupational Safety and Health Administration regulates chlordane levels in the workplace. The maximum allowable level in workplace air is 0.5 mg/m^3 for a person who is exposed for 8 hours per workday and 40 hours per workweek.
- NIOSH: The National Institute for Occupational Health and Safety also recommends an exposure limit of 5 mg/m^3 for a person exposed to chlordane in the workplace for 8 hours per workday and 40 hours per workweek.

Australia

- Safe Work Australia: Safe Work Australia has established a Time Weighted Average (TWA) concentration for chlordane of 0.5 mg/m^3 for a 40-hour workweek.

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Tumors find many ways to evade groundbreaking cancer drug

2021-06-23

Researchers were ecstatic 2 years ago when, after decades of effort, they devised drugs that could block a tumor-promoting protein in cancer patients called KRAS, which previously seemed impervious to treatment. But many of these KRAS inhibitors—the first of which was approved by U.S. regulators in May—quickly lost their luster, like other targeted cancer drugs: Most patients' tumors resumed growing after a few months, as their cancer cells became resistant to the inhibitors. Now, a study finds that the roots of this resistance are surprisingly complex, with tumors using an array of escape routes to evade the attack on KRAS.

"There appears to be huge variation" in drug resistance mechanisms, says lung cancer specialist Colin Lindsay of the University of Manchester, who was not involved in the study.

Up to 20% of tumors carry mutations in the gene for KRAS, a protein that sets off a cascade of signals within a cell that causes it to divide. In normal cells, this pathway stays off most of the time, but in cancers in which the gene is mutated, it stays on, causing cells to divide uncontrollably.

Up to 20% of tumors carry mutations in the gene for KRAS, a protein that sets off a cascade of signals within a cell that causes it to divide.

The mutant KRAS protein in these cancers was long considered "undruggable," partly because the protein's surface is smooth, and thus has no pockets to which a drug can bind. But in 2013, chemical biologist Kevan Shokat of the University of California, San Francisco, found a small molecule that slipped perfectly into a groove of KRAS proteins that had a cancer-promoting mutation called G12C. In clinical trials, a drug similar to the molecule shrank tumors in many lung cancer patients for about 7 months before resistant cells emerged—and the cancer returned.

To find out how the cancer cells counter such drugs, Dana-Farber Cancer Institute medical oncologists Andrew Aguirre and Mark Awad and colleagues analyzed tissue samples from 38 lung and colon cancer patients in a clinical trial for a KRAS inhibitor called adagrasib, made by the biotech company Mirati Therapeutics. The researchers sequenced the genes of tumor tissue and tumor DNA circulating in the blood, both at the start of drug treatment and after tumors regrew, looking for any differences that could explain the newfound resistance. They found genetic alterations or other changes in 17 patients' tumors that appeared to explain resistance to the drug.

Seven patients' tumors had changes in the KRAS gene itself. Most also had alterations in other genes in the KRAS cell division signaling pathway, and in two cases, tumors apparently became resistant by undergoing more profound, nongenetic changes that turned the tumor into a different type of lung cancer based on how it looked under a microscope. Seven of 17 patients had at least two potential resistance-conferring genetic changes in their tumors, the researchers report today in The New England Journal of Medicine.

This array of resistance mechanisms sets KRAS inhibitors apart from two approved, widely used drugs that target proteins called EGFR and ALK, which drive the growth of some lung cancer patients' tumors. When these tumors develop resistance, the patient often turns out to have one of just a few common resistant mutations in their cancer cells. That has led companies to develop next-generation drugs that either target that mutation or several mutations at once; these have kept some patients' tumors in check for years.

Aguirre says the complexity of KRAS resistance mechanisms suggests researchers may need to try several different drug combinations to overcome the problem—some of these are already in trials, he notes.

Shokat says one silver lining is that tumors that developed resistance to KRAS inhibitors usually didn't lose the G12C mutation, which would have taken away the pocket where a drug can bind. "The most feared resistance mechanism doesn't seem to be as easy to evolve" as it is for some other targeted drugs, he says. And despite the challenges, Lindsay is optimistic: "I doubt the research community will be daunted by this … given how far they have come over nearly 40 years."

sciencemag.org, 23 June 2021

https://www.sciencemag.org

Why Australia's Great Barrier Reef may end up on the world heritage 'in danger list' – and what it means

2021-06-27

"When things get really crazy above the water line, I flee to the sea. Our reef speaks to the identity of every Belizean, and we say that with pride."

Janelle Chanona is a former television news anchor in Belize, the tiny central American country on the Caribbean Sea famed for its world heritage barrier reef – the second largest on the planet.

"We want to stay vigilant now," Chanona says.

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Earlier this week, Unesco recommended the planet's biggest – the Great Barrier Reef – should be placed on a list of world heritage sites "in danger".

Chanona, who now leads a group of conservationists in the country for Oceana, knows exactly what that means.

In 2009, the world heritage committee put Belize's Caribbean jewel on the same list.

Illegal fishing, coastal and island developments and the threat of oil and gas drilling meant the country wasn't doing enough to preserve the site.

But just as Australia is now staring down the barrel of a perceived ignominy of the "danger" tag, Belize now looks back at it.

The country, bordered by Mexico and Guatemala, introduced a raft of new laws to stop the disappearance of mangroves, regulate fishing and outlaw oil and gas exploration.

In 2018, the world heritage committee scratched the "in danger" status. Now the Belize government has a new "Ministry of Blue Economy" and has renewed hope for its reef.

"We want to stay vigilant now," Chanona says.

A wake-up call to the government

The University of Queensland marine biologist Prof Peter Mumby's career has straddled the two great reefs of Australia and Belize. His wife of 22 years is Belizean. "The reef is very ingrained in their identity," he says.

He says even before Belize hit the danger list, fishermen were seeing the damage from overfishing – particularly on parrot fish that help clean the reef – and were themselves lobbying the government to put restrictions on their catch.

Mumby says both reefs are now being hit by climate change, but he worries a danger listing for Australia's reef could re-enforce a wrongly held perception globally that the reef is doomed.

"But there does need to be that wake-up call to the commonwealth government," he says. "The reef is facing an uncertain future, for sure."

World heritage sites are enshrined on the UN list for their cultural or natural significance, or sometimes both.

There are 53 sites on the world heritage "in danger" list, including Florida's Everglades, Indonesia's Sumatran rainforests, the city of Vienna and Liverpool's historic waterfront (which could lose its world heritage status entirely at next month's meeting).

Next month's meeting, chaired by China, will decide the Great Barrier Reef's status.

Unesco's recommendation is that the reef should be placed on the "in danger" list and the next version of the Queensland and federal governments' cornerstone joint Reef 2050 policy should be explicit about how Australia will bring greenhouse gas emissions down in line with the Paris climate agreement.

If the committee accepts the recommendation in full, then Unesco wants to carry out a monitoring mission "to develop a set of corrective measures" that would also look at driving improvements to water quality – another key area of concern.

Some tourism figures in Queensland fear an "in danger" listing will be more bad news that could discourage international visitors from travelling once borders reopen.

"I really think that's a furphy," says Dr Jon Day, a former Australian government representative on the world heritage committee and a veteran of the meetings.

He says when other sites have been placed on the danger list, "there's no indication that visitor numbers went down".

"I really think that the international tourists are already well aware of the issues facing the reef."

Some tourism operators point out that there are still many great places to go on the Great Barrier Reef and visitors are still as awed by their experience as ever.

But Day says those "great areas" that operators rightly identify "won't continue to be great in the future".

"It's a really short-sighted perspective. Those great areas are going to be suffering very soon."

He says if the Queensland jewel does find itself on the danger list, there could be positives. "It's not just a slap on the wrist, but actually a chance to bring this to the world's attention."

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Day says Australia has always fought criticisms of its world heritage properties, especially when the threat of an "in danger" listing is raised.

He says Australia lobbied intensively to keep the Northern Territory's Kakadu national park off the list in 1999, after concerns over uranium mining and its effect on Aboriginal sites.

"That left a very sour taste in many countries' mouths. People still talk about it," he says. "This should not be about arguing and fighting. It is about the world recognising that its heritage is under threat and then doing something about it."

'Start taking climate policy seriously'

Prof Tiffany Morrison of James Cook University led research published last year into all the times when the world heritage committee has considered putting natural sites – known in UN language as "properties" – on the danger list.

Morrison found countries such as Australia with economies dependant on high-value natural resources – regardless of their state of development – tended to push back on Unesco's recommendations.

If the committee did ignore Australia's pleading this time, Morrison said, an appearance on the "in danger" list would mean "Australia would need to start taking climate policy seriously".

She said: "We would hope that [climate policy] would get Australia back off the in danger list.

"I think [Unesco] are trying to force Australia's hand. That is why we have these international conventions. They are supposed to have teeth."

There were two competing forces at play as Australia tries to make its lobbying count, she said.

"This is actually about reputational risk, both from Australia's and Unesco's point of view," Morrison said. "The more Australia gets away with its lobbying, the more reputational damage there is to Unesco."

Dr Simon Cripps, the executive director of marine conservation at the international Wildlife Conservation Society, says when a site makes its way on to the world heritage list – as the Great Barrier Reef did in 1981 – "it's not the end of journey, actually it's the beginning".

"As with your house or your car, sites need constant maintenance to keep them in a healthy condition," he says. "Australia is a land of environmental paradoxes in that their fantastic work to conserve and sustainably manage the marine environment right around their coastline has set an example to so many other countries.

"Yet it is undermined by their appalling performance on combating climate change that will cause huge environmental, social and economic damage to the very coasts they are seeking to protect."

Back in Belize, the marine scientist and WWF campaigner Nadia Bood says it took "plenty of political will" to get her country's reef off the danger list.

As a 15-year-old rural farm girl, Bood had never seen her country's famous barrier reef until she dived in for a school field trip.

"It was just like, wow," says Bood, from her home in Belize City. "It was then I decided to be a marine scientist.

"As humans, we are dependent on all the species. They allow us to live the life we are living. They give us our food and shelter and the reef protects us from storms.

"We have to try and protect them as much as possible. Australia and our reefs are sisters. We can be championing each other."

theguardian.com, 27 June 2021

https://www.theguardian.com

Strange 'blinking star' defies all explanation

2021-06-23

The strange behavior of a star that dimmed, nearly disappeared, and then brightened back to its normal brilliance has left astronomers scratching their heads. Though other stars are known to dip in brightness on occasion, none are so dramatic or sustained, leading to speculation that this "blinking star" is an entirely new class of object.

The mysterious entity was spotted by the VISTA Variables in the Via Lactea (VVV) survey, which uses the VISTA telescope located atop Cerro Paranal mountain in Chile's Atacama Desert to look at nearly 1 billion stars using infrared light. After perusing the data, the team conducting the survey noticed that a single star lost 97% of its glare and then brightened again over the course of roughly six months.

"It's really quite unusual, that's not something that's been seen before," Philip Lucas, an astrophysicist at the University of Hertfordshire in the U.K., told Live Science. PL

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"It's really quite unusual, that's not something that's been seen before," Philip Lucas, an astrophysicist at the University of Hertfordshire in the U.K., told Live Science. PLAY SOUND

The researchers named the star VVV-WIT-8, where WIT stands for "What Is This?," he added. The object is an old, cool star about 100 times bigger than the sun, located 25,000 light-years away in the direction of the constellation Sagittarius, near the center of the Milky Way.

Some stars, called Cepheid variables, have regular fluctuations in brightness, but astronomers only saw the object dim once during the time the survey looked at it. (The survey has been running since 2010, and the dip occurred in 2012.) There are also stars like Epsilon Augirae, which is partially eclipsed by a large dust disk every 27 years, though it only loses 50% of its brightness when this happens.

The slow and lasting nature of the brightness dip suggested that something was passing in front of VVV-WIT-8, yet if it had a companion star orbiting it, telescopes should have picked up light from such a partner, Lucas said.

Furthermore, whatever was causing the light loss seemed to be "really thick, almost as impenetrable to light as a solid object," he added.

Lucas and his colleagues still aren't sure what's going on. "There's a lot of possibilities and none of them quite work," Lucas said. Their findings appeared June 11 in the Monthly Notices of the Royal Astronomical Society.

One possibility is that a random object happened to fly in front of the star, though the researchers think this is unlikely given the extremely small odds of such a chance alignment. Another is that VVV-WIT-8 has natural dips just as Cepheids do, though no Cepheid has ever been seen fluctuating to such an extreme degree.

The scientists' current favored explanation is that a large, dusty disk of material surrounds the star and occasionally passes in front of it, blocking its light. A similar occurrence happened during the recent dimming of the famous star Betelgeuse, which may have shot out a huge cloud of dust that obscured its brightness, as Live Science's sister site Space.com reported.

If a dust disk surrounds VVV-WIT-8, the disk might be orbiting on its own or it could surround some kind of dense companion — either a dim star or perhaps even a black hole, Lucas said. Black holes tend to shine brightly in

X-rays, so the team is hoping to conduct further observations to see if they can spot any such energetic light coming from the region.

An orbiting object also means that telescopes might capture another dipping event sometime in the future. But data from the dip suggests that the two companions would be separated by at least 20 times the distance between Earth and the sun, Lucas said, implying that the obscuring entity could take hundreds of years to pass in front of the star again.

The idea that there is a companion with a thick disk is "probably the most complete description that can fit the data," Tabetha Boyajian, an astrophysicist at Louisiana State University in Baton Rouge who was not involved in the work, told Live Science.

But additional research will be needed to pin down an explanation, she added. She noted that the last sentence of the team's paper ends with an exclamation point.

"When you end a paper with an exclamation point, it's a telltale sign that we need to do more work," she said.

In the meantime, the researchers have identified two more stars with similar light-loss behavior, meaning there might be other objects that can help them solve this mystery.

Originally published on Live Science.

livescience.com, 23 June 2021

https://www.livescience.com

Flea collar chemicals are poisoning kids and pets

2021-06-26

All of us want to keep our children and pets safe. So, what do we do when EPA allows the sale of products that jeopardize the health of our kids and pets across the country?

Nearly two-thirds of people in the U.S. own pets, and 95% of pet owners consider their pets to be members of the family. So, it's no surprise that consumers were shocked in March when they learned that nearly 1,700 pets had died from exposure to pesticides in Seresto flea collars, which are sold across the country. The EPA received 75,000 incident reports documenting pet harms associated with the collars, according to documents uncovered in a USA Today study with the Midwest Center for

The EPA received 75,000 incident reports documenting pet harms associated with the collars […].

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Investigative Reporting, yet did nothing to protect pets. Unfortunately, Seresto collars aren't the only dangerous flea collars.

But here's some good news: some retailers are protecting pets and their families. Petsmart (the nation's largest pet retailer), under pressure from NRDC, has stopped selling products containing another dangerous pesticide, tetrachlorvinphos, (TCVP) in its retail stores and on its website. And Petco, the nation's second-largest pet retailer, has followed suit. Petco officially ended all sales of flea collars containing TCVP in March.

But the danger to consumers and pets still lurks in other major outlets, including Walmart and Target, grocers including Kroger, Albertsons & Giant, pharmacies including CVS Health and Rite Aid, and online retailers like Amazon, which all continue to sell flea collars containing tetrachlorvinphos where these collars are sold under the brand names Hartz, Zodiac, and Adams.

When used as intended, these products are designed to leave pesticide residue on a pet's fur to kill fleas and ticks. However, that residue can rub off on anyone who pets the animal, and objects the pet comes into contact with, such as furniture and bedding. And young children, whose developing brains are most at risk from TCVP, can absorb the pesticide not only through their skin, but by ingesting it since they put their hands in their mouths a lot. A 2009 NRDC report, and EPA's own assessment under the Obama administration in 2016, found that normal use of a TCVP collar left enough residue on pets' fur to pose neurological risks to toddlers' developing brains.

Organophosphates are a particularly dangerous family of pesticides. They're known to damage the developing brains and nervous systems of young children, toddlers, and fetuses. The use of TCVP in pet flea collars is the last remaining residential use of this toxic family of chemicals; six other dangerous organophosphates once used in pet products have been removed from the market.

It is time for the EPA to stop allowing a pesticide that threatens the health of kids on pets. And while we continue to hold EPA accountable to the science through the courts, responsible retailers need to follow the lead of PetSmart and Petco and remove these dangerous products from their store shelves and their websites.

We haven't waited for courts to act or for the EPA to do its job and protect consumers. NRDC has launched market campaigns to educate major retailers about the dangers associated with TCVP, and to inform the public

about the hazards to children and pets that are lurking in the flea collars sold on store shelves and retail websites.

Parents and pet owners cannot wait another decade.

nrdc.org, 26 June 2021

https://www.nrdc.org

Scientists spot earliest-known supermassive black hole 'storm'

2021-06-23

A massive maelstrom that raged in the universe's youth could help scientists better understand how galaxies and their central black holes interact.

Most, if not all, galaxies harbor a supermassive black hole at their core. Our own Milky Way has one, for example — a behemoth known as Sagittarius A*, which is about as massive as 4.3 million suns.

Galaxies and their supermassive black holes have a tight relationship. The objects seem to evolve together, perhaps through the action of "winds" that the central black holes generate as they gobble up dust and gas. The black holes' gravity accelerates this infalling stuff to incredibly high speeds, causing it to release energy that can blow other material outward. PLAY SOUND

"The question is, when did galactic winds come into existence in the universe?" Takuma Izumi, a researcher at the National Astronomical Observatory of Japan (NAOJ), said in a statement. "This is an important question, because it is related to an important problem in astronomy: How did galaxies and supermassive black holes co-evolve?"

Galaxies and their supermassive black holes have a tight relationship.

Takumi led a team of researchers that dug into these questions. Using the NAOJ's Subaru Telescope in Hawaii, the scientists found more than 100 galaxy-supermassive black hole duos that lie at least 13 billion light-years from Earth, meaning they existed more than 13 billion years ago. (It's taken that long for their light to reach Earth.) The universe was young then, relatively speaking; the Big Bang occurred about 13.82 billion years ago.

Next, the team studied the motion of gas within these galaxies using the Atacama Large Millimeter/submillimeter Array (ALMA), a network of powerful radio telescopes in Chile. The ALMA data revealed that a galaxy called HSC J124353.93+010038.5 features a galactic wind traveling at

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about 1.1 million mph (1.8 kph) — fast enough to propel lots of material outward and hinder star-formation activity.

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HSC J124353.93+010038.5 lies 13.1 billion light-years from Earth. And that makes it a record breaker: The earliest known galaxy with a sizable wind had been an object about 13 billion light-years away, the researchers said.

The new results, which were published online in The Astrophysical Journal on June 14, shed further light on the very tight, and very old, bond between galaxies and their central black holes.

"Our observations support recent high-precision computer simulations which have predicted that coevolutionary relationships were in place even at about 13 billion years ago," Izumi said. "We are planning to observe a large number of such objects in the future, and hope to clarify whether or not the primordial coevolution seen in this object is an accurate picture of the general universe at that time."

livescience.com, 23 June 2021

https://www.livescience.com

There are thousands more toxic chemicals in plastic than we thought

2021-06-24

You may already be trying to cut down on your plastic usage because the material doesn't biodegrade and it can pollute the planet for hundreds of years. But there's another reason you might want to stay away.

A new study finds that plastics release many more toxic chemicals throughout their life cycle than previously thought, posing significant risks to both people and the planet. Until now, only a small number of these chemicals have been properly studied. But the new paper published in the journal Environmental Science & Technology provides the most comprehensive database of chemicals in plastic, and offers a terrifying look into just how harmful the material may be.

The team of researchers, led by Stefanie Hellweg, a professor of ecological systems design at the Swiss university ETH Zurich, identified a whopping 10,500 chemicals in the plastics they studied. The team spent two and a half years studying a wide variety of plastic products, using scientific, regulatory, and industry databases to identify all the chemicals contained

The team of researchers, led by Stefanie Hellweg, a professor of ecological systems design at the Swiss university ETH Zurich, identified a whopping 10,500 chemicals in the plastics they studied.

within them. They then cross-referenced these chemicals with scientific databases that identified whether the chemicals were hazardous, benign, or not adequately studied.

Of these chemicals, about a quarter—2,480—were "substances of potential concern," which means there is some evidence to indicate they are harmful. In some cases, the chemicals are known to be toxic to aquatic life, cancer-causing, or damaging to specific organs. In others, the chemicals can accumulate in humans and animals, causing problems such as memory loss over time.

Helene Wiesinger, lead author of the study and a doctoral student at ETH Zurich, says that at least 1,000 of the chemicals identified as substances of concern can be harmful even in small doses. "If something is a carcinogen, it is agreed upon in the scientific community that there is no safe level of exposure," she tells Fast Company. "Even at very low levels, these can lead to cancer, and obviously [it] gets worse with high doses. With endocrine disruptors, small doses can be problematic. With these chemicals, using any at all is a problem."

The researchers could not properly categorize a further 39%—4,100—of the chemicals, because there is no clear evidence about whether or not they are hazardous. There are many ingredients in plastic that scientists agree are not harmful, but this study reveals that there are many chemicals that have just not been adequately studied. "Our research was designed to nudge the scientific community to devote more resources to studying these chemicals," Wiesinger says. "So far, scientists have focused on a limited number of dangerous chemicals in plastic, but there's a lot we don't know."

They also eventually invade our ecosystems, where they can harm both people and animals. Some plastics end up in the ocean, where sea animals mistake them for food, and eventually become part of the human food chain. Chemicals can also be released in recycling processes, which means they can make recycled plastic unsafe.

So why are plastics so jam-packed with chemicals? Plastic is a cheap substance that can be transformed into almost any material you can imagine, from silk-like synthetic fabrics to sturdy furniture. To create these different materials, factories use additives to give the plastic its desired properties, such as antioxidants to prevent degradation, flame retardants, and plasticizers to reduce brittleness. During production, catalysts, solvents, and other chemicals are used to help process the material.

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Researchers have known that some of these chemicals are dangerous. A study by the U.S. Consumer Product Safety Commission about phthalates (which make materials more flexible) found that they cause asthma, breast cancer, type 2 diabetes, disruption to reproductive health, and a slew of other health problems. The Environmental Protection Agency also determined that brominated flame retardants found on furniture, in house dust, and indoor air have been linked to hormone disruption and development problems in children. But this latest study identified other chemicals in plastics that researchers aren't paying enough attention to. A propanol commonly used as a solvent in colorants is known to cause damage to the reproductive system. A benzene used in controlling polymerization is known to cause skin sensitivity and harm aquatic life.

Even regulators aren't keeping track of these chemicals. A full 53% of chemicals the researchers identified as potentially concerning are not regulated in the United States, the European Union, or Japan. In fact, 901 chemicals known to be hazardous are actually approved for use in contact with food in these regions.

A big part of the problem, the researchers say, is that there isn't a central database that offers information about all of these different chemicals and their potential risks. Indeed, the researchers spent two and a half years combing through 190 publicly available data sources to figure out what constituted a substance of potential concern. There is also a lack of transparency in the plastics industry about the chemicals that go into their products. In the study, the researchers call on regulators to compel plastics manufacturers to disclose all the ingredients in their products.

What's a consumer to do? We can opt for organic materials whenever possible, but it is virtually impossible to eradicate plastic from our lives completely. The modern world is saturated with plastic, from the coatings on our wood furniture to the garments that fill our closets to the paints that cover our walls. To Wiesinger, the onus is on companies to better track and eliminate these chemicals.

"It's an overwhelming burden to ask consumers to be responsible for keeping the environment they live in safe by choosing the right kinds of plastics," Wiesinger says. "This is a problem that needs to be tackled by the industry and regulators, rather than by the consumers themselves. But

what every citizen can do is demand more transparency from companies that produce plastic."

fastcompany.com, 24 June 2021

https://www.fastcompany.com

China's most mysterious wildcat may not be its own species

2021-06-23

Deep in the alpine meadows of the Tibetan Plateau slinks one of the world's most mysterious felines. The Chinese mountain cat—with its sky-blue eyes, sandy coat, and unusual lack of markings—is so elusive that it wasn't photographed in the wild until 2007. For decades, many have considered the stocky-legged feline the only species of cat native to China. But that may be about to change.

A new genetic analysis of more than two dozen Chinese mountain cats concludes that the creature is not its own species, but rather a subspecies of feline that gave rise to several modern wildcats and the domestic cat. That demotion could hamper efforts to save the vulnerable animal, fears Jim Sanderson, a wildlife ecologist with the conservation group Re:wild who snapped that first photo. "The belief is that if it's not a species, nobody cares."

The new study began as an attempt to figure out whether China had independently domesticated the housecat. Most scholars believe domestic cats arose in the Middle East about 10,000 years ago. But there was evidence that other domestications could have occurred in Asia thousands of years later. Was the Chinese mountain cat involved?

To find out, Peking University geneticist Shu-Jin Luo traveled to the Tibetan Plateau, where she had mountaineered in college—"a dream come true," she remembers. Luo and her colleagues trekked the windswept heights looking for Chinese mountain cats to sample. It wasn't easy. Locals, some of whom hunt the cat for its bushy pelt, call the feline the "grass cat" because it blends in so well with the dry stalks of its surroundings.

That may explain why the researchers never encountered a live specimen. Instead, they got their DNA samples from roadkill, old pelts, and cats in museums and zoos. In what became the largest genetic study of Chinese cats, the scientists collected DNA from 27 Chinese mountain cats, 239

"The belief is that if it's not a species, nobody cares."

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domestic cats, and four Asiatic wildcats—another small feline that ranges across Asia. The team looked at entire nuclear genomes, including Y chromosomes passed down from fathers and mitochondrial DNA passed down from mothers.

The domestication question was easy to settle. All of the Chinese domestic cats were genetically indistinguishable from their comrades across the globe, confirming that all domestic cats originated from the same Middle Eastern ancestor, the team reports today in Science Advances.

But the genetic analysis also led the scientists into a taxonomic minefield. When a French biologist first classified the Chinese mountain cat in 1892, he christened it Felis bieti (after a French missionary), designating it as its own species. That classification largely stood until 2007, when a mitochondrial genetic analysis suggested the Chinese mountain cat was instead a subspecies of the wildcat (F. silvestris). F. bieti became F. sylvestris bieti, joining five other felines—including the Asiatic wildcat (F.s. ornata) and the domestic cat (F.s. catus)—as taxonomically subordinate to the wildcat. Then, in 2017, a team of biologists reversed course after considering the feline's appearance and geographic range, among other criteria. The Chinese mountain cat was once again its own species, they declared.

"It's politics, not science. It's become a sideshow," says Carlos Driscoll, a geneticist at the research nonprofit Galton Corp. who was involved with both earlier efforts and the new study, but stands by the conclusions of the 2007 paper. To this day, Driscoll says, experts don't agree on what exactly the Chinese mountain cat is.

Luo's findings largely support Driscoll's 2007 study. Her team discovered that the Chinese mountain cat, the Asiatic wildcat, and the domestic cat formed three distinct genetic clusters equidistant from each other—and that all three were much more closely associated with the wildcat than with small felines like Africa's black-footed cat and the jungle cat, which roams the Middle East and Asia. Together, this suggests the Chinese mountain cat, the Asiatic wildcat, and the direct ancestor of the domestic cat descended from a wildcat ancestor probably about 1.5 million years ago, the researchers conclude.

"It's a very nice study," says Claudio Ottoni, a paleogeneticist at the Sapienza University of Rome and an expert on ancient cat DNA. "The genetic signal is pretty clear."

Still, he contends, the findings only show that the Chinese mountain cat, the Asiatic wildcat, and the domestic cat should have the same taxonomic rank. The genes alone can't determine whether the cats are all subspecies of the wildcat or all species in their own right, he says.

Sanderson, who also runs the Small Wild Cat Conservation Foundation, prefers the latter option. As part of the 2017 effort that elevated the status of the Chinese mountain cat, he says the feline's distinctive appearance and relatively ancient origin are reasons enough to make it its own species. "It's clearly a different kind of animal."

Sanderson admits he's motivated by a desire to save the Chinese mountain cat. Estimates put the feline's numbers at less than 10,000, and it's listed as "vulnerable" by the International Union for Conservation of Nature. An illegal trade in the cat's fur, habitat loss and degradation, and the poisoning of one of its main food sources—the mouselike crop pest pika—are major threats. And an influx of people into the Tibetan Plateau since the 1950s has led to a surge of domestic cats—which appear to be interbreeding with the Chinese mountain cat, potentially corrupting its genome.

"We're living in an age of extinction," Sanderson says. "The Chinese mountain cat deserves every bit as much attention as the panda."

Luo agrees, and adds that although the unusual cat may not enjoy as much popularity as her country's famed bear, people still want to save it. "Even if it's just a subspecies," she says, "it still has a lot of value."

sciencenews.org, 23 June 2021

https://www.sciencemag.org

These bottles are the first made from plastic recycled by enzymes

2021-06-24

Inside landfills, researchers have found rare but naturally occurring enzymes that break down plastic. By tweaking one of these enzymes, scientists at Carbios, a France-based startup, have figured out how to make the process happen faster—and now they've made the first prototypes of food-grade, enzymatically recycled bottles out of the material.

The tech makes it easier to recycle plastic that might otherwise be trashed. Currently, traditional recycling involves chopping up plastic, then washing and melting it. For a drink company, it's only possible to recycle other old

"This new technology allows us to use all those materials which we normally wouldn't otherwise be able to use."

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drink bottles; even if other items are made out of PET, the material used to make bottles, it might be contaminated with non-food-grade material.

"What that means is we're not able to use quite a lot of other waste [PET] material which is out there in the world, which would otherwise just go to landfill," says Ron Khan, vice president of beverage packaging at PepsiCo, which is part of an industry consortium working with Carbios to help scale up the technology. "This new technology allows us to use all those materials which we normally wouldn't otherwise be able to use." Traditional mechanical recycling also eventually "downcycles" the plastic into a lower-quality material.

Instead of breaking down plastic into tiny pieces that are melted, the new process breaks down the material into its basic molecular building blocks. By "depolymerizing" the PET, "we get back to the exact chemical molecules, which come from fossil fuels," Khan says. "Those exact molecules are sort of plug and play for the PET manufacturers." The recycling process can happen repeatedly without a loss in quality.

PepsiCo—along with L'Oréal, Nestlé Waters, and Suntory Beverage & Food Europe—has been helping the small startup with R&D so it can move faster. Each company is also testing the recycled material in the new bottles to make sure it meets quality standards for their various products, from soda to makeup.

For brands, the new technology could help with supply of recycled plastic. Pepsi is shifting to 100% recycled PET for its drink bottles in Germany, Spain, and some other European countries this year, and others next year. Globally, it plans to hit a target of 25% recycled content in all plastic packaging by 2025. (The company is also working on some other alternative materials and new models, like refillable bottles with products like SodaStream.)

In countries where PET recycling rates are high—like Norway, where more than 90% of bottles are recycled—it isn't challenging to use traditional recycling. In other areas, being able to recycle more than bottles can help fill a gap. Anything made from PET, from polyester clothing to carpet, could be safely turned into new plastic.

Building new recycling facilities at the necessary scale will be challenging. Carbios plans to begin building a demonstration plant this fall, and to

launch an industrial facility by 2025. At scale, Khan says, the new plastic could compete in cost with traditionally recycled plastic.

fastcompany.com, 24 June 2021

https://www.fastcompany.com

Embryos appear to reverse their biological clock early in development

2021-06-25

As people age, so do all of our cells, which accumulate damage over time. But why our offspring don't inherit those changes — effectively aging a child even before birth — has been a mystery. "When you are born, you don't inherit your parents' age," says Yukiko Yamashita, a developmental biologist at MIT who studies the immortality of germline cells such as eggs or sperm. "For some reason, you are at zero."

Experts once thought that germline cells might be ageless — somehow protected from the passage of time (SN: 3/10/04). But studies have shown signs of aging in eggs and sperm, dispelling that idea. So researchers have hypothesized that germline cells might instead reset their age after conception, reversing any damage.

In a new study, scientists describe evidence that supports that rejuvenation hypothesis. Both mouse and human germline cells appear to reset their biological age in the early stages of an embryo's development. A rejuvenation period that takes place after an embryo has attached to the uterus sets the growing embryo at its youngest biological age, dubbed "ground zero," researchers report June 25 in Science Advances.

Understanding how germline cells reverse aging could help researchers develop treatments for age-related diseases, such as arthritis or Parkinson's, says Vittorio Sebastiano, a developmental biologist at Stanford University School of Medicine who was not involved in the work. In such diseases, certain cells might become dysfunctional due to damage. Resetting the age of those cells could prevent them from causing problems.

It's possible that this rejuvenation period "can be leveraged and hijacked somehow to basically try to promote similar processes of rejuvenation in normal cells," Sebastiano says.

Vadim Gladyshev, a biochemist and geneticist who studies aging at Harvard Medical School and Brigham and Women's Hospital in Boston,

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and colleagues used molecular clocks to predict the approximate ages of mouse embryos in the early stages of development. The clocks measure epigenetic changes, chemical tags on DNA that can accrue as cells age or are exposed to things like pollution. Such tags can change a gene's activity but not the information that the gene contains.

The scientists were studying the embryos' biological ages, which refers to the function and health of cells, in contrast with chronological ages, which mark time in years (SN: 7/13/16). By tracking epigenetic changes, the team found that the age of the mouse embryos stayed constant during the first stages of cell division immediately following fertilization. But by around 6.5 to 7.5 days into development, after an embryo attached to the uterus, the average biological age of embryos had dipped — a sign that cells were undergoing some type of rejuvenation event. A mouse embryo's ground zero may be somewhere between 4.5 to 10.5 days after fertilization, the researchers say. At some point during development, though the exact point is still unclear, mouse embryos' biological age then began to climb.

So researchers have hypothesized that germline cells might instead reset their age after conception, reversing any damage.

Studying human embryos at the earliest stages of development is prohibited, so similar data for humans was unavailable, Gladyshev says. But some human embryos that were slightly farther along in development than the mouse embryos didn't immediately age, a hint that a similar process happens in people.

The study is a first step and "poses more questions than answers," Sebastiano says, "which is great." Some of those questions: What mechanism pushes cells to reset their age? Are there specific genes that drive the process? Do all living things rejuvenate in this way?

Still, there's reason to be cautious about interpreting the results, says Yamashita, who was not involved in the study. It's possible that epigenetic changes are only part of the story, so relying solely on them could lead to miscalculations. Other factors linked to a cell's biological age, for instance, include whether a cell has multiple copies of specific genes. As a result, the clocks that measure epigenetic changes might not pinpoint the precise "ground zero" for germline cells. Future work might uncover other phenomena that help measure cells' age, Yamashita says.

sciencenews.org, 25 June 2021

https://www.sciencenews.org

Tasmanian devils wide out colony of little penguins in major conservation backfire

2021-06-24

Conservationists in Tasmania may be ruing the decision to introduce endangered Tasmanian devils to a small island, after a new survey revealed that the alien invaders have wiped out the entire colony of little penguins living there.

Tasmanian devils (Sarcophilus harrisii), the world's largest carnivorous marsupials, were introduced to Maria Island — a 45-square-mile (116 square kilometers) island east of Tasmania — by the Tasmanian Department of Primary Industries, Parks, Water and Environment (DPIPWE) in 2012. The government agency hoped to create a new devil population to prevent the species from being wiped out by a deadly disease that has decimated their numbers in Tasmania.

However, the introduction of one species has meant the end of another: The new DPIPWE survey showed that the introduction of devils to the island wiped out 3,000 breeding pairs of little penguins (Eudyptula minor) living on the island, according to The Guardian.

PLAY SOUND

Critics are now blaming the DPIPWE's decision to introduce the devils to Maria Island and the department's subsequent handling of the situation.

"This was a predictable and avoidable outcome," Eric Woehler, an ornithologist at the University of Tasmania and head of conservation group BirdLife Tasmania, told Live Science.

Insurance policy

The International Union for Conservation of Nature, which maintains a list of threatened species, classifies the Tasmanian devil as endangered. One major threat to the species is the emergence of a rapidly transmissible form of cancer known as devil facial tumor disease, which has killed 90% of their population (which is mostly confined to Tasmania) since the disease first appeared in 1990, Live Science previously reported. DPIPWE scientists believed the only way to prevent a devil extinction was to create isolated populations of healthy individuals away from Tasmania.

In addition to keeping the devils safe on Maria Island, conservationists thought the transplanted individuals would help control the island's population of small predators, such as feral cats and possums; traditionally,

However, the introduction of one species has meant the end of another […]

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officials had instead culled the predators to protect bird populations, according to The Guardian.

Similar attempts to introduce Tasmanian devils to the Australian mainland have been successful, and wild devils were recently born there for the first time in over 3,000 years, Live Science previously reported. However, the new population on Maria Island quickly grew out of control from 28 individuals, introduced between 2012 and 2013, to more than a hundred by 2016, according to The Guardian.

"The devil population is currently managed to achieve a population-size range of between 60-90 individuals," a DPIPWE spokesperson told Live Science, which they claim is the current estimated carrying capacity to "reduce impacts to island ecology."

Conservation nightmare

With that population boom, Tasmanian devils became the dominant predator on Maria Island, and some endemic species, such as the little penguin, could not adapt fast enough to survive the onslaught.

"The devils ate the adults and young," Woehler said. "The penguins that were not predated abandoned the colony in the face of predation pressure," most likely joining up with other colonies in Tasmania, Australia or even New Zealand.

The devils also killed and ate short-tailed shearwaters (Puffinus tenuirostris), significantly reducing the birds' numbers on Maria Island, according to a study published in 2020 in the journal Biological Conservation.

Other bird species at risk from the devils' appetite include the Cape Barren goose (Cereopsis novaehollandiae) and the Tasmanian native hen (Tribonyx mortierii), Woehler said. "All ground-nesting and ground-feeding bird species are at potential risk," he added.

Avoidable outcome

One of Woehler's and others' biggest criticisms of the project is that until now, the DPIPWE had not properly monitored the penguin population, so the organization had "no idea" what was happening as a result, Woehler said. "Parks staff undertook no monitoring for 12 years, and that's when they discovered no penguins remaining," Woehler said.

A lack of monitoring also means it is unclear if Tasmanian devils had any impact on predator populations as was hoped, Woehler said.

However, the DPIPWE claims that monitoring has been carried out on Maria Island, even though it doesn't seem to have done them any good.

"The Save the Tasmanian Devil Program (STDP) continually monitors, evaluates and reviews the devil population and program activities," a DPIPWE spokesperson, told Live Science. "All effective conservation programs are adaptive and the STDP will continue to evolve in line with new knowledge in science and emerging priorities."

Proper monitoring might have been able to save the penguins, but the project should never have gotten a green light in the first place, Woehler said.

In 2011, before Tasmanian devils were introduced to Maria Island, the DPIPWE released a report that predicted the introduction of the carnivorous marsupials would have "a negative impact on little penguin and shearwater colonies on Maria Island through devil predation," according to The Guardian.

However, the desire to save the iconic Tasmanian devils from devil facial tumor disease led to the rash decision to introduce them regardless, Woehler said.

"The outcome was predicted by many people," Woehler said. More research should have been carried out before the devils were introduced to help inform the DPIPWE's decision, he added.

Ironically, new studies suggest that the native population of devils on Tasmania is now likely to survive the devil facial tumor outbreak, as the disease is starting to spread much more slowly, according to a study published in 2020 in the journal Science. Therefore, the introduction of Tasmanian devils to Maria Island was ultimately unnecessary.

Not too late

Although the introduction of Tasmanian devils to Maria Island has caused a huge amount of ecological damage, there is still hope that the problem can be remedied.

By removing the devils from the island, there is a chance that the little penguins will return home, Woehler said.

"They are responding to predator pressure," Woehler said. "Remove the pressure, and the birds will return."

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However, there is no indication of a devil removal project being carried out anytime soon, Woehler said.

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https://www.livescience.com

Earth has a 'pulse' of 27.5 million years

2021-06-23

Most major geological events in Earth's recent history have clustered in 27.5-million-year intervals — a pattern that scientists are now calling the "pulse of the Earth," according to a new study.

Over the past 260 million years, dozens of major geological events, from sea level changes to volcanic eruptions, seem to follow this rhythmic pattern.

"For quite a long time, some geologists have wondered whether there's a cycle of around 30 million years in the geologic record," said lead author Michael Rampino, a professor in the departments of biology and environmental studies at New York University. But until recently, poor dating of such events made the phenomenon difficult to study quantitatively.

"Many, but maybe even most, [geologists] would say that geological events are largely random," Rampino told Live Science. In the new study, Rampino and his team conducted a quantitative analysis to see if they were indeed random or if there was an underlying pattern.

The team first scoured the literature and found 89 major geological events that occurred in the past 260 million years. These included extinctions, ocean anoxic events (times when the oceans were toxic due to oxygen depletion), sea level fluctuations, major volcanic activity called flood-basalt eruptions and changes in the organization of Earth's tectonic plates.

Then, the researchers put the events in chronological order and used a mathematical tool known as Fourier analysis to pick up spikes in the frequency of events. They discovered that most of these events clustered into 10 separate times that were, on average, 27.5 million years apart. That number may not be "exact," but it's a "pretty good estimate" with a 96% confidence interval, meaning it's "unlikely to be a coincidence," Rampino said.

The researchers looked only at the past 260 million years — when the dating of such events is most accurate — but they think the results likely extend further back in our planet's history. For example, data from sea level changes go back around 600 million years and also seem to follow this pulse, Rampino said.

It's not clear what's causing such a pulse in geological activity, but it could be internally driven by plate tectonics and movement inside the mantle,

But until recently, poor dating of such events made the phenomenon difficult to study quantitatively.

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the researchers wrote in the study. Or it could have something to do with the movement of Earth in the solar system and the galaxy, Rampino said. For example, the 27.5 million year pulse is close to the 32 million year vertical oscillation around the midplane of the galaxy, according to the study.

One theory is that the solar system sometimes moves through planes containing larger amounts of dark matter in the galaxy, Rampino said. When the planet moves through dark matter, it absorbs it; large amounts of captured dark matter can annihilate and release heat, which can produce a pulse of geological heating and activity, Rampino said. Perhaps this interaction with large amounts of dark matter correlates with the pulse of the Earth, Rampino said. (But of course, this is just a theory. Scientists still don't know what dark matter is made of, and don't know how it's distributed in the solar system.)

Rampino and his team hope to get even better data on the dating of certain geological events and plan to analyze a longer time period to see if the pulse extends further back in time. They also hope that if, one day, they can get better numbers on the astronomical movements of Earth through the solar system and the Milky Way, they can see if there's any correlation in the astronomical and geological cycles.

In any case, if such a pattern exists, the last cluster was about 7 million to 10 million years ago, so the next one would likely come in 15 million to 20 million years, Rampino said.

The findings were published online June 17 in the journal Geoscience Frontiers.

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https://www.livescience.com

How palm oil became the world's most hated, most used fat source

2021-06-24

Palm oil is everywhere today: in food, soap, lipstick, even newspaper ink. It's been called the world's most hated crop because of its association with deforestation in Southeast Asia. But despite boycott campaigns, the world uses more palm oil than any other vegetable oil – over 73 million tons in 2020.

Palm oil has long been a staple food in a region stretching from Senegal to Angola along Africa's western coast.

That's because palm oil is cheap. The plant that makes it, the African oil palm, can produce up to 10 times more oil per hectare than soybeans.

But as my new book on palm oil's history shows, this controversial commodity hasn't always been cheap. It became that way thanks to legacies of colonialism and exploitation that still shape today's industry and that make it challenging to shift palm oil onto a more sustainable path.

From slavery to skin care

Palm oil has long been a staple food in a region stretching from Senegal to Angola along Africa's western coast. It entered the global economy in the 1500s aboard ships engaged in the transatlantic slave trade.

During the deadly "middle passage" across the Atlantic, palm oil was a valued food that kept captives alive. As the author of a 1711 book noted, traders also smeared captives' skin with palm oil to make them "look smooth, sleek, and young" before sending them to the auction block.

By the mid-1600s, Europeans were rubbing palm oil on their own skin, too. European writers, learning from African medicinal practices, claimed that palm oil "does the greatest cures upon such, as have bruises or strains on their bodies." By the 1790s, British entrepreneurs were adding palm oil to soap for its reddish-orange color and violetlike scent.

After Britain abolished the slave trade in 1807, traders sought out legal products. In the following decades Britain slashed tariffs on palm oil and encouraged African states to focus on producing it. By 1840, palm oil was cheap enough to completely replace tallow or whale oil in such products as soap and candles.

As palm oil became increasingly common, it lost its reputation as a luxurious good. Exporters made it even cheaper with labor-saving methods that allowed palm fruit to ferment and soften, though the results were rancid. European buyers, in turn, applied new chemical processes to strip away foul odors and colors. The result was a bland substance that could be freely substituted for more expensive fats and oils.

Palm oil colonialism

By 1900, a new industry was gobbling up all kinds of oils: Margarine was invented in 1869 by the French chemist Hippolyte Mège-Mouriès as a cheap alternative to butter. It soon became a mainstay of working-class diets in Europe and North America.

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Palm oil was first used to dye margarine yellow, but it turned out to be a perfect main ingredient because it stayed firm at room temperature and melted in the mouth, just like butter.

Margarine and soap magnates like Britain's William Lever looked to Europe's colonies in Africa for larger quantities of fresher, edible palm oil. However, African communities often refused to provide land for foreign companies because making oil by hand was still profitable for them. Colonial oil producers resorted to government coercion and outright violence to find labor.

They had more success in Southeast Asia, where they created a new oil palm plantation industry. Colonial rulers there gave plantation companies nearly unlimited access to land. The companies hired "coolies" – a derogatory European term for migrant workers from southern India, Indonesia and China, based on the Hindi word Kuli, an aboriginal tribal name, or the Tamil word kuli, for "wages." These laborers toiled under coercive, low-paying contracts and discriminatory laws.

The oil palm itself also adapted to its new locale. While scattered palms grew to towering heights on African farms, in Asia they remained short in tight, orderly plantations that were easier to harvest efficiently. By 1940, plantations in Indonesia and Malaysia were exporting more palm oil than all of Africa.

A golden gift?

When Indonesia and Malaysia gained independence after World War II, plantation companies retained their access to cheap land. Indonesian authorities dubbed palm oil from their fast-growing plantation industry a "golden gift to the world."

Palm oil consumption grew as competitors dropped away: first whale oil in the 1960s, then fats like tallow and lard. In the 1970s and 1980s, health concerns about tropical oils such as coconut and palm undercut demand in Europe and North America. But developing countries snapped up palm oil for frying and baking.

Plantations expanded to meet the demand. They kept costs down by recruiting poorly paid and often undocumented migrant workers from Indonesia, the Philippines, Bangladesh, Myanmar and Nepal, reproducing some of the abusive practices of the colonial era.

In the 1990s, U.S. and EU regulators moved to ban unhealthy trans fat, a type of fat found in partially hydrogenated oils, from foods. Manufacturers

turned to palm oil as a cheap and effective substitute. From 2000 through 2020, EU palm oil imports more than doubled, while U.S. imports shot up almost tenfold. Many consumers didn't even notice the switch.

Because palm oil was so inexpensive, manufacturers found new uses for it, such as replacing petroleum-based chemicals in soaps and cosmetics. It also became a biodiesel feedstock in Asia, although research suggests that making biodiesel from palms grown on newly cleared land increases greenhouse gas emissions instead of reducing them.

The EU is phasing out palm oil biofuels because of concerns over deforestation. Undeterred, Indonesia is working to increase the palm component in its biodiesel, which it markets as "Green Diesel," and to develop other palm-based biofuels.

Boycott or reform?

Today there are enough oil palm plantations worldwide to cover an area larger than the state of Kansas, and the industry is still growing. It is concentrated in Asia, but plantations are spreading in Africa and Latin America. A 2019 investigation of one company in the Democratic Republic of Congo found dangerous conditions and abusive labor practices that echoed colonial-era palm oil projects.

Endangered animals have received more press. According to the International Union for the Conservation of Nature, tropical forest clearing for oil palm plantations threatens nearly 200 at-risk species, including orangutans, tigers and African forest elephants.

However, the IUCN and many other advocates argue that shifting away from palm oil is not the answer. Since oil palm is so productive, they contend, switching to other oil crops could cause even more harm because it would require more land to cultivate substitutes.

There are more just and sustainable ways to make palm oil. Studies show that small-scale agroforestry techniques, like those historically practiced in Africa and among Afro-descendant communities in South America, offer cost-effective ways to produce palm oil while protecting the environment.

The question is whether enough consumers care. Over 20% of palm oil produced in 2020 received certification from the Roundtable for Sustainable Palm Oil, a nonprofit that includes oil palm producers and processors, consumer goods manufacturers, retailers, banks and advocacy groups. But barely half of it found buyers willing to pay a premium for

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sustainability. Until this changes, vulnerable communities and ecosystems will continue to bear the costs of cheap palm oil.

theconversation.com, 24 June 2021

https://www.theconversation.com

Project to map entire ocean floor for 2030 passes 20% mark

2021-06-25

About 70% of Earth's surface is covered in water, and researchers are trying to map every last inch of it. On June 21 (that's World Hydrography Day, in case you forgot to update your Calendar of Very Nerdy Events), a group of international researchers announced that they are about one-fifth of the way to that goal, having mapped 20.6% of Earth's total underwater area using modern sonar techniques, according to a statement.

The project, called Seabed 2030, aims to map 100% of the global ocean floor by 2030 using largely crowd-sourced data from science vessels, corporations and private boat owners around the world. The current level of coverage shows a modest increase over last year's figure of 19% (research was hampered by COVID-19, project director and hydrographer Jamie McMichael-Phillips told the BBC), but the project has nevertheless seen huge gains since its inception four years ago.

"When Seabed 2030 was launched in 2017, only 6% of the oceans had been mapped to modern standards," the team wrote in the statement. In the last year, the team completed another 1.6% of the global ocean map, adding an area "roughly around half the size of the United States," McMichael-Phillips added.

Recent coverage includes some of the most hard-to-reach places on Earth, thanks to data shared by billionaire explorer Victor Vescovo and the crew of his ship, the DSSV Pressure Drop. In September 2019, Vescovo completed a personal mission to descend to the deepest points in all five of Earth's oceans aboard a small submersible. Vescovo's team also used bathymetric instruments aboard the Pressure Drop to map these bottom-of-the-world hotspots while the ship was in the neighborhood. The team's expeditions mapped an area equivalent to the size of France in roughly 10 months, more than half of which had never been seen before, the BBC reported.

"When Seabed 2030 was launched in 2017, only 6% of the oceans had been mapped to modern standards," the team wrote in the statement.

Why map the entire ocean? It's not to uncover the lost city of Atlantis (at least, not officially). According to the Seabed team, a comprehensive understanding of the ocean floor is crucial to various scientific and commercial pursuits. On the business side, good seafloor maps can help vessels navigate more efficiently, and they can also aid endeavors like laying cables and constructing pipelines, the team said.

But more importantly, these maps can reveal previously unknown patterns in deep ocean currents, which are influenced by variations in the seafloor topography. Accurate information about currents can help improve climate change models, as the ocean plays a key role in moving heat around Earth, the BBC reported.

With a sluggish 2020 behind them, the Seabed team is optimistic that the project will reach 100% ocean floor coverage by 2030. For more project updates, tune in again next year on World Hydrography Day.

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New fossils reveal a strange-looking Neanderthal in Israel

2021-06-24

Some of the earliest bands of modern humans who ventured out of Africa and into the Middle East 120,000 to 140,000 years ago might have met a strange-looking character with the look of a primitive Neanderthal, but a stone toolkit as modern as their own. New fossils of this individual, found over the past decade in Israel, are stirring intense debate among paleoanthropologists: Was it the earliest known Neanderthal in the Middle East, or a late remnant of a previously unknown Neanderthal ancestor?

Finding modern tools with such a primitive-looking toolmaker at this time in the main passage between Africa and Eurasia makes this "a major discovery," writes paleoanthropologist Marta Mirazón Lahr of the University of Cambridge in an accompanying commentary.

Researchers have long known the Middle East was a busy crossroads for modern humans and Neanderthals. Although fossils of modern humans in Israel date back 130,000 years, recognizable Neanderthals don't show up in the fossil record of the region until about 60,000 to 70,000 years ago. Both fossils and ancient DNA have suggested Neanderthals arose more

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Was it the earliest known Neanderthal in the Middle East, or a late remnant of a previously unknown Neanderthal ancestor?

than 400,000 years ago in Europe and spread later into the Middle East, where they likely met and mated with modern humans who had migrated out of Africa.

The new fossils and tools were found over the past few years in a sinkhole in a limestone quarry in central Israel, after a construction crew uncovered the first tools from the site in 2010. Over the next 5 years, a team led by archaeologist Yossi Zaidner of the Hebrew University of Jerusalem excavated the open-air site at Nesher Ramla and found pieces of an ancient skull, a nearly complete jawbone, and a molar, all likely from the same individual. They also dug up animal bones and flint tools from the same layer of sediments, which date to 120,000 to 140,000 years ago, according to one of two papers published today in Science.

The stone tools were made with a so-called Levallois method: typical of the area's modern humans, as well as of Neanderthals who appeared later in the region. But the fossils were clearly not Homo sapiens, says Tel Aviv University paleoanthropologist Hila May. And they didn't look like early or late Neanderthals in the Middle East or Europe, says co-author María Martinón-Torres, a paleoanthropologist at CENIEH, the national center for research on human evolution. "They didn't fit with anything," she says.

Instead, the fossils show a "weird" mix of archaic and Neanderthal-like traits, May says. For example, the robust jaw and molar were similar to Neanderthals, but the parietal skull bones were thicker, and more like those in archaic members of Homo, May says. Dental anthropologist Rachel Sarig, also at Tel Aviv University, says the inner structure of the molars reminds her of the teeth of archaic members of the Homo genus found at Qesem Cave in Israel, dating to about 400,000 years ago. This suggests the fossils belonged to the "late survivors" of a previously unknown population of Homo, or to another Neanderthal lineage that lived in the Middle East. They could have also belonged to a hybrid who was a mix of Neanderthal and archaic Homo, says paleoanthropologist Israel Hershkovitz of Tel Aviv University, which would add another member to the diverse cast of hominins that ranged across Eurasia and Africa during the Middle Pleistocene, some 790,000 to 130,000 years ago.

The researchers end their paper with a radical idea: They propose that the fossils, with their mix of archaic and Neanderthal-like traits, could have been late survivors of a group that was a source population in the Middle East for both late and early Neanderthals in Europe and Asia, they write today in Science.

That suggestion, however, has quickly drawn fire. Paleoanthropologist Jean-Jacques Hublin of the Max Planck Institute for Evolutionary Anthropology says the fossils were too recent to represent the source population for Neanderthals, whose earliest known ancestors lived more than 400,000 years ago at Sima de los Huesos in Spain. "That's an overinterpretation of the fossil evidence," he says. Instead, he thinks the mix of archaic and Neanderthal traits may reflect regional variation, with Neanderthals living in the Middle East being different from the classic Neanderthals of Europe, or at least a hybrid mix of different groups. He adds that in his view, teeth are the most important body part for classifying a fossil, and "that tooth is like a Neanderthal tooth."

Paleoanthropologist Mirjana Roksandic of the University of Winnipeg agrees that the Nesher Ramla specimen is too young to be "seriously considered" as evidence for the source Neanderthals. She does think, however, the new fossils show that modern humans and Neanderthals were interacting earlier than previously believed in the Middle East. That's a pattern she has also seen at a fossil site in Europe's Balkan Mountains, where a minimum of two Homo lineages were present and interacted. "It is exciting that they are seeing this pattern in the Levant as well."

sciencemag.org, 24 June 2021

https://www.sciencemag.org

A slimy calamity is creeping across the sea

2021-06-22

Divers who have seen the phenomenon firsthand describe many types of underwater sea snot. There are the "stringers," which most resemble the sticky goo that might actually come out of your nose. But there are also floating "clouds," white and ethereal, so delicate that they break apart in your fingers. Then there are the tiny flakes of "marine snow," which begin as drops of mucus and accumulate organic debris as they drift slowly, slowly down to the bottom of the sea.

Then there is whatever is happening off the coast of Turkey—a downright "mucilage calamity," in the words of Turkish President Recep Tayyip Erdoğan. The sea snot there has surfaced and turned monstrous, gelling into a thick layer of yellowing slime atop the water. For months, this foul mucus has blanketed the Sea of Marmara, which connects the Black Sea and the Aegean Sea in the Mediterranean. It's smothering shellfish, clogging nets, and destroying the fishing industry.

The sea snot there has surfaced and turned monstrous, gelling into a thick layer of yellowing slime atop the water.

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The slime is, in short, a national crisis. Turkey is now trying to vacuum up its embarrassment of sea snot, dispatching workers with hoses to collect mucus by the tons for incineration. But scientists say that much more is probably lurking under the water. And even worse, the floating mucus is a sign of much larger disruptions in the sea. As unsightly as sea snot might be, its most devastating effects happen far away from human eyes, deep below the surface.

Slime in the sea is not inherently unusual. "Mucus is everywhere," says Michael Stachowitsch, a marine ecologist at the University of Vienna. "There's no marine organism that doesn't produce mucus, from the lowly snail to the slimy fish." But in healthy waters, mucus doesn't amass to epic proportions. The current sea-snot outbreak can be blamed on phytoplankton, a type of algae that produces the small bits of mucus that turn into flakes of marine snow. When these phytoplankton receive an infusion of imbalanced nutrients from fertilizer runoff or untreated wastewater, they make an overabundance of mucus. Beads of that mucus accumulate into stringers, which accumulate into clouds, which accumulate into the unending sheets now washing up on Turkey's coast.

But pollution alone doesn't explain the appearance of so much sea snot—or marine mucilage, to use the scientific term. This much slime buildup also requires specific weather conditions: hot and calm. In spring and summer, the sun heats up the top layer of seawater, leaving a layer of cool, denser water underneath. (Salinity also plays a role in the density gradient: Saltier water will sink beneath fresher water.) Because of this gradient, the mucus will sink until it starts to float; then it lingers. The longer it stays, the more it accumulates. And without strong winds or storms, nothing creates turbulence to churn the water and rip the mucus apart.

Bacteria trapped in the mucus will eventually start to eat and digest it, creating air bubbles that ultimately float the whole sheet of sea snot up to the surface. In the Adriatic Sea, the arm of the Mediterranean just east of the Italian peninsula, the floating mucus can dry and toughen in the sun. Seagulls are known to walk on it.

Mass outbreaks of sea snot have appeared dozens of times in the Adriatic over the past three centuries, probably because its geography and calm winds create the perfect conditions for large sheets to form. Sea snot has had big economic consequences there. "The main problems are fisheries and tourism," Michele Giani, an oceanographer at the National Institute of Oceanography and Applied Geophysics, in Italy, told me. Boats cannot go to sea at all because mucus clogs up the seawater intake that cools

the motor. "A motor can have a meltdown within a minute," Stachowitsch said. Fishing nets become slimy and heavy. And tourists, of course, want nothing to do with the mess. It doesn't help that as sea snot degrades on the surface, its smell can turn quite nasty too.

The first description of mare sporco, or "dirty sea," in Italian dates back to 1729. But in the early 2000s, marine mucilage started breaking out pretty much every year, which scientists, in a 2009 paper, linked to climate change. (Huge swaths of marine mucilage have also turned up near Turkey at least once before, in 2007.) You might think of the snot as a symptom of "ocean flu," says Antonio Pusceddu, a marine ecologist at the University of Cagliari, in Italy, who co-authored that paper: The snot's appearance is a sign of deeper sickness in the sea, caused by climate change and pollution.

The link between marine mucilage on the surface and the clouds and stringers underwater became clear during the 1980s, when researchers diving in the Adriatic first observed the unusual masses. Scientists had missed this phenomenon earlier, Stachowitsch said, "because the instruments that were used to bring up water samples from the ocean were quite brutal, so they shook up the water," destroying the mucus. Humans could see it only if they went down themselves, either with scuba gear or in submersibles. Gerhard Herndl, an oceanographer now at the University of Vienna, told me that while diving in the '80s, he mistook the first cloud of mucus he ever saw for a shark. Until that moment, he had not known that sea snot could grow to such behemoth proportions.

The mucus floating underwater was fascinating—even beautiful—but what scientists saw on the seafloor was disturbing. They already knew that unsightly layers of the mucus could float to the surface. Now they discovered that they could also sink, covering corals, sponges, brittle stars, mollusks, and any other unlucky creatures on the seafloor, cutting them off from oxygen. "They're literally smothered," says Alice Alldredge, an oceanographer at UC Santa Barbara. "Sure, it's uncomfortable for us as human beings to have all this gunk at the surface. But the bottom-dwelling organisms are going to die." An ecosystem takes years to fully recover from such a mass mortality.

For this reason, vacuuming up sea snot on the surface in Turkey is too little, too late for the local ocean ecosystem. To deal with the root of the problem, Turkey will have to prevent untreated wastewater and runoff from entering the Sea of Marmara in the first place. That certainly won't clear up the sea this summer. But evidence from Italy suggests that such efforts might quell Turkey's ocean flu in the long run. In the Adriatic,

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Pusceddu says, mucilage outbreaks have died down since Italy began cleaning up the wastewater that flows into it. The sea has returned to what looks like a healthier, less slimy normal.

theatlantic.com, 22 June 2021

https://www.theatlantic.com

These cauliflowerlike anemones snack on ants

2021-06-25

Scientists long suspected the giant plumose anemone (Metridium farcimen), which flourishes along the U.S. Pacific coast, lived off a respectable ocean diet of zooplankton and tiny marine invertebrates. A new study shows they were mostly right. But when given the chance, the cauliflower-shaped sea creature also feasts on an unusual culinary delight: ants.

To find out what the anemones were eating, researchers collected 12 anemones near docks off the coast of Washington state and analyzed their stomach contents. Using a process called DNA metabarcoding, which looks at DNA from a sample and matches it to a list of species in an online database, they found that the anemones ate crab larvae, barnacles, and plankton. But about 10% of their diet was made up of ants, they report this month in Environmental DNA.

How the ants came to be in the anemones' stomachs was the next question. After some speculating, the scientists realized the anemones were collected during the mating season of local pale-legged field ants (Lasius pallitarsis). For a few weeks in August, the ants are everywhere by the Washington oceanside docks. It's likely, the researchers say, that some of these unlucky ants may have been blown away by the wind into the nearby water, where they were trapped and eaten by the giant anemones.

But when given the chance, the cauli-flower-shaped sea creature also feasts on an unusual culinary delight: ants.

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hat caused the Surfside condo collapse in Miami-Dad County?

2021-06-28

Early Thursday (June 24) morning, part of a condominium complex in Surfside, Florida, suddenly collapsed. In about 11 seconds, 55 of the building's 136 units crumbled into a pile of rubble, and now, as the search

for survivors continues, experts are investigating why the catastrophe happened in the first place, according to news reports. So far, structural damage, poor building design and sinking land beneath the condo have all been flagged as possible triggers for the disaster.

Allyn Kilsheimer, a veteran engineer who investigated the 1995 Oklahoma City federal building bombing and the 1993 World Trade Center bombing, will examine the foundation of the building and look for cracks, leaks and any intrusions of groundwater or saltwater, The Washington Post reported. He noted that building collapses are often caused by several factors that work together.

For instance, in October 2018, engineer Frank Morabito described various concerns about the Surfside condo, called the Champlain Towers South Condo, in a report that he'd prepared for the condo association, The Miami Herald reported. He noted that the building's pool deck and outdoor planters were not sloped to facilitate proper water drainage, which had led to "major structural damage" over time.

This design flaw could be traced back to the original contract documents drawn for the building 40 years ago, Morabito wrote in the report.

Standing water on the pool deck had damaged the underlying concrete, and in particular, the parking garage beneath the pool deck showed signs of structural stress, in the form of "sizable" cracks and exposed rebar that was corroding in various locations. "Though some of this damage is minor, most of the concrete deterioration needs to be repaired in a timely fashion," Morabito wrote. "Failure to replace waterproofing in the near future will cause the extent of the concrete deterioration to expand exponentially."

Given the building's age, however, the reported damage was "fairly typical," Kenneth Direktor, an attorney for the building's condominium association, told The Washington Post. "Something horrible happened," Direktor said. "This isn't the result of hairline cracks in the concrete."

The 2018 report didn't signal that the building could be in danger of collapse, and in general, experts aren't yet sure that concrete deterioration and corrosion were the sole triggers behind the structural failure, The New York Times reported.

However, videos of Thursday's disaster "would suggest a foundation-related matter — potentially corrosion or other damage at a lower level," Donald Dusenberry, a consulting engineer, told the Times. One resident

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also reported seeing some sort of hole open up near the pool just before the partial collapse, which supports the idea that the collapse began underground, the Times reported. On a call with her husband Michael, condo resident Cassie Stratton mentioned that she could see the hole from her fourth-floor unit before the call abruptly cut off.

"You certainly can't rule out a design or construction error that has survived for 40 years," although again, it is not yet certain whether the water-related corrosion caused the collapse, Dusenberry said.

Beyond corrosion, the building could have been compromised by poor design, substandard building materials or improperly installed pipes, the Times reported. Heavy construction also took place near the building in 2019, and a condo board member had reached out to the city citing "concerns regarding the structure of our building," due to the associated ground shaking; the city did not intervene in the matter.

Another explanation for the collapse is that a void or a sinkhole opened up under the reinforced concrete pilings that sit beneath the building, causing some pilings to shift downward while others remained in place, David Peraza, a structural engineer at Exponent, an engineering and scientific consulting firm, told the times. "Whether there's something geologically under the building that caused this, that's definitely something that's got to be investigated," he said.

In that vein, a 2020 study, published in the journal Ocean & Coastal Management, suggested that the land beneath Champlain Towers South has been gradually sinking since the 1990s through a process called "subsidence." Subsidence occurs when large amounts of groundwater get drawn out of the sediment and no longer help prop up the land above, according to the U.S. Geological Survey; subsidence is usually caused by human activities, such as draining underground reservoirs to prepare land for development.

The town of Surfside sits on a barrier island in the Atlantic Ocean, separated from mainland Miami by Biscayne Bay; according to space-based radar data, the island experienced subsidence at the rate of about 0.04 to 0.1 inches (1 to 3 millimeters) per year between 1993 and 1999, although that sinking was not evenly distributed across the entire landmass, the researchers reported in the 2020 paper. Most pockets of subsidence appeared on the western side of the island, where buildings were constructed on reclaimed wetlands, but some pockets also appeared on the eastern side, where Surfside is located.

"This was unusual, the pocket we saw in Surfside," as that side of the island is known to be more stable than the western side, senior author Shimon Wdowinski, and Florida International University (FIU) professor, said in a statement.

"The western part of Miami Beach was built on reclaimed wetlands and has been subjected to more subsidence," Wdowinski told Live Science in an email. "The eastern side of the city is built on higher ground overlying limestone and is less likely to experience subsidence." The rate of subsidence under Surfside was about 0.08 inches (2 mm) per year, "which is relatively low, but still above the detection level," he said.

The observed rate of subsidence is fairly low compared with places like Mexico City, which is subsiding at a rate of roughly 15 inches (38 centimeters) per year, according to the FIU statement, although a 2021 study suggests an even faster rate of 20 inches (50 cm) per year, according to Eos Magazine.

That said, the small changes like those in Surfside accumulate over time and can amount to several inches of sinking over the course of decades, Wdowinski noted.

However, based on earlier studies by Wdowinski and his colleagues, "in most cases, these buildings just move … there's no catastrophic collapse like in the case here in Surfside, which was very unfortunate," he said. In other words, it's unlikely that the subsidence alone caused the structure to fail. In theory, the deep-set pilings beneath the condo would have provided stability despite the gradual sinking, so other factors are likely to blame, Peraza told the Times.

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How do most lobsters stay cancer-free? Newly sequenced genome could reveal their secrets

2021-06-23

Consider the American lobster—a bottom-dwelling crustacean that lives up to 100 years in the wild. Scientists have long wondered at its astonishing longevity: Lobsters do not grow weaker with age and only rarely suffer from cancers. Now, researchers have published the first high-quality draft of the lobster genome, yielding surprising insights about the

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animal's immune system and genomic stability that may one day help answer fundamental questions about aging—not only in lobsters, but also in humans.

Lobsters are "very different from us," says Jose Lopez, a molecular evolutionary biologist at Nova Southeastern University who was not involved with the study. "But we do share a lot of homologous genes with these seemingly very distant animals." Lopez calls the new work "a monumental effort," especially given that the lobster genome may be even longer than that of humans.

Much like a fine wine or certain Hollywood actors, American lobsters (Homarus americanus) seem to only get better with passing years. They do not lose strength, experience large shifts in metabolism, or lose fertility with age. They also spend their whole lives growing bigger and bigger. And whereas it is estimated that nearly 40% of all people will be diagnosed with cancer at some point, a 2008 literature review across more than 60 years of research found just one credible case of a tumorous growth in the American lobster.

To see whether lobster genes hold the secret to their cancer-free longevity, researchers at the Gloucester Marine Genomics Institute (GMGI) launched a project to sequence the animal's entire genome in 2015. But by 2017, the team had sequenced less than half of the genome using standard "short-read" technology, which could only process very small fragments of the lobster genome at a time. Two GMGI researchers—biochemist Andrea Bodnar and marine biologist Jennifer Polinski—pushed for additional sequencing using newer long-read sequencing technology. But that meant they had to redo their entire analysis. "It was almost like starting over again," Bodnar says.

By 2019, GMGI's work had yielded the most complete lobster genome to date—capturing an estimated 72% of the entire sequence, the researchers report today in Science Advances. When Bodnar, Polinski, and colleagues in Florida, Maryland, Canada, and Russia analyzed the data—comparing their sequence with those of seven other marine invertebrates—they found dozens of examples in which groups of genes related to nerve cell function, immunity, genome integrity, and cell survival were enriched or expanded.

For example, the researchers found genes encoding a wide variety of proteins that help regulate the movement of ions through cell membranes, known as ligand-gated ion channels—and even discovered a new type of channel. Ion channels play key roles in many physiological

processes, from nerve cells' firing to immune cells' recognizing foreign substances. The newly discovered ion channels combine functions typically found in the immune and nervous systems, suggesting unique neuroimmune interactions may contribute to the American lobster's resistance to disease, Bodnar says.

The researchers were surprised to find that, compared with mammals and fruit flies, the lobster has few genes that activate programmed cell death. In most animals, that process inhibits tumors and gets rid of diseased cells. Because lobsters almost never get tumors, Polinski says, the team expected to find many more genes linked to activating programmed cell death. Instead, the researchers found many more genes known to inhibit it, suggesting lobsters may rely on other strategies to curb tumor growth.

Bodnar says more research could help explain how lobsters remain virtually cancer-free—and how those lessons might one day translate to people. "Humans already have a wonderfully long life span," she says. "The problem with human biology is that we spend a lot of our life span in decline, and especially towards [our] older years, we get … increased incidence of disease and morbidity." She hopes insights from the lobster genome might eventually lead to new medications or a new understanding of the role metabolism plays in longevity.

Meanwhile, Polinski sees a more immediate application for the lobster genome. "Lobsters are very sensitive to the temperature of the water," she says. As waters in the North Atlantic Ocean have warmed, lobsters along the eastern U.S. and Canadian seaboard are moving north, decimating lobster fisheries across southern New England. Knowing more about how lobsters might react to such pressures, Polinski says, could help scientists better understand both how they will migrate in the years ahead and how their population structure may shift as it moves—and it might provide fishery managers with an important tool to predict their own futures.

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How fast does the Earth move?

2021-06-28

Earth is constantly moving. As it zooms around the sun, Earth also spins on its axis, like a basketball on the tip of a player's finger.

Earth turns on its own axis about once every 24 hours (or, to be precise, every 23 hours, 56 minutes and 4 seconds).

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So, how fast is Earth moving? In other words, how fast is it rotating on its axis and how fast is it orbiting the sun? To go even further, how fast is the solar system orbiting the Milky Way galaxy?

Now that your head is spinning just like Earth, let's start with the planet itself. Earth turns on its own axis about once every 24 hours (or, to be precise, every 23 hours, 56 minutes and 4 seconds). Earth measures 24,898 miles (40,070 kilometers) in circumference, so when you divide distance by time, that means the planet is spinning 1,037 mph (1,670 km/h).

PLAY SOUND

Meanwhile, Earth orbits the sun at about 67,000 mph (110,000 km/h), according to Ask an Astronomer, a blog run by astronomers at Cornell University in Ithaca, New York. Scientists know that by taking the distance Earth travels around the sun and dividing it by the length of time Earth takes to complete one orbit (about 365 days).

Ask an Astronomer explains the math: To calculate Earth's distance around the sun, all scientists need to do is to determine the circumference of a circle. We know that the Earth is, on average, about 93 million miles (149.6 million km) away from the sun, and we know that it travels in a generally circular path (it's actually more elliptical, but it's simpler to do this equation with a circle). That distance between the sun and Earth is the radius of the circle. To get the circumference of that circle, the equation is 2*pi*radius, or 2*3.14*93 million miles. Once the circumference (the distance Earth travels around the sun in one orbit) is calculated, its orbital speed can be determined.

The solar system, which includes our sun and all of the objects that orbit it, is also moving; it's located within the Milky Way, which orbits around the galaxy's center. Scientists know that the Milky Way is orbiting a galactic center based on observations of other stars, said Katie Mack, a theoretical astrophysicist at North Carolina State University. If stars very far away seem to be moving, that's because the solar system is moving compared with the relative position of those far away stars.

To bring this concept back down to Earth, "If I start walking, I can tell that I'm moving because the buildings I pass by seem to be moving," from in front to behind me, Mack said. If she looks at something more distant, like a mountain on the horizon, it moves a little slower because it's farther away than the buildings, but it still moves relative to her position.

By studying other stars' movements relative to the sun, scientists have determined that the solar system orbits the Milky Way's galactic center at about 447,000 mph (720,000 km/h).

Then there's the entire Milky Way, which is pulled in different directions by other massive structures, such as other galaxies and galaxy clusters. Just like scientists can tell that the solar system is moving based on the relative movement of other stars, they can use the relative movement of other galaxies to determine how fast the Milky Way is moving through the universe.

Even though everything is moving all the time, living organisms on Earth's surface don't feel it for the same reason passengers on an airplane don't feel themselves zipping through the air at hundreds of miles an hour, Mack said. When the plane lifts off, passengers feel the plane's acceleration as it speeds down the runway and lifts off; that weighted feeling is caused by the plane's quickly changing speed. But once the plane is flying at cruising altitude, passengers won't feel the speed of hundreds of miles per hour because the speed doesn't change.

The passengers won't feel the speed because those passengers are actually moving at the same speed and direction, or velocity, as the airplane. There's no relative motion — everyone sitting on the airplane is moving at the same speed as the airplane itself. The only way passengers might notice their and the plane's movement is by looking out the window at the passing landscape.

For humans standing on the surface of our planet, they don't feel Earth hurtling around the sun because they're also hurtling around the sun at the same speed.

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Why does outer space look black?

2021-06-26

Look up at the night sky with your own eyes, or marvel at images of the universe online, and you'll see the same thing: the inky, abysmal blackness of space, punctuated by bright stars, planets or spacecraft. But why is it black? Why isn't space colorful, like the blue daytime sky on Earth?

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Surprisingly, the answer has little to do with a lack of light.

"You would think that since there are billions of stars in our galaxy, billions of galaxies in the universe and other objects, such as planets, that reflect light, that when we look up at the sky at night, it would be extremely bright," Tenley Hutchinson-Smith, a graduate student of astronomy and astrophysics at the University of California, Santa Cruz (UCSC), told Live Science in an email. "But instead, it's actually really dark." PLAY SOUND

Hutchinson-Smith said this contradiction, known in physics and astronomy circles as Olbers' paradox, can be explained by the theory of space-time expansion — the idea that "because our universe is expanding faster than the speed of light … the light from distant galaxies might be stretching and turning into infrared waves, microwaves and radio waves, which are not detectable by our human eyes." And because they are undetectable, they appear dark (black) to the naked eye.

Miranda Apfel, who is also a graduate student of astronomy and astrophysics at UCSC, agreed with Hutchinson-Smith. "Stars give off light in all colors, even colors not visible to the human eye, like ultraviolet or infrared," she told Live Science. "If we could see microwaves, all of space would glow." Apfel said this is because the cosmic microwave background — light energy from the Big Bang that was scattered by protons and electrons existing during the early universe — still fills all of space.

Another reason interstellar and interplanetary space appear dark is that space is a nearly perfect vacuum. Recall that Earth's sky is blue because molecules that make up the atmosphere, including nitrogen and oxygen, scatter a lot of visible light's component blue and violet wavelengths from the sun in all directions, including toward our eyes. However, in the absence of matter, light travels in a straight line from its source to the receiver. Because space is a near-perfect vacuum — meaning it has exceedingly few particles — there's virtually nothing in the space between stars and planets to scatter light to our eyes. And with no light reaching the eyes, they see black.

That said, a 2021 study in The Astrophysical Journal suggests that space may not be as black as scientists originally thought. Through NASA's New Horizons mission to Pluto and the Kuiper Belt, researchers have been able to see space without light interference from Earth or the sun. The team sifted through images taken by the spacecraft and subtracted all light from known stars, the Milky Way and possible galaxies, as well as any light

Surprisingly, the answer has little to do with a lack of light.

that might have leaked in from camera quirks. The background light of the universe, they found, was still twice as bright as predicted.

The reasons for the additional brightness, which remain unknown, will be the focus of future studies. Until then, one thing seems likely: Space could very well be more "charcoal" than pitch-black.

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CHEMICAL EFFECTS

Safety and efficacy of a feed additive consisting of ferric (III) ammonium hexacyanoferrate (II) for ruminants (domestic and wild), calves prior the start of rumination, lambs prior the start of rumination, kids prior the start of rumination and pigs (domestic and wild) (Honeywell Specialty Chemicals Seelze GmbH)

Exposure and Toxicity Characterization of Chemical Emissions and Chemicals in Products: Global Recommendations and Implementation in USEtox

Endocrine-disrupting chemicals in a typical urbanized bay of Yellow Sea, China: Distribution, risk assessment, and identification of priority pollutants

ENVIRONMENTAL RESEARCH

Exploring the impacts of microplastics and associated chemicals in the terrestrial environment - Exposure of soil invertebrates to tire particles

A comprehensive review on the analytical method, occurrence, transformation and toxicity of a reactive pollutant: BADGE

Perturbation of amino acid metabolism mediates air pollution associated vascular dysfunction in healthy adults

Ecotoxicological effects of new generation pollutants (nanoparticles, amoxicillin and white musk) on freshwater and marine phytoplankton species

OCCUPATIONAL

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The interaction effects of FEN1 rs174538 polymorphism and polycyclic aromatic hydrocarbon exposure on damage in exon 19 and 21 of EGFR gene in coke oven workers

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Evaluation of external contamination on the vial surfaces of some hazardous drugs that commonly used in Chinese hospitals and comparison between environmental contamination generated during robotic compounding by IV: Dispensing robot vs. manual compounding in biological safety cabinet