CHEMWATCH

Bulletin Board

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ASIA PACIFIC

Coming soon! Updates to the AICIS Business Services online portal

2021-02-19

A key priority for us this year is to add more online processes into our business systems and make it easier for introducers to manage their regulatory obligations.

Accordingly, we've added several new features and applications to the AICIS Business Services portal in our IT release slated to go live next week.

From Monday 22 February 2021, you will be able to:

- Download a copy of your submitted pre-introduction report (PIR).

Note: at this stage this feature only applies to PIRs submitted after 22 February 2021 and where there is no chemical data provider.

- Vary a previously submitted PIR, including the ability to cancel if you decide not to proceed with the PIR variation (applies to all PIRs submitted from 1 July 2020).
- Check if the Chemical Abstracts Service (CAS) number you enter into your PIR is in the valid CAS format (applies only to PIRs submitted from 22 February 2021).

Many introducers have been asking for these features — particularly the option to download submitted pre-introduction reports.

We've also added a new application:

- Apply for early inclusion of your certificate terms to the Inventory terms of listing (we refer to this as an 'early variation').
- View and track your early variation application.

Plus, we've added a new 'Evaluations' dashboard to the portal so that businesses can view and reply to our information requests as well as respond to our draft evaluation statements.

Read More

AICIS, 19 February 2021

https://www.industrialchemicals.gov.au/news-and-notices/coming-soon-updates-aicis-business-services-online-portal

Accordingly, we've added several new features and applications to the AICIS Business Services portal in our IT release slated to go live next week.

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Pre-introduction report – highest indicative risk is low risk

2021-02-19

This guide is designed to help you complete the pre-introduction report form in AICIS Business Services for the type called 'highest indicative risk is low risk and the other types do not apply'.

When you shouldn't submit a pre-introduction report

Do not submit if:

- you did not categorise your introduction – use our categorisation guide to work out the introduction category and the next steps you must take
- your introduction is categorised as listed – meaning that your chemical is already on our Inventory and your introduction meets the regulatory obligations specified in the chemical's 'Inventory terms of listing' (if there are any)

When you must submit a pre-introduction report

Submit if one of the following applies:

1. The chemical you plan to introduce is not on the Inventory and you have worked out that your introduction is in the reported category.
2. You're planning to introduce an Inventory-listed chemical outside the parameters of the defined scope of assessment and you have worked out that your introduction is in the reported category.

Record-keeping obligations

Even after you have submitted your pre-introduction report, you are legally required to keep certain records about your introduction. For details see, Record-keeping obligations for reported introductions.

Read More

AICIS, 19 February 2021

https://www.industrialchemicals.gov.au/business/reporting-and-record-keeping-obligations/pre-introduction-reports/pre-introduction-report-highest-indicative-risk-low-risk

This guide is designed to help you complete the pre-introduction report form in AICIS Business Services for the type called 'highest indicative risk is low risk and the other types do not apply'.

New chemical public reports – 19 February 2021

2021-02-19

The public report for each of following new industrial chemicals are published in accordance with s13 of the Industrial Chemicals (Consequential Amendments and Transitional Provisions) Rules 2019.

List of new chemical public reports published

AICIS, 19 February 2021

https://www.industrialchemicals.gov.au/news-and-notices/new-chemical-public-reports-19-february-2021

AMERICA

What's in store for PFAS regulation in 2021?

2021-02-19

Poly or perfluoroalkyl compounds (PFAS) are a class of over 5,000 man-made chemicals that have seen heavy use since the 60s in applications as varied as non-adhesive cookware, water-repellent clothing, and firefighting foam for combating oil blazes. PFAS are almost unreactive and incredibly resistant to extreme heat and other environmental actions. However, the same properties behind their success might make PFAS chemicals a threat to human health. **Strong suggestive evidence** surfaced in recent years associating PFAS with cholesterol problems, birth defects, hormonal deficiencies, and a number of cancers. Due to their high chemical integrity and persistent nature, PFAS are prone to accumulate in water sources and food chains.

As of this date, the Environmental Protection Agency (EPA) classifies poly-perfluoroalkyl compounds as "emerging chemicals of concern". This means that the agency cannot yet legally enforce any of the guidelines set for the handling, manufacture, import, disposal, and environmental removal of PFAS substances from their initial **2009 draft onward**. The action aimed at mitigating the PFAS problem had thus far fallen under the discretion of state or other government actors, most **notably the Department of Defense (DoD)**, who in 2016 agreed to follow the EPAs **health advisory guidelines** in treating water sources on military sites.

The latest evolution of the 2009 draft – recently saw a number of additions that strongly suggest that the agency will be renewing its efforts for imposing formal regulations on PFAS.

The public report for each of following new industrial chemicals are published in accordance with s13 of the Industrial Chemicals (Consequential Amendments and Transitional Provisions) Rules 2019.

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Most saliently, the agency issued "final regulatory determination", which it said will fast track the process of listing two of the most notorious PFAS, namely Perfluorooctanoic acid (PFOA) and Perfluorooctanesulfonic acid (PFOS) as hazardous substances under the Safe Drinking Water Act. This will allow the EPA to issue a "Maximum Contaminant Level" (MCL), which will set the maximum concentration of PFOA and PFOS allowed in drinking water before cleanup becomes mandatory. The current non-binding figure suggested by the EPA is 70 parts per trillion of both chemicals. This is amply disputed by a number of state panels and independent organizations – most notably the Environmental Working Group, **which advices for a** safe level as low as 1 ppt.

The EPA is inviting independent organizations to share data that may better inform future regulatory measures through an "advanced notice of proposed rulemaking" for PFOA and PFOS. The stated object of this is to help the agency decide on whether PFOA and PFOS should be placed under the Comprehensive Environmental Response, Compensation, and Liability Act CERCLA (Superfund) or Resource Conservation and Recovery Act (RCRA). A classification under Superfund will be significant, as this will allow the EPA to enforce clean-up operations on contaminated sites that are no longer in use. The highest concentrations of PFAS are usually found around former military bases, which can act as hotbeds for contaminating the surrounding areas.

Under Unregulated Contaminant Rule 5, a new country-wide sampling operation will be underway beginning 2022. Using more advanced methods than previously employed, this will monitor for no less than 23 PFAS chemicals and their spread in the nation's waterways.

The toxicity assessment for **perfluorobutane sulfonic acid (PFBS)** has also been released with the new document. PFBS is part of a subcategory of PFAS with a short-chain fluorocarbon string. These are widely recognized as less toxic than long-chain PFOA and PFOS but are harder to filter or clean. The EPA's latest assessment bears both these conclusions. The DOD is currently considering PFBS-based firefighting foam as a replacement for the PFOA and PFOS solutions currently in the process of being phased out.

The agency is also redoubling its efforts to collect data on the presence of PFAS in manufacturers' wastewater, if upstream from drinking sources. This is done in anticipation of regulating PFAS manufacturers under the national Effluent Limitation Guidelines.

Read More

Jurist, 19 February 2021

https://www.jurist.org/commentary/2021/02/traven-pyles-pfas-regulation/

Cloth or N95? New standards will take the guesswork out of choosing the most effective face masks

2021-02-18

Americans may soon be able to choose between two clearly labeled levels of face mask protection while browsing store shelves.

The new national mask standard outlines minimum fit, design, performance and testing requirements for face masks and would require user instructions, package labeling and a permanent tag on the product.

ASTM International — an international standards organization — spent seven months conducting expedited testing and review and published its guidance on Tuesday. Experts and industry leaders say the new "Standard Specification for Barrier Face Coverings" has the potential to transform the quality of masks available for personal protection in the American marketplace.

"The new specification for barrier face coverings addresses a key gap and will support consumer confidence when purchasing a face covering that's labeled as meeting the ASTM standard," ASTM International told CNN in an email.

ASTM International has already created standards for a number of consumer products, including art supplies like crayons, playgrounds, sports equipment and baby cribs.

Until this point, there were no standards even though masks are highly recommended by US health officials to help prevent the spread of the coronavirus.

These standards are a joint effort between ASTM International, the National Personal Protective Technology Laboratory (NPPTL), academics, industry stakeholders, government agencies and independent participants.

Until this point, there were no standards even though masks are highly recommended by US health officials to help prevent the spread of the coronavirus.

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To meet ASTM standards, manufacturers are required to test their facial coverings in accredited labs to certify performance, register their products and use the outlined ASTM labeling system on their products.

If a mask has ASTM labeling, it means that it meets testing and quality requirements outlined by ASTM. The standard has been created to evaluate only consumer masks. These new standards do not apply to medical masks and respirators used in healthcare settings.

Read More

The Mercury News, 18 February 2021

https://www.mercurynews.com/2021/02/18/cloth-or-n95-new-standards-will-take-the-guesswork-out-of-choosing-the-most-effective-face-masks/

Minnesota calls for stronger state regulation of PFAS chemicals

2021-02-17

Minnesota's Statewide PFAS Strategy

Last week, Minnesota state officials announced a statewide strategy to address PFAS chemicals present within the state. PFAS are a class of man-made compounds that do not easily break down and can accumulate over time in the environment. They are used to create fluoropolymer coatings which make products resistant to heat, oil, stains, grease and water.

In its ten-point plan, Minnesota aims to designate the entire class, estimated to include over 5,000 different chemicals, a "hazardous substance" under Minnesota state law. The new law will make it easier for the state to hold companies liable for cleanup of PFAS contamination.

In addition to hazardous substance designation, the plan will require companies to disclose information on the use of PFAS chemicals when monitoring shows the presence of the chemicals in the environment. Currently in Minnesota, there are no labeling requirements for PFAS use in commercial products and the uses of many PFAS chemicals are considered proprietary information. The state seeks to close the gap on which industries and products use PFAS and for what purpose.

The strategy also includes $3 million in funding over the next two years to research PFAS contamination and solutions. It allocates $700,000 to identify sources of PFAS in the environment; $500,000 to evaluate PFAS going to landfills, compost sites and wastewater treatment plants;

The new law will make it easier for the state to hold companies liable for cleanup of PFAS contamination.

$400,000 to sample fish and water for PFAS to prevent consumption of fish with elevated PFAS levels; and $1.4 million to study the impacts of PFAS in wastewater biosolids, compost contact water and landfill leachate as well as evaluate potential drinking water treatment options.

Currently, fewer than one percent of PFAS chemicals have been tested for toxicity. Minnesota Pollution Control Agency Commissioner Laura Bishop says more research is needed to understand the effects of PFAS on human health and the environment. PFAS are often called "forever chemicals" because they do not break down and tend to accumulate in the environment, humans and other animals.

What is included?

There are currently a handful of PFAS measures in the state legislature, including a proposal to ban PFAS in food packaging. However, the diverse class of chemicals are used in a wide range of products including pacemakers, solar panels, fabric stain protectors, MRI machines, cookware, waterproof clothing, firefighting foam, cars and cosmetics. Because of the broad use of PFAS chemicals and the number of different chemicals within the class, the proposal has drawn opposition from manufacturers and businesses who claim that the designation is overly broad.

Minnesota's new plan follows a long line of increased scrutiny of PFAS within the state. Regulators have been investigating PFAS for the past two decades. In 2018, the state settled a lawsuit against 3M after the company agreed to pay $850 million for PFOA and PFOS found in drinking water in the Twin Cities metro in the early 2000s. 3M will invest about $1 billion over the next 20 years in its environmental goals, including improving water quality and working toward carbon neutrality. PFOA and PFOS chemicals are no longer produced in the United States, but many other PFAS chemicals are and the Minnesota plan includes the entire class of chemicals.

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JD Supra, 17 February 2021

https://www.jdsupra.com/legalnews/minnesota-calls-for-stronger-state-9240728/

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EUROPE

Global game-changer? EU chemicals strategy could create watershed moment if 'properly implemented'

2021-02-18

The European Commission's Chemicals Strategy for Sustainability has the potential to set an example to the world if concrete actions and legislative proposals build it out into something meaningful over the coming years, says the Center for International Environmental Law (CIEL).

In October 2020, the European Commission (EC) adopted its *Chemicals Strategy for Sustainability* to further strengthen protection of human and environmental health. **The strategy**, part of the EC's wider **European Green Deal**, proposed a phase out of the most harmful substances and a simplification of the risk assessment process around chemicals, among many other things.

The Commission said the overarching goal was to boost innovation for *"safe and sustainable chemicals"* – a broad goal supported by trade associations Cosmetics Europe and the UK's Cosmetic, Toiletry and Perfumery Association (CTPA), though both agreed details needed fleshing out.

Read More

Cosmetics Design Europe, 18 February 2021

https://www.cosmeticsdesign-europe.com/Article/2021/02/18/EU-Chemicals-Strategy-for-Sustainability-could-be-game-changer-globally-says-Center-for-International-Environmental-Law

The European Commission's Chemicals Strategy for Sustainability has the potential to set an example to the world if concrete actions and legislative proposals build it out into something meaningful over the coming years, says the Center for International Environmental Law (CIEL).

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Nature protection: Commission is calling on POLAND to implement the Court of Justice ruling on nature protecting on the Bialowieża Forest

2021-02-18

The Commission is following up with Poland to implement the judgment of the Court of Justice of the EU regarding the country's failure to fulfil its obligations under the Directives on Habitats (Directive 92/43/EEC) and Birds (Directive 2009/147/EC) as regards the protection of the Białowieża Forest. The Directives include various obligations for Member States including taking measures to prevent the deterioration of habitats and disturbance of species, verifying whether a project is likely to have

a significant impact on a Natura 2000 site before authorisation, and establishing a system of strict protection for a number of species. The European Green Deal and the European Biodiversity Strategy also both indicate that it is crucial for the EU to halt biodiversity loss by protecting and restoring biodiversity.

In its judgment of 17 April 2018 the Court ruled against Poland for failing to ensure that the forest management plan for the Białowieża Forest District would not adversely affect the integrity of the Natura 2000 sites. Poland had also failed to establish the necessary conservation measures for the protected species and habitats, and to guarantee the strict protection of protected species and of birds regarding their deliberate killing or disturbance, or the deterioration or destruction of their breeding sites or nests in the Białowieża Forest District.

Poland has still not fully complied with the ruling. Most importantly, Poland has not repealed and replaced the annex to the forest management plan for the Białowieża Forest District, introduced in 2016, with measures which would preserve the integrity of the site, ensure conservation and protect the species and habitats. Actions envisaged by Poland are not in line with the Directives nor with the Court ruling. Despite meetings and exchanges at technical level, at which the Commission has expressed its concerns and offered advice on the correct implementation of the judgment, the situation in Poland has not changed.

The Commission is therefore asking Poland today by letter of formal notice to take all required measures to remedy the situation. Poland has two months to reply to the concerns raised by the Commission. Otherwise, the Commission may refer the case back to the Court of Justice of the EU with proposed financial sanctions.

Read More

European Commission, 18 February 2021

https://ec.europa.eu/commission/presscorner/detail/en/inf_21_441

Air quality: The commission calls on ROMANIA to improve its rules on industrial emissions

2021-02-18

The Commission is asking Romania to bring its national legislation into line with the EU Directive on industrial emissions (IED) (Directive 2010/75). Industrial activities have a significant impact on the environment. The

Industrial activities have a significant impact on the environment.

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Directive on industrial emissions aims to prevent and reduce harmful industrial emissions across the EU while promoting the use of techniques that reduce pollutant emissions and that are energy and resource efficient. The European Green Deal, with its Zero Pollution ambition, puts emphasis on cutting air pollution, which is among the key factors negatively affecting human health. Full implementation of the air quality standards enshrined in EU legislation is key to effectively protect human health and safeguard the natural environment.

The Romanian legal system fails to guarantee the implementation of the key objectives of the directive, in particular that installations must only be allowed to operate if they have permits. On the one hand, the Romanian legal system, in its current state, introduces very low and inadequate penalties, which fail to ensure effectiveness, proportionality and dissuasiveness as required by the Directive. On the other hand, the Romanian authorities fail to implement the existing legislation in a coherent manner on an administrative level (e.g. suspend the operation of installations without permits), while the Romanian judiciary fails to enforce the sanctions, nullifying any effectiveness and dissuasiveness.

Therefore, the Commission is sending a letter of formal notice to Romania, which now has two months to address the shortcomings raised by the Commission. Otherwise, the Commission may decide to send a reasoned opinion.

Read More

European Commission, 18 February 2021

https://ec.europa.eu/commission/presscorner/detail/en/inf_21_441

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INTERNATIONAL

CFP 2020 Report: Front-runners in chemical footprinting

2021-02-11

5th Annual Chemical Footprint Project Report features best practices in proactive chemicals management by Beautycounter, Herman Miller, HP Inc., Humanscale, Naturepedic, RB (Reckitt Benckiser), & Seventh Generation

Somerville, MA – Today Clean Production Action Released the ***5th Annual Chemical Footprint Project (CFP) Report*** analyzing the results of the

CFP 2020 Survey. The Survey evaluates and benchmarks participating companies on their progress to best practices in proactive chemicals management. The 33 companies participating in the 2020 Survey came from seven industry sectors and ranged in size from small privately owned companies to large publicly traded multinational corporations. For the first time in five years of the CFP Survey, seven companies scored over 80 percent of possible points. These Front-runners were far more likely than other participants in the Survey to:

Have senior management leadership and Board level engagement in chemicals management—support at the highest levels is critical to sustained attention to and progress in reducing chemical footprints in the face of competing corporate demands.

Publicly disclose their Restricted Substances List (RSL), manufacturing RSL (MRSL), and CFP 2020 Survey responses and score.

Measure their chemical footprint using the CFP Chemicals of High Concern (CoHC) reference list of over 2200 chemicals—100% of the Front-runners calculated their footprint by mass and many had no chemicals of high concern in their reported products.

Invest in safer alternatives to CoHCs—Front-runners explicitly included preferences for safer alternatives in their corporate policies and business strategy, and rewarded suppliers for using safer alternatives. These measures are essential to preventing the use of regrettable substitutes.

Investors, retailers, and non-governmental organizations (NGOs) want to know where companies are on their chemicals management journey. CFP Signatories include investors with over $2 trillion in assets under management, and retailers and health care organizations with over $800 billion in purchasing power. First Affirmative Financial Network (FAFN)—a pioneer in sustainable, responsible, and impact investing—"is a long time signatory to the Chemical Footprint Project because it provides investors with the necessary framework for companies and their investors to measure, manage, and reduce these chemical risks while enhancing quality of life for people and planet" emphasized Holly Testa, Director, Shareowner Engagement at FAFN.

Read More

BizNGO, 11 February 2021

https://www.bizngo.org/resources/entry/cfp-2020-report-front-runners-in-chemical-footprinting

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ECHA finds health benefits outweigh costs of REACH restrictions

2021-02-17

On February 16, 2021, the *European Chemicals Agency (ECHA)* published a study analyzing the economic and public health impacts of REACH chemical restrictions proposed between 2016 and 2020.

As of the time of publishing, *ECHA* has processed 36 restriction proposals, of which twelve restrictions involved an estimate of the benefits and costs. The report found the proposed restrictions under REACH achieve annual health benefits worth €2.1 billion, which is four times higher than the estimated associated costs of approximately €0.5 billion. The analysis finds the restrictions are protecting over seven million EU citizens from the risk of "serious illness such as cancers, sexual development disorders, asthma, and skin allergies" as well as preventing the annual release of 100 000 tons of polluting chemicals.

Among the restricted chemicals under REACH are the four phthalates bis(2-Ethylhexyl) phthalate (DEHP; CAS 117-81-7), dibutyl phthalate (DBP; CAS 84-74-2), benzyl butyl phthalate (BBP; CAS 85-68-7), and diisobutyl phthalate (DIBP; CAS 84-69-5), which have been categorized as toxicants for reproduction with endocrine-disrupting properties (FPF dossier). Exposure to these phthalates occurs, for example, through the ingestion of food that has been in contact with plastics that contain these additives. According to the *ECHA* study, the benefits of restricting DEHP, DBP, BBP, and DIBP are estimated to outweigh the associated costs of finding substitute and alternative technologies by more than 10 times (€235 million versus €17.6 million per year) in addition to other significant but non-quantifiable benefits.

Read More

Food Packaging Forum, 17 February 2021

https://www.foodpackagingforum.org/news/echa-finds-health-benefits-outweigh-costs-of-reach-restrictions

The report found the proposed restrictions under REACH achieve annual health benefits worth €2.1 billion, which is four times higher than the estimated associated costs of approximately €0.5 billion.

Restricting hazardous chemicals protects millions of Europeans from serious diseases

2021-02-19

ECHA/NR/21/09

REACH Update

FEB. 26, 2021

EU-wide restrictions protect the health of citizens by reducing risks of serious illness such as cancers, sexual development disorders, asthma and skin allergies. They also prevent 100 000 tonnes of chemicals from polluting the environment every year.

Helsinki, 16 February 2021 – Restricting the manufacture and use of chemicals that pose a risk in the EU results in health benefits worth around €2.1 billion each year over the next decades. This is what ECHA estimates in its new study on the *Costs and benefits of REACH restrictions*. The health benefits include, for example, reduced risk of cancers, sexual development disorders, occupational asthma and allergic skin or respiratory diseases. As the associated costs to society add up to €0.5 billion per year, the health benefits are four times greater than the costs.

Once all restrictions included in the study take effect, at least seven million EU citizens will be less exposed to harmful chemicals at work or in their everyday life. For example, there are five million people already sensitised to harmful chemicals in finished textile and leather articles. Limiting the use of skin sensitising chemicals in these articles will prevent allergic reactions for many of them and additionally protect up to 180 000 people each year from becoming sensitised in the first place. This is expected to result in health benefits of at least €708 million a year.

Restrictions are also estimated to prevent more than 95 000 tonnes of hazardous substances from being released into the environment every year. For example, the proposed restriction on intentionally added microplastics would prevent 500 000 tonnes of microplastic from being released to the environment over the next 20 years. Reduced emissions bring multiple benefits to all EU citizens, such as a cleaner environment and reduced chemical exposure through drinking water, food and air.

The estimated costs of the restrictions related to environmental risks amount to €1.2 billion a year. Most of these costs would be incurred as companies need to replace their restricted chemicals with safer ones or alternative technologies.

Peter van der Zandt, Director for Risk Management concludes: "*REACH restrictions are a powerful and effective way to control the risks of chemicals at EU level and drive substitution. This study shows that societal benefits of restrictions are considerably higher than the associated costs. Together with classification and labelling and REACH authorisation, restrictions form the backbone of regulating harmful chemicals in the EU – protecting our citizens and the environment.*"

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REACH Update
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Background

Restrictions under the regulation on Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH) protect human health and the environment from unacceptable risks posed by hazardous chemicals. They can limit the manufacturing and use of chemicals or ban their placement on the EU market. They can also be used to control imports of hazardous chemicals.

The study published today presents ECHA's analysis on the impacts of REACH restrictions proposed in 2016-2020. It also aggregates the overall impact of restrictions by including the findings of the first costs and benefits of restrictions report published in 2016.

In January, a similar report on the *Socio-economic impacts of REACH authorisations* was published.

Read More

ECHA, 19 February 2021

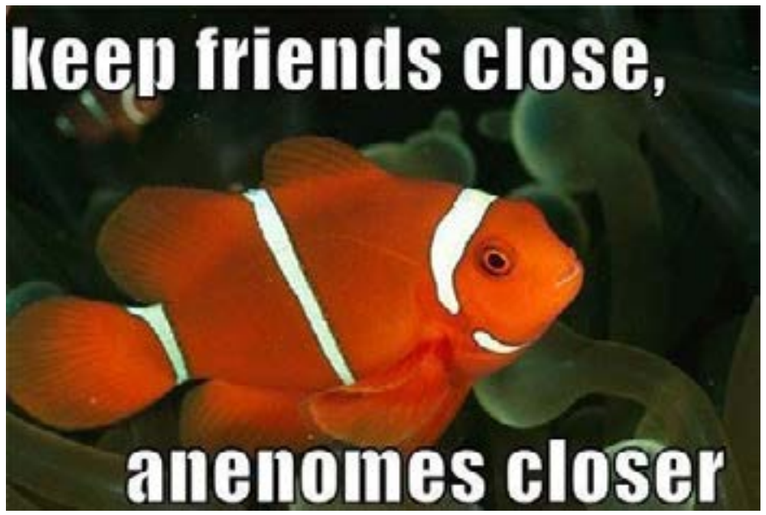
https://echa.europa.eu/-/restricting-hazardous-chemicals-protects-millions-of-europeans-from-serious-diseases

Janet's Corner

FEB. 26, 2021

Keep Your Enemies Closer

2021-02-26



https://www.coolpun.com/topic/marine+biology#&gid=1&pid=26

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Hazard Alert

FEB. 26, 2021

Aluminium

2021-02-26

Aluminium (or aluminum) is a chemical element in the boron group with symbol Al and atomic number 13. It is silvery white, and it is not soluble in water under normal circumstances. Aluminium is the third most abundant element (after oxygen and silicon), and the most abundant metal, in the Earth's crust. It makes up about 8% by weight of the Earth's solid surface. Aluminium metal is so chemically reactive that native specimens are rare and limited to extreme reducing environments. Instead, it is found combined in over 270 different minerals. The chief ore of aluminium is bauxite. Aluminium is remarkable for the metal's low density and for its ability to resist corrosion due to the phenomenon of passivation. [1]

USES [2]

Aluminium is used in many industries to make millions of different products and is very important to the world economy. Structural components made from aluminium are vital to the aerospace industry and very important in other areas of transportation and building in which lightweight, durability, and strength are required. The use of aluminium exceeds that of any other metal except iron. Pure aluminium easily forms alloys with many elements such as copper, zinc, magnesium, manganese and silicon. All modern mirrors are made using a thin reflective coating of aluminium on the back surface of a sheet of float glass. In addition, telescope mirrors are coated with a thin layer of aluminium. Other applications are electrical transmission lines, and packaging (cans, foil, etc.). Because of its high conductivity and relatively low price compared to copper, aluminium was introduced for household electrical wiring to a large degree in the United States in the 1960s. Unfortunately problems on the functioning were caused by its greater coefficient of thermal expansion and its tendency to creep under steady sustained pressure, both eventually causing loosening the connection; galvanic corrosion increasing the electrical resistance. The most recent development in aluminium technology is the production of aluminium foam by adding to the molten metal a compound (a metal hybrid), which releases hydrogen gas. The molten aluminium has to he thickened before this is done and this is achieved by adding aluminium oxide or silicon carbide fibres. The result is a solid foam that is used in traffic tunnels and in space shuttle.

Aluminium (or aluminum) is a chemical element in the boron group with symbol Al and atomic number 13.

IN THE ENVIRONMENT [3]

Aluminium cannot be destroyed in the environment; it can only change its form. In the air, it binds to small particles, which can stay suspended for many days. Under most conditions, a small amount of aluminium will dissolve in lakes, streams, and rivers. Some plants can take it up from soil. Aluminium is not accumulated to a significant extent in most plants or animals.

SOURCES OF EMISSION & ROUTES OF EXPOSURE

Sources of Emission [3,4]

General Populations

- Virtually all food, water, air, and soil contain some aluminium.
- The average adult in the United States eats about 7-9 mg aluminium per day in their food.
- Living in areas where the air is dusty, where aluminium is mined or processed into aluminium metal, near certain hazardous waste sites, or where aluminium is naturally high.
- Eating substances containing high levels of aluminium (such as antacids) especially when eating or drinking citrus products at the same time.
- Children and adults may be exposed to small amounts of aluminium from vaccinations.
- Very little enters your body from aluminium cooking utensils
- The intake of aluminium from food and water is low, especially compared with that consumed by people taking aluminium-containing medicinals.
- Inhalation exposure and dermal contact may also contribute a small amount to an individual's daily aluminium exposure.

Routes of Exposure [4]

Inhalation – generally limited to occupational exposure.

Oral – primary route of exposure for the general population. Aluminium is found in food, drinking water, and medicinal products such as antacids and buffered aspirin.

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Dermal (skin) contact – minor route of exposure; aluminium is found in some topically applied consumer products such as antiperspirants, first aid antibiotics, and sunscreen and suntan products.

HEALTH EFFECTS [3,4]

Exposure to aluminium is usually not harmful, but exposure to high levels can affect your health. The most sensitive target of aluminium toxicity is the nervous system.

Impaired performance on neurobehavioral tests of motor function, sensory function, and cognitive function have been observed in animals. Neurobehavioral alterations have been observed following exposure of adult or weanling animals and in animals exposed during gestation and/or lactation.

Workers who breathe large amounts of aluminium dusts can have lung problems, such as coughing or abnormal chest X-rays. Some workers who breathe aluminium dusts or aluminium fumes have decreased performance in some tests that measure functions of the nervous system. Some people with kidney disease store a lot of aluminium in their bodies and sometimes develop bone or brain diseases, which may be caused by the excess aluminium. Some studies show that people exposed to high levels of aluminium may develop Alzheimer's disease, but other studies have not found this to be true. It is unclear whether aluminium causes Alzheimer's disease.

There is some indication that skeletal effects (e.g., osteomalacia) can result from long-term use in some individuals. Studies in animals show that the nervous system is a sensitive target of aluminium toxicity. Obvious signs of damage were not seen in animals after high oral doses of aluminium. However, the animals did not perform as well in tests that measured the strength of their grip or how much they moved around. It is unknown whether aluminium affects reproduction in people. Aluminium does not appear to affect fertility in animals.

SAFETY

First Aid Measures

Eye Contact:

- Check for and remove any contact lenses. In case of contact, immediately flush eyes with plenty of water for at least 15 minutes. Get medical attention if irritation occurs.

Skin Contact:

- Wash with soap and water. Cover the irritated skin with an emollient. Get medical attention if irritation develops.

Inhalation:

- If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical attention immediately.

Ingestion:

- Do NOT induce vomiting unless directed to do so by medical personnel. Never give anything by mouth to an unconscious person. If large quantities of this material are swallowed, call a physician immediately. Loosen tight clothing such as a collar, tie, belt or waistband.

Exposure Controls & Personal Protection

Engineering Controls

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

Personal Protection

the following personal protective equipment is recommended when handling aluminium:

- Safety glasses
- Lab coat
- Gloves

Personal Protection in Case of a Large Spill:

- Safety glasses
- Lab coat
- Gloves

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REGULATION [6,7]

United States

OSHA: The current Occupational Safety and Health Administration (OSHA) permissible exposure limit (PEL) for aluminium is 15 milligrams per cubic metre (mg/m^3) of air for total dust, and 5 mg/m^3 for the respirable fraction, as an 8-hour time-weighted average (TWA) concentration [29 CFR 1910.1000, Table Z-1].

NIOSH: The National Institute for Occupational Safety and Health (NIOSH) has established a recommended exposure limit (REL) for aluminium of 10 mg/m^3 for total dust, and 5 mg/m^3 for the respirable fraction, as a TWA for up to a 10-hour workday and a 40-hour workweek [NIOSH 1992].

ACGIH: The American Conference of Governmental Industrial Hygienists (ACGIH) has assigned aluminium a threshold limit value (TLV) of 10 mg/m^3 for metal dust, as a TWA for a normal 8-hour workday and a 40-hour workweek [ACGIH 1994, p. 12].

Australia

Safe Work Australia: Safe Work Australia has established a 8 hours time weighted average concentration for aluminium (metal dust)of 10 mg/m^3 and aluminium (welding fumes) of 5 mg/m^3.

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Hopes evaporate for the superheavy element flerovium having a long life

2021-02-12

For decades, nuclear physicists have blasted record-breaking superheavy elements into existence, extending the periodic table step by step beyond uranium, the heaviest natural element. Such heavyweights tend to be unstable, but theory predicts "magic numbers" of protons and neutrons that confer extra stability, and finding a long-lived superheavy has long been a holy grail for researchers.

Element 114, known as flerovium and first created in 1998, was considered the best candidate for extra stability, as theorists believed 114 was a magic number of protons. But researchers now report that it is no more stable than the superheavy elements near it on the periodic table. Element "114 is apparently not magic, or at least not as magic as classical predictions suggest," says study leader Dirk Rudolph of Lund University.

The result focuses attention on the next candidate for a magic number of protons: element 120. Never before synthesized, element 120 is a goal of the Superheavy Element Factory (SHEF), a new facility in Russia that began its first experiments in November 2020. Researchers there have already made 60 atoms of moscovium, element 115, by firing ion beams at a thin layer of target material. But the chase for 120 is on hold until researchers obtain the amount of californium—a rare element produced in high-flux nuclear reactors—needed for 120's target. "A limited amount of target material poses technical problems that we need to solve in the near future," says Yuri Oganessian of Russia's Joint Institute for Nuclear Research (JINR), home of the SHEF. Oganessian is the namesake for oganesson, element 118, discovered in 2004 by his team at JINR and currently the heaviest ever made.

To explain why some nuclei are more stable than others, theorists believe protons and neutrons reside in "shells," similar to the orbital shells of electrons that surround the nucleus and define each element's chemistry. Just as a full electron shell makes a chemically inert noble gas, a full shell of protons or neutrons offers extra stability and longer lifetimes. Nuclei with full shells of both protons and neutrons, such as helium-4 (atomic number 2), oxygen-16 (atomic number 8), and lead-208 (atomic number 82)—known as "doubly magic" nuclei—are among the most stable isotopes in nature.

Element "114 is apparently not magic, or at least not as magic as classical predictions suggest."

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But the theory can only approximate what the magic numbers are for superheavy elements. In 1998, when Oganessian's team at JINR produced a solitary nucleus of element 114 for the first time, things looked promising for a magic shell of 114 protons: The atom appeared to survive for more than 30 seconds—an eternity for a superheavy element. But that long life was never replicated, and most of the half-dozen other confirmed isotopes of flerovium do not survive longer than 1 second.

So, last year, a team led by Rudolph and Christoph Düllmann of the University of Mainz took another look at the stability of flerovium with upgraded detectors at the GSI Helmholtz Centre for Heavy Ion Research in Germany. They fired a beam of calcium-48 ions at metal foils coated with plutonium-242 and plutonium-244. Most of the ions passed through the target, but over the course of a few weeks, a few collided with a plutonium nucleus and fused into flerovium.

After being ejected from the foil, the fresh flerovium nuclei were separated from beam ions and other debris by a magnetic field that deflects ions according to their mass. The nuclei embedded in a particle detector, which timed and measured decay products to reveal the identity of the superheavy nucleus—and how long it lived.

The researchers created two atoms of flerovium-286 and 11 of flerovium-288, the team reported last month in Physical Review Letters. They identified decay paths of the nuclei, including one never seen before, that wouldn't be present in a stable nucleus with a full shell. These decay routes are so efficient, Rudolph says, that they concluded 114 is "not an outspoken magic number."

Oganessian is not surprised. He says theorists believe the extra stability conferred by a full proton shell is "much weaker and blurred," whereas a full neutron shell would have a much greater effect on stability. Frustratingly, the next full neutron shell, at 184, is currently out of reach: Researchers have never produced a nucleus with more than 177 neutrons.

But that doesn't mean the search for magic stability is over. The GSI team's improved data on element 114 will help theorists refine their models by providing "anchor points for theory," Rudolph says. Newer versions of the nuclear shell model invoke shells shaped like rugby balls and other shapes instead of spheres and suggest the full proton shell actually lies at 120 or 126, not 114.

Getting there is a matter of the right beam and target materials plus beam intensity and long run times. "Brute force," as Düllman calls it. He says

elements 119 and 120 lie beyond the grasp of the current GSI facility, but they should be within reach of the RIKEN particle physics lab in Japan as well as SHEF. "I'm pretty convinced they will get us 119 and 120."

sciencemag.org, 12 February 2021

https://www.sciencemag.org

England's Stonehenge was erected in Wales first

2021-02-11

Around 3200 B.C.E., Stone Age farmers in Wales's Preseli Hills built a great monument: They carved columns of unspotted dolerite, or bluestone, from a nearby quarry, then thrust them upright in a great circle aligned with the Sun. Exactly what the circle meant to them remains a mystery. But new research reveals that several centuries later, their descendants took down many of the giant stones and hauled them 200 kilometers to the Salisbury Plain, where they created what is still the world's most iconic prehistoric stone monument: Stonehenge.

The paper's authors "make a very good argument Stonehenge is a dismantled stone circle from Wales," says Alison Sheridan, a curator emerita at the National Museum of Scotland who was not part of the research team. "They dealt with very tricky data but came up with a brilliant hypothesis."

Researchers had already traced Stonehenge's slabs of bluestone to the west coast of Wales; they'd even identified some of the quarries where the stones were extracted more than 5000 years ago.

But radiocarbon dating showed a puzzling gap of several centuries between activity at the bluestone quarries and the earliest construction at Stonehenge. Researchers wondered whether the distinctive, 2- to 3-meter-tall bluestones had been used to build other stone circles first, then moved to Stonehenge later. "They're clearly not spending 200 years slowly moving them across the landscape," says University of Southampton archaeologist Joshua Pollard, one of the co-authors. "It always seemed likely they were dismantling existing monuments."

Over the past decade, researchers led by University College London archaeologist Michael Parker Pearson searched for ritual structures in the Preseli region that might have provided the stones—and the blueprint—for Stonehenge. In 2017 and 2018, they excavated parts of an ancient monument called Waun Mawn, where a handful of toppled bluestones similar to those at Stonehenge form a partial circle.

"It always seemed likely they were dismantling existing monuments."

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The excavations revealed distinctive socket-shaped pits where other stones had once stood. Connecting the dots between the empty sockets and toppled bluestones at Waun Mawn, researchers sketched out a circle 110 meters across—the same dimensions as the outer earthen ditch that was part of Stonehenge's original layout. (The ritual center was rearranged multiple times over its 1000 year life span.) And, like at Stonehenge, the circle's entrance was oriented toward sunrise on the midsummer solstice.

Parker Pearson's team then measured the last time sediments inside the socket holes at Waun Mawn had been exposed to light, using optically stimulated luminescence; they also radiocarbon dated charcoal found inside the pits. They estimate the missing stones were erected between 3400 and 3200 B.C.E. and then removed 300 or 400 years later, around the time the first construction at Stonehenge began, they report today in Antiquity. "We're quite confident the reason they come down is they've gone to Stonehenge," says Parker Pearson.

Researchers say the dismantling of Waun Mawn and the rise of Stonehenge could have been part of a larger migration from the Preseli Hills to the Salisbury Plain. Human and animal remains found at Stonehenge have chemical signatures suggesting their early years were spent on the Welsh coast. "We've got regular contact between the two regions," Pollard says.

The results add to an emerging picture of Stonehenge's origins in a complex, interconnected region centered on the Irish Sea that flourished in the fourth millennium B.C.E., Sheridan says. "People and ideas and objects were moving over long distances, and the movement clearly had to do with the way society expressed power," Sheridan says. "Uprooting stones is a classic example."

Back in the Preseli Hills region, radiocarbon dates and pollen evidence suggest that millennia of farming and human occupation ended around the time the Waun Mawn circle was dismantled. "Evidence for human activity drops around 3400 B.C.E.," Parker Pearson says, though researchers aren't sure why the people left.

The researchers say the migrants from Wales might have relocated the stones as a way to stay symbolically connected to their past—or to draw on their ancestors' authority to claim a new region. "They're bringing ancestral symbols as an act of unification," Parker Pearson says.

*Correction, 12 February, 10:20 a.m.: This story has been updated to accurately reflect the date of stone monuments in the region centered around the Irish Sea.

sciencemag.org, 11 February 2021

https://www.sciencemag.org

In the social distancing era, boredom may pose a public health threat

2021-02-15

In recent months, journalists and public health experts have bandied about the term "pandemic fatigue." Though not clearly defined, the general gist is that people have grown tired of the pandemic and keeping apart for almost a year and running. That fatigue can manifest as feelings of anxiety, hopelessness, frustration, anger and boredom.

Seeing boredom on that list worries those who study the phenomenon. "Usually boredom tells you that you should do something else," says sports psychologist Wanja Wolff of the University of Konstanz in Germany. "In the context of a pandemic … that might not be the best thing."

Recently, those fears have received more traction. Two similar yet independent studies, one by Wolff and colleagues and another by a U.S.-Canadian research team, found that people who frequently feel bored are more likely than others to flout social distancing guidelines. Those boredom-prone individuals also appear to be at higher risk of contracting the coronavirus.

Boredom, these studies suggest, may well constitute a real, yet underappreciated, public health threat.

Defining boredom

Across the Western humanities, boredom has typically been depicted as an individual failing. The 19th century German pessimist Arthur Schopenhauer defined boredom as the sensation of the emptiness of existence. French philosopher Jean-Paul Sartre called it a "leprosy of the soul."

But researchers studying boredom say it merits a more neutral reading. That feeling of having nothing to do — what Russian author Leo Tolstoy called "the desire for desires" — serves as a signal, a call to the body to shift gears, goes the current thinking.

Those boredom-prone individuals also appear to be at higher risk of contracting the coronavirus.

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"Boredom is a sign that you're not meaningfully engaged in the world," says social psychologist Erin Westgate of the University of Florida in Gainesville. Researchers, including Westgate, have identified two paths to boredom: a loss of focus or a loss of meaning.

Certainly, many of us have lost the focus, or mental acuity, of the Before Times, Westgate says. In addition to a deadly pandemic that has brought city shutdowns and remote schooling, there have been civil rights protests, political unrest, a crippling recession and myriad other stressors both big and small. Those disturbances, which hobble our ability to stay mentally sharp, can lead to dullness. When boredom is defined this way, the busyness of, say, parents of young children provides little protection against feeling blah. In fact, Westgate and others have found that both understimulation and overstimulation can short-circuit one's ability to pay attention.

Meanwhile, many of our lives have come unraveled. Research by personality and social psychologist Samantha Heintzelman of Rutgers University-Newark in New Jersey shows that simple routines, like getting coffee from the same café every day or a standing lunch date with a friend, actually imbue life with meaning. "We're in a collective loss of routine right now," Heintzelman says. That is to say, the social distancing guidelines aimed at protecting us from a deadly disease have also stolen the seemingly little things that give life meaning (SN: 8/14/20).

When people lose both focus and meaning in their lives, this form of boredom is "doubly bad," Westgate says. "You can be bored because something is meaningful, but you can't pay attention because it's too easy or too hard. You can also be bored because you can pay attention, but it's meaningless," she says. "But if something is meaningless and you can't pay attention, you're like double bored."

Prone to the blahs

Those two new boredom studies — each including almost 1,000 North American participants — show how elevated boredom levels among those prone to the feeling may be playing out during this pandemic.

In the study by the U.S.-Canadian team, researchers sought to quantify the link between a person's innate propensity for boredom and rule-breaking behaviors during the pandemic, such as spending fewer hours apart from others or holding a social gathering. Boredom proneness across the sample explained 25 percent of the variance in rule-breaking behaviors, the team reports in the March Personality and Individual Differences. The

researchers did not find a strong relationship between rule-breaking and other factors that might influence it, such as age or gender. (Young adults and men tend to score higher on boredom than other groups.)

Social distancing struggles

In a recent study, individuals who scored high on a five-point scale of proneness to boredom and relatively low on a five-point scale of self-control typically found it more difficult to adhere to social distancing guidelines (larger circles) than others.

No single factor can explain 100 percent of any human behavior, says study coauthor and cognitive neuroscientist James Danckert of the University of Waterloo in Canada. But "25 percent is a huge amount."

Wolff and colleagues, whose findings appeared online July 28 in the International Journal of Environmental Research and Public Health, meanwhile found that boredom-prone people ranked social distancing as more difficult than others did, and were less likely to adhere to social distancing guidelines. Both teams showed that those who scored higher in boredom were also slightly more likely than those scoring lower to report having gotten COVID-19.

"Boredom is an incredibly powerful motivator for behavior," Wolff says. Yet, he adds, people can struggle with how to respond to that signal in safe and meaningful ways.

The danger of the doldrums

Westgate is not surprised that people who are especially prone to boredom, yet able to socially distance, find staying home mind-numbingly dull. She does wonder, though, about the rest of us: How are people who aren't used to being bored contending with the loss of focus and meaning brought on by the pandemic? Are they also breaking the rules?

The research here is less direct but suggestive. In a 2014 study in Science, Westgate and colleagues asked 42 undergraduate students to sit alone with their thoughts for several minutes, no cell phones allowed. The students, though, had the option to push a button to receive a painful electric shock. About two-thirds of the male and a quarter of the female students pushed that button, some repeatedly, suggesting that even pain can be preferable to boredom for some (SN: 7/3/14).

Similarly, a 2019 study in Behavioral Decision Making by social psychologist Wijnand Van Tilburg and colleagues showed that inducing

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boredom in people through a repetitive gambling game prompted them to make riskier decisions.

Momentary boredom is not inherently bad, says Van Tilburg, of the University of Essex in England. But over a longer period, boredom can lead to serious public health outcomes if the situation "is unresolved or the resolution to it is harmful, like overeating or becoming aggressive or not wearing a mask," he says.

A recent study provides clues to how unresolved boredom may be playing out. Most epidemiological models assume that people will start and maintain social distancing as soon as COVID-19 cases begin going up in an area. That would cause deaths, which lag cases by a few weeks, to spike but then plummet in response to the social distancing — causing the model forecasts of deaths to resemble a mountain with a sharp peak.

But researchers reporting in the Dec. 22 Proceedings of the National Academy of Sciences found, based on Google's COVID-19 Mobility Reports,that in most U.S. states, people did initially hunker down as cases rose in the spring and summer, but then increased their movements before the threat had passed. As a result, true curves of COVID-19 fatalities resemble not a peak but plateaus or short dips followed by a rapid increase. That is, death rates did not plummet as expected but remained high. When the researchers incorporated that premature resurgence of activity into epidemiological models, the predicted curves better replicated real-life fatality patterns.

The authors attribute people's actions, and the higher-than-expected death toll, to pandemic fatigue, which includes boredom.

In the coming months, boredom from pandemic fatigue may well intensify. The spread of the coronavirus, including new and even more contagious variants (SN: 1/15/21), in the United States and many other places continues to spiral out of control. Though hope is at hand with the rollout of vaccines, public health experts warn that vaccinating enough people to halt the virus' spread in the United States could take us well into 2021. What is that collision of hope and despair doing to our levels of boredom? How many of us will drop our guard?

What now?

Wolff is now investigating how to help those experiencing boredom follow social distancing rules. His July paper showed that when boredom-prone people exhibit high self-control, they do a better job with adherence.

Training people to have more self-control may be difficult though, Wolff says. Instead, he suggests that people reduce the need for self-control by creating contingency plans.

His preliminary research, posted online June 25 at PsyArXiv.com, suggests that such "if-then" plans can help. For instance, if an indoor gym is too dangerous, a person could instead plan to start running outside. Wolff suggests people take small steps to make it easier to follow such a change in routine, such as putting workout clothes out on the bed the night before and sneakers by the front door. "The idea is to make behavior more automatic," he says.

But even with the best-laid plans, retaining focus and meaning during the pandemic is no easy task. Researchers say it's worth reminding ourselves that boredom is a neutral signal, neither bad nor good. And some people who hunker down right now and explore that feeling may discover that the boredom has deeper roots that may even predate the pandemic.

So perhaps the most optimistic framing of the situation is that some people will use this protracted moment of boredom to think about larger life goals, Van Tilburg says. "It is possible to get meaning out of these negative situations."

sciencenews.org, 15 Feburary 2021

https://www.sciencenews.org

Dead, sick baby turtles wash up on central Queensland beaches after eating plastic

2021-02-17

Dead and sick baby turtles are washing up on Capricorn Coast beaches in numbers never seen before by researchers, after swallowing plastic.

The Department of Environment (DES) said an "unusually large number" of weeks old flatback turtles have been found on the west coast of Keppel Bay.

Chief Scientific Officer Col Limpus said fragments of floating hard plastics and soft plastics had been found in the post-hatchling turtles.

"We've never seen this sort of event in previous years," Dr Limpus said.

"We've never seen this sort of event in previous years," Dr Limpus said.

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"The concern is that several of these turtles that have washed in have actually been compromised because they have been swallowing plastic debris.

"These little turtles feed at the surface and feed on plankton and they don't discriminate between plankton and our floating rubbish."

International study underway

Dr Limpus said many of the turtles had been tagged as hatchlings before they left a nearby major flatback nesting area.

"The Peak Island nesting population has been declining for some years and we haven't been able to understand why, and this may in fact be giving us some clue as to what is happening," he said.

Marine Parks staff and volunteers had been recording, photographing and collecting the turtles.

"These little post hatchling flatbacks and those that are dead are being stored frozen so we can do detailed analysis," Dr Limpus said.

Those found alive are being rehabilitated and released.

"We had one little turtle that's 8 centimetres long and it [had consumed] a piece of plastic film, glad wrap type of film, that was 5cm by 2cm," he said.

"I mean, that is a heck of a big piece of plastic in such a small animal.

"But after it had been able to pass that piece of plastic it perked up and we were able to release it."

DES said those who come across sick or dead turtles should contact the wildlife hotline on 1300 130 372.

"We have a collaborative study with researchers in England that are looking at plastic problems in the Mediterranean, Caribbean and here in Australia," he said.

"Unfortunately the public are not aware of the study and so quite often they are burying the hatchlings on the beach or putting them out to sea immediately."

Impact on future numbers

Dr Limpus said plastic problems had increased in recent decades and no "solid solutions" had been found.

"It wasn't an issue back 40 to 50 years ago when we were in our early years of research, now it's a major problem globally," he said.

"This won't impact the next breeding season, it will impact the season when they are due to come back as adults.

"We are talking a couple of decades … this is going to impact breeding numbers in the future."

abc.net.au, 17 February 2021

https://www.abc.net.au

Giant 14-foot-long crocodile found with human remains in stomach

2021-02-18

Human remains have been found inside the stomach of a 14-foot-long (4.2 meters) crocodile on an island north of Queensland, Australia. According to local authorities, the remains likely belong to Andrew Heard, a 69-year-old fisherman who went missing from the area on Feb. 11.

Heard was last seen that Thursday afternoon when he left his yacht on Hinchinbrook Island (close to the coast of northeastern Australia) in a small fishing dinghy, according to the Australian Broadcasting Corporation (ABC) news site. When he failed to return that night and stopped responding on his radio, Heard's wife called the authorities.

His dinghy was found capsized early Friday morning (Feb. 12), showing damage indicative of a crocodile attack.

On Friday night, investigators discovered human remains in the area; the next day, they found the gigantic croc nearby, according to the Queensland government. Environmental authorities euthanized the croc and cut it open, revealing more human remains in its guts.

"The crocodile captured yesterday is believed to be the animal involved in the disappearance of a man," Queensland Environment, a local government agency, tweeted on Saturday (Feb. 13). "Our thoughts are with the family at this difficult time."

The coasts around Queensland are home to the largest species of crocodile on Earth: the saltwater crocodile (Crocodylus porosus). Saltwater crocs can grow up to 23 feet (7 m) long, though they rarely exceed 16 feet (5 m), according to the Queensland Museum. They inhabit coastal

According to local authorities, the remains likely belong to Andrew Heard, a 69-year-old fisherman who went missing from the area on Feb. 11.

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waters throughout the western Pacific, from the southern coast of India to northern Australia. And they are known to attack humans.

Indeed, two additional crocodile attacks were reported in Queensland in the last two weeks, according to Vice News. In late January, a man in his 40s was bitten on the head while swimming at Lake Placid, roughly 100 miles (160 kilometers) north of Hinchinbrook Island. The man survived with minor injuries after prying the croc's jaws open with his hands, according to news reports.

Several days later, a 22-year-old man was attacked by a 12-foot-long (3.6 m) crocodile while swimming near Australia's northernmost tip. He survived with lacerations to his hand, and the croc was subsequently euthanized.

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https://www.livescience.com

Gene therapy trials for sickle cell disease halted after two patients develop cancer

2021-02-16

A company has stopped its clinical studies of a promising gene therapy for the blood disorder sickle cell disease after two people who participated developed leukemia-like cancer. Bluebird bio is now investigating whether a virus it uses to deliver a therapeutic gene caused the cancers, reviving old concerns about the risks of this approach.

It's also possible the cancers stemmed from chemotherapy the patients received to prepare their bodies for the gene's delivery. "This is really a sad development whatever the cause," says Donald Kohn of the University of California, Los Angeles, who has led gene therapy trials for sickle cell and other diseases.

In the bluebird bio trials, scientists remove a patient's blood stem cells and treat them in a dish with a modified virus related to HIV. It carries DNA encoding the oxygen-carrying protein hemoglobin and is intended to compensate for the patient's defective gene for this molecule. After this step, called "ex vivo" because a patient's cells are treated outside the body, doctors infuse the cells back into the person. Fourteen people who have received the latest version of the bluebird bio therapy are now virtually free of the pain crises their sickled red blood cells once caused.

It's also possible the cancers stemmed from chemotherapy the patients received to prepare their bodies for the gene's delivery.

But today came the news that a patient treated 5 years ago in one of the studies has developed acute myeloid leukemia (AML). Another has myelodysplastic syndrome (MDS), which can develop into AML. A previous patient in the same study developed MDS in 2018, but tests showed it had likely resulted from the DNA-damaging chemotherapy that wipes out a patient's bone marrow cells to make room for treated cells.

Still, the gene therapy could play a more direct role. In past small clinical trials, several boys with an inherited immune disorder who received similar ex vivo gene therapy developed leukemia. In those cases, a mouse virus ferrying a curative gene into cells landed its genetic cargo in a location that turned on a cancer gene. Researchers then switched to a potentially safer delivery system, a lentivirus that also inserts the genes it carries into the host's DNA but in sites less likely to trigger a cancer gene. A 2019 report that a monkey treated with a lentiviral gene therapy had developed a leukemia-like condition suggested, however, that the cancer risk had not been eliminated.

Bluebird bio told investors today that although its scientists have found the virus inserted DNA into the chromosomes of the leukemia cells of the treated sickle cell patient with AML, they don't yet know its location. They'll look to see whether the viral DNA landed near a known cancer-promoting gene, perhaps driving its activity. The company says these tests should take a matter of weeks.

Meanwhile, bluebird bio has also halted sales in Europe of an approved treatment that uses the same vector to treat the blood disorder beta-thalassemia. The company's stock price plunged 38% today.

Another sickle cell disease clinical trial that uses the CRISPR gene-editing tool to turn on a fetal form of hemoglobin reported promising results last year. That treatment doesn't rely on a virus to deliver CRISPR; instead, it uses a zap of electricity to get CRISPR editing molecules into cells in a dish. However, CRISPR itself can make off-target effects and rearrange chromosomes, and whether that can trigger cancer may not be known for several years.

The bluebird bio news comes on the heels of a December 2020 report that a patient in a gene therapy trial for hemophilia had developed a liver tumor. The company, uniQure, planned to explore the possible role of its vector, an adeno-associated virus (AAV). Even though AAVs are supposed to be safer than lentiviruses for gene therapy because they are not

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designed to insert their cargo into a cell's genome, animal studies have found they sometimes can.

sciencemag.org, 18 February 2021

https://www.sciencemag.org

Passing oil pollution from dolphin to calf

2021-02-19

The 2010 Deepwater Horizon spill and subsequent oil pollution have had long-term health effects for dolphins, according to new research.

The study, published in the Environmental Journal of Toxicology and Chemistry, found that bottlenose dolphins still had alterations in their immune systems eight years after the spill, with higher levels of some immune cells, and cells that reacted differently in lab studies.

Moreover, the immune alterations were present in dolphins that had been born after the spill.

Moreover, the immune alterations were present in dolphins that had been born after the spill.

Exposure to crude oil has been shown to affect the immune systems of many animals, including various types of fish – and even humans. This research suggests that the effects in dolphins have lasted nearly a decade and don't seem to be diminishing.

"The long-term effects and potential for multigenerational effects raise significant concerns for the recovery of dolphin populations following the spill," said Sylvain De Guise, lead author on the study.

Between 2011 and 2018, researchers regularly captured, assessed and released bottlenose dolphins from two bays on the Gulf of Mexico: one (Barataria Bay) had recorded heavy oiling, and the other (Sarasota Bay) had been unaffected by oil.

They found that dolphins from oily areas had higher proliferation of T cells compared to unaffected dolphins. They also found that mice had similar reactions when they – or their parents – were exposed to crude oil in the lab.

De Guise said the research was useful for understanding the effects of oil pollution in mammals, and that in combination with the mice studies

"really helped build the weight of evidence between oil exposure and specific effects on the immune system."

cosmosmagazine.com, 19 February 2021

https://www.cosmosmagazine.com

Endangered black-footed ferret cloned for the first time

2021-02-19

Researchers have successfully cloned a highly endangered ferret species using cells that were frozen more than three decades ago, according to news reports.

The adorable clone, named Elizabeth Ann, is a species of black-footed ferret, one of the most endangered mammals in North America, according to the World Wildlife Fund for Nature. Born on Dec. 10, 2020, Elizabeth Ann was created using cells from "Willa," a wild black-footed ferret who died and had her cells cryopreserved in 1988, according to a statement from the U.S. Fish and Wildlife Service (USFWS), which was involved in the cloning.

The feat marks the first time an endangered species in the U.S. has been cloned, the statement said.

The feat marks the first time an endangered species in the U.S. has been cloned, the statement said. Researchers hope Elizabeth Ann will help bring genetic diversity to the black-footed ferret population, which today is descended from just seven individual ferrets, making all living members of the species essentially half-siblings, according to The New York Times.

"It was a commitment to seeing this species survive that has led to the successful birth of Elizabeth Ann," Ryan Phelan, executive director of Revive & Restore, a conservation organization that was involved with the cloning, said in the statement. "To see her now thriving ushers in a new era for her species and for conservation-dependent species everywhere. She is a win for biodiversity and for genetic rescue."

Black-footed ferrets were once thought to be extinct, but scientists found a small population in 1981, which allowed conservationists to start captive breeding programs for the species. About 250 to 350 of the ferrets live in captivity, and 300 more live in reintroduction sites in the wild, according to Revive & Restore. But the limited genetic diversity of the species has challenged its recovery, making the creatures prone to health disorders and certain infections, the Times reported.

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Since Willa was not one of the "seven founders" of the population, her genes — which are now possessed by Elizabeth Ann — could bring much-needed variation to the population's genetics.

The project to clone a black-footed ferret began in 2013, and was a result of a partnership between USFWS, Revive & Restore, the company ViaGen Pets & Equine, San Diego Zoo Global, and the Association of Zoos and Aquariums.

Several other endangered animals have been cloned in other parts of the world, including gaur, or wild cattle, in 2001, bucardo, or wild goats, in 2009, and wild coyotes in 2012, according to Scientific American.

Originally published on Live Science.

livescience.com, 19 February 2021

https://www.livescience.com

'Touchdown confirmed!' Perseverance landing marks new dawn for Mars science

2021-02-18

"Perseverance is safely on the surface of Mars!"

It's a new day on Mars. NASA's $2.7 billion Perseverance rover has successfully landed in Jezero crater, alighting just 35 meters away from hazardous boulders it had identified during descent. At about 3:55 p.m. EST, confirmation came back of the rover safely touching its wheels down, resulting in exuberant but socially distanced applause from double-masked engineers at the mission's control room at the Jet Propulsion Laboratory (JPL).

"Touchdown confirmed," said Swati Mohan, the JPL engineer narrating the landing attempt. "Perseverance is safely on the surface of Mars!" Soon after, a camera returned the first image, showing dust, rocks, and the shadow of the rover looming over the black-and-white martian surface.

The rover landed some 2 kilometers southeast of Jezero's fossilized delta, locating a safe flat spot, tilting only 1.2°, and amid a field of hazards. (A map in the control room showed spots of safe green swarmed by dangerous red.) "We did successfully find that parking lot, and have a safe rover on the ground," said Allen Chen, head of the rover's landing team at JPL. The region is informally dubbed "Canyon de Chelly," after a national monument in Navajo tribal lands.

The mission marks the start of a long-standing quest for Mars scientists: to gather rock samples and return them to Earth, where they will be probed for signs of life and clues to the planet's past warm-and-wet climate.

The rover's descent was as dramatic as it was choreographed. Plunging through the martian atmosphere while experiencing temperatures of up to 1300°C, the rover deployed a parachute as big as a basketball court as it approached its 7-kilometer-wide landing zone, the most precisely targeted of any NASA Mars lander. After identifying a safe haven free of dunes and boulders, the rover and its sky crane—a sort of rocket-propelled hovercraft—detached from the parachute.

The sky crane, falling at a walking pace, unspooled the rover to the surface with nylon cords. Finally, moments before touchdown, the rover deployed its six cleated aluminum wheels. The sky crane cut the cords and flew off to crash a safe distance away. The news, relayed by NASA's Mars Reconnaissance Orbiter with an 11-minute delay, was greeted with cheers by those in JPL's control room. Mars had a new martian.

The touchdown marks NASA's ninth successful landing on the martian surface out of 10 tries. The Soviet Union is the first and only other nation to have performed the feat, in 1971, when its Mars 3 lander survived for 2 minutes. China, whose Tianwen-1 arrived at Mars a week ago, will attempt to put a rover and lander on the surface in several months.

Perseverance's landing is likely to ensure additional attempts: NASA and the European Space Agency have begun to develop the two multibillion-dollar missions, which could launch in 2026 or 2028, needed to collect the samples gathered by Perseverance. If the samples make it to Earth a few years after that, researchers will analyze them for signs of life that could be preserved in fossilized microbial mats or, more likely, a lumpy distribution of organic molecules. Other minerals could capture the frozen imprint of the martian magnetic field as it failed, which allowed the ancient atmosphere—and, presumably, the warm climate—to escape to space.

Jezero crater is a great place to look for those clues: It holds a playground of habitable environments. Some 3.8 billion years ago, a thicker and warmer martian atmosphere allowed water to flow on the surface: One river penetrated Jezero, creating a delta of sediments and filling the crater nearly to the rim with water. Life could have found a niche in delta deposits, ancient shorelines, or hydrothermal springs exposed in the crater wall—all of which the rover should reach in its first 2 years of operation as it climbs up from the crater floor. It's a "4-billion-year window into

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planetary evolution," says Katie Stack Morgan, the mission's deputy project scientist at JPL.

But first the rover rests. Today is Sol 0, as one martian day is called. Perseverance will sit still after the landing, peering through transparent dust covers on its cameras to assess its location and erecting its high-gain antenna, used for direct communication to Earth. And then it will take a nap, using its radioactive thermoelectric generator to recharge its batteries, says Jennifer Trosper, the mission's deputy project manager at JPL. "The rover's had a long day."

Over the next few days, the rover will raise its mast 2 meters above the surface and its main cameras will fix on the Sun, orienting the rover. The team will begin to image the landing site and the rover itself, checking the health of its instruments. By early next week, any video or audio captured during the rover's landing should be relayed to Earth, the first time any Mars landing has been captured in such detail.

Each martian sol is half an hour longer than 1 day on Earth. To maximize the robot's operations during daylight hours, the rover team will operate on "Mars time" for the first few months. Eventually, that will cause team members to experience a sort of perpetual jet lag, with team members sleeping during the day and working at night. And, unlike the similar schedule used for Curiosity—Perseverance's predecessor that landed in 2012—engineers and scientists will largely work from home because of social distancing guidelines. Trosper, a veteran of several rover missions, is ready for the upheaval to her schedule: "I finally purchased a sleep mask," she says. (She already had earplugs.)

Over the next month, the rover will remain in a commissioning phase. Its five-jointed, 2-meter-long robotic arm, which carries the rover's rotary-percussive coring drill and several of its most sensitive cameras, will be extended and put through "calisthenics." And a second robotic arm—this one inside the rover's gut and designed to manipulate its cache of 43 stored ultraclean sample tubes—will be run through its paces. Sometime after that, it will conduct a first 5-meter test drive.

The first order of business after the monthlong commissioning phase will be loosing the 1.8-kilogram Ingenuity helicopter, currently attached to the rover's belly. The pint-size Ingenuity is a technology demonstration, a bid to fly a rotor-powered vehicle on another planet for the first time. Perseverance will drive to flat terrain and drop Ingenuity to the surface. The helicopter will then furiously spin its rotors to ascend in the thin martian air. Four additional flights could follow, with the copter expected

to have a total of 30 days to demonstrate its chops. "It will be truly a Wright brothers moment, but on another planet," says MiMi Aung, Ingenuity's project manager at JPL.

After that, Perseverance's science campaign, which includes an international team of 450 researchers, can begin in earnest. The rover will travel at a swift pace compared with Curiosity, capable of driving 200 meters per day thanks to improved automation and upgraded wheels. By the end of its 2-year primary mission, the team aims to collect at least 20 rock samples. The team has already scouted several possible routes, and the first drilling is likely to come this summer, says Ken Farley, the mission's project scientist and a geologist at the California Institute of Technology.

The rover landed near a divide between two geological units on the lakebed targeted by the mission. One, rich in the mineral olivine, may have formed before the lakebed, perhaps marking an eruption or impact that occurred before the water arrived. Such rocks contain trace radioactive elements that decay at a certain rate, so lab scientists on Earth could date the eruption and put a bound on the age of the lake.

Another set of dark rocks was potentially formed by ash or lava deposited onto the crater after the water vanished. If it is also volcanic, dates from it could constrain the lake's demise. Put together, the two dates could bracket the formation of the lake and delta and this wetter period in Mars's history.

But the geology of each layer—inferred from orbit—is deeply uncertain, with scientists not even agreeing on the order in which they were deposited. That's why, Farley says, the team is likely to target this boundary. "This is a great place to be because one of the things that scientists love to do is look to see how two different geologic units come together."

After exploring that interface, the cliffs of Jezero's fossilized delta will then loom; the fine-grained clay-bearing mudstones buried there would be a natural target. "The delta," Farley says, "is what brought us to this location in the first place—a spectacular piece of geology." On Earth, such clays blanket living things and preserve them as fossils. In similar clays at Gale crater, the Curiosity rover—which remains operational—detected traces of complex organic compounds that resembled kerogen, the feedstock of oil. But it could not determine whether the compounds were produced by ancient life or deposited by meteorites.

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*Correction, 19 February, 1 p.m.: An earlier version of this story misstated the hypothesized stratigraphic order of two geological units near Perseverance's landing site.

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https://www.sciencemag.org

There's a rare yellow penguin on South Georgia island, and biologists can't quite explain it

2021-02-23

Black-and-white tuxedos may be the conventional dress code in the penguin world, but one dashing individual is breaking the status quo with an à la mode yellow coat.

A wildlife photographer captured images of the rare penguin on a remote island in South Georgia in December 2019 and only recently released the photos. A king penguin "walked up straight to our direction in the middle of a chaos full of sea elephants and Antarctic fur seals, and thousands of other king penguins," the photographer from Belgium, Yves Adams wrote on an Instagram post. "How lucky could I be!"

At the time, Adams was leading a two-month photography expedition through the South Atlantic and had stopped on a South Georgia beach. While unpacking safety equipment, he saw a fluttering of penguins swimming toward the shore — one individual immediately caught his eye.

"I'd never seen or heard of a yellow penguin before. There were 120,000 birds on that beach, and this was the only yellow one there," Adams told Kennedy News and Media. "We all went crazy when we realized. We dropped all the safety equipment and grabbed our cameras."

King penguins (Aptenodytes patagonicus), just like the closely related emperor penguins (Aptenodytes forsteri), typically adorn a black-and-white coat with a yellowish-gold dash of color on their collar. The yellow pigments are "unique to penguins," though not all species have them, according to the Australian Antarctic Program.

This particular penguin seems to have retained its yellow feathers but lost its dark ones, which are typically colored by a blackish brown pigment known as melanin.

Penguins with unusual plumage are relatively rare, and sometimes it can be difficult to identify the cause behind the rare colors just by looking

"…There were 120,000 birds on that beach, and this was the only yellow one there," Adams told Kennedy News and Media.

at the penguins, according to the Australian Antarctic Program. Some unusual coloring can be due to injury, diet or disease, but many instances are due to mutations in the bird's genes. Such mutations can cause, for example, "melanistic" penguins whose typically white parts are black and "albinistic" penguins that don't have any melanin and thus are white.

Adams told Kennedy News that the yellow bird has a genetic condition known as leucism in which only some of the melanin is lost.

Dee Boersma, a conservation biologist and professor at the University of Washington who was not a part of the expedition, agreed. "This penguin is lacking some pigment so it is [leucistic]," Boersma told Live Science in an email. "True albinos have lost all pigment." (Boersma said the bird has a brown head and so must have retained some of the pigment.)

Still, others disagree.

"I wouldn't call the bird leucistic," because the penguin seems to lack all melanin, said Kevin McGraw, an integrative behavioral ecologist at Arizona State University, who also wasn't part of the expedition.

"It does look albino from the perspective that it lacks all melanin" in its plumage, feet and eyes, McGraw said. Still, "we'd need feather samples for biochemical testing if we aimed to unequivocally document," whether melanin is present, he said.

Animals can be albino but still have non-melanin pigment, he added.

The penguin has lost the carotenoid or yellow-orange-red pigment in its beak and the melanin pigment in its feathers, while retaining the yellow pigment in its feathers. So the genetic and cellular machinery for some pigments were knocked out whereas others were not. "I'm not aware of many other images or birds like this," McGraw said. "I've been fascinated by this photo."

Such oddly colored birds are rare — and likely for a reason.

Penguins use body and plumage color for a variety of functions, including mate selection, camouflage or protection from the sun, McGraw said. "It's conceivable that such color aberrations could impact both survival and reproduction."

The team was lucky that the yellow penguin landed close enough that they were able to "get this show of a lifetime," Adams said. "Our view wasn't blocked by a sea of massive animals. Normally, it's almost impossible to move on this beach because of them all."

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From butterfly wings to shrimp claws: Mimicking nature on the nanoscale

2021-02-15

BOSTON—Standing at a lab bench, Tanya Shirman eyes her creation: a tiny glass vial filled with an iridescent, sand-like material.

Holding it between her thumb and forefinger, she gives the vial a gentle shake, and the material inside turns from shimmering blues to greens.

"This is what happens in butterfly wings," the petite Shirman, lifting her voice over the roar of a lab fume hood, told EHN. "The spectrum of colors changes from the structures in the wings at the nanoscale," that is, a scale hundreds of thousands of times smaller than the head of a pin.

Shirman, vice president of materials design at the Boston-based startup Metalmark Innovations, is referring to the concept of structural color found in nature—such as in butterfly wings, bird feathers, beetles, berries, and the sky.

In a butterfly's wings, for example, chitin—a complex carbohydrate that forms the outer shell of arthropods, insects, crustaceans, fungi and some algae—is ordered in ways that reflect or refract the light, like tiny prisms. These same microscopic structures that bring beauty to a butterfly also provide strength, lightness, and water repellency. It's this efficient design that has captured the imagination of Metalmark's founders and inspired their invention: indoor air purification systems that destroy, rather than trap, volatile organic compounds, viruses, and ultrafine particles.

The iridescent specks in Shirman's tiny vial mimic the three-dimensional, honeycombed protein structures found in the wings of a metalmark butterfly. They're fabricated from metal oxides, such as silica or titanium, and metal nanoparticles that act as catalysts that destroy air pollutants. Metalmark applies the material as a thin coating within air purification units. The technology is more effective, more energy efficient, and less costly to maintain than comparable air purification systems, Sissi Liu, Metalmark CEO, told EHN. And a study published by Oak Ridge National Laboratory that found Metalmark's technology performed better than commercial counterparts using 40 percent less of the catalytic metals, and at lower operating temperatures, backs up her claims.

Liu said there's been a surge of interest in Metalmark's technology since the coronavirus pandemic, because it's so effective at killing viruses.

"The spectrum of colors changes from the structures in the wings at the nanoscale," that is, a scale hundreds of thousands of times smaller than the head of a pin.

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Metalmark is one of a growing group of startups using biomimicry—designing materials and systems modeled on nature—to address sustainability challenges from indoor air pollution, to water pollution in the fashion industry, to inadequate sanitation systems in low-income countries. Many of these startups are inventing wholly new materials that mimic nature at the nanoscale: non-toxic adhesives based on a mussel's sticky foot, lighter weight composites for airplanes inspired by the helical structural of a mantis shrimp's claw, biodegradable fabrics inspired by the proteins in red fluorescent coral. While these innovations offer great promise, many rely on nanoscience and synthetic biology, which have potential human and environmental health risks, including the ability for these very tiny materials to enter the body and react with human tissue. More research and innovation into bio-based or safer chemistries, and stronger regulations, could help ensure that biomimicry innovations meet their promise without unintended consequences.

"Biomimicry without green chemistry could be a big problem," John Warner, a pioneer of green chemistry and distinguished research fellow at Zymergen, a manufacturer of bio-based materials, told EHN. "If we're mimicking nature, we better mimic it using green chemistry."

Biomimicry at the nanoscale

Janine Benyus's seminal 1997 book, Biomimicry: Innovation Inspired by Nature, helped lay the groundwork for the surge of interest in biomimicry today, but inventors have long been inspired by nature. Think of Leonardo DaVinci's blueprint for an "ornithopter," or a human-powered flight machine. More recently, the design-with-nature and permaculture movements have infused principles of biomimicry and systems thinking into architecture and urban planning.

Now, however, researchers are zooming in on nature's building blocks—that is, proteins and complex carbohydrates like chitin, cellulose and keratin. These biopolymers provide structure and function to plants and animals throughout nature, conferring attributes from strength to flexibility to color to water-repellency, depending on their unique ordering.

Researchers seek to mimic these structures to innovate products more in harmony with nature.

They liken it to building with LEGO blocks, where each LEGO is a simulated chitin molecule that can be assembled into different formations that can yield different functions.

Biomimicry startups use chemistry and materials science to recreate nature's nanostructures. Starting with molecules or polymers (chains of molecules), they employ "bottom up" approaches that rely on kinetic energy or thermodynamics to drive the molecules to assemble into the structures they seek to create. Much of the work is done in a chemistry lab, without fancy equipment, though sophisticated imaging technology, like electron microscopy, is required to analyze the structures. Metalmark, which spun out of research at Harvard's Biomineralization and Biomimetics Lab, relies on the university's Center for Nanoscale Systems for analysis of its structures.

"Nature uses structure first with a very limited materials palette, whereas we do the opposite. We have very complicated chemistry because we're trying to get multiple performance qualities [in a single material]," Beth Rattner, executive director of the Biomimicry Institute, told EHN. Co-founded by Janine Benyus, the Institute is a nonprofit that runs educational programs, a business accelerator and a prize program, the Ray of Hope, to help give startups like Metalmark a boost.

What Rattner means is that manufacturers generally use multiple chemicals, each with a specific function, to create a product. In contrast, nature has evolved materials like chitin to achieve multiple functions through their unique molecular structuring, such as stacking, cross-hatching, coiling, or the hexagonal shape found in some metalmark butterfly wings.

"If you can get those structures, which are nanostructures, into the materials that we use every day, you don't need the toxic chemistry," Rattner claimed, adding, "we could get to the global sustainability that companies are seeking faster, more elegantly, and maybe at a better price point by turning to structure."

Bypassing synthetic chemicals

Werewool is a good example of what Rattner means. The startup creates biodegradable fibers for clothing based on proteins found in nature that confer such qualities as color, stretch, and water repellency. Synthetic chemicals are used to achieve those properties in clothing today, including per- and polyfluoroalkyl substances, or PFAS, the "forever chemicals," for water repellency. PFAS are hormone disruptors, linked with cancer, reproductive and other harms. Their ubiquitous use in products from clothing to firefighting foam has led to widespread drinking water contamination.

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Werewool's founders are Fashion Institute of Technology (FIT) alumni who met while students at a textiles sustainability class in India and saw the huge water pollution problems caused by the industry's use of toxic dyes and finishing agents. Textile mills generate 20 percent of global industrial water pollution.

The students entered a bio-design challenge and set out to engineer a protein similar to keratin, the main structural protein that forms the hair, wool, feathers, nails, and horns of many animals. . "Along the way they became really fascinated," about keratin's versatility, assistant professor of Science at FIT and former campus chair and faculty lead for the Biodesign Challenge. Schiros is now co-founder and chief science officer at Werewool.

Still in the research and development phase, the startup has successfully created a fiber with color based on the red fluorescent protein also found in discosoma coral. They've teamed up with experts in protein engineering and biomaterials at Columbia University, and plan to next identify a protein for harnessing water repellency, such as from a paper wasp's nest.

Werewool's final product will likely be constructed from a combination of biopolymers, and protein or polysaccharide fibers that it creates using synthetic biology, Schiros told EHN. The team is focused on creating alternatives to high-performance fabrics that rely on synthetic fibers for moisture wicking, she said, noting that such fabrics are the top source of marine microplastic pollution.

If Werewool succeeds, it could fundamentally disrupt how clothing is made and reduce not only the amount of harmful chemicals used in apparel, but microplastic pollution as well.

Other biomimicry innovators with a similar potential for disruption include Berkeley-based Cypris Materials, which produces colorants for paints, printer inks, and cosmetics that mimic structural color found in butterfly wings and eliminate the need for toxic dyes and pigments. Its colorants, made from plastic polymers like polyacrylates or polyesters, may also reduce the need for harmful stabilizers added to hold pigments in solution.

On a smaller scale, spotLESS Materials mimics the nanostructures that create the slippery rim of a pitcher plant to fabricate silicone-based coatings for ceramics that shed sludges and liquids more effectively than non-coated surfaces. Developed in response to the Gates Foundation

World Toilet Challenge, the product requires fewer cleaning agents and less water to keep toilets clean.

How safe are nanomaterials?

Some of these innovators, like Metalmark, use nanomaterials to create their innovations, while others create products containing nanomaterials, which raises potential health and environmental concerns.

Nanomaterials are defined as having at least one dimension measuring 100 nanometers or less. They are the same size as ultrafine particles, like those in diesel exhaust, and are similarly more able to enter the body, and react with human tissue, than larger particles. Some nanomaterials are highly reactive because of their large surface area relative to their mass.

While much research has been conducted into the health and environmental safety of nanomaterials, Andrew Maynard, a physicist and associate dean for curricula and student success at Arizona State University College of Global Futures, told EHN, "I'm not convinced that 20 years of research has given us everything we need to know…I'm not convinced we're asking all the important questions about what makes something potentially harmful, and how we engineer that harm out."

Occupational exposure to nanomaterials may be the biggest concern, with health studies of workers handling nanomaterials finding changes in biomarkers and enzymes, that indicate the potential for harm to lungs and other organs.

Still, Maynard said that when you look at the big span of environmental concerns needing immediate attention, "it's hard to justify many nanoparticles appearing on that scale. …it doesn't mean that they're safe, and it doesn't mean that they're not important."

It means, rather, that we need to be asking smart questions—about the materials in use, what measures are taken to ensure nanoparticles aren't released into the environment, and what's done to ensure that if they do enter the body, they won't cause harm.

Current regulations to ensure such safety are weak. Nanomaterials are regulated by the Food and Drug Administration (FDA), and the Environmental Protection Agency (EPA), through the Toxic Substances Control Act. However, there are no specific regulations written for nanomaterials. The FDA treats them like any other drug or cosmetic.

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Many biomimicry researchers don't actually use nanomaterials to create their nanostructures. Rather they work with polymers, or molecules, in their "bottom up" approaches. That's not true for Metalmark, which uses nanometals like palladium because of their catalytic ability to break down air pollutants.

Toxicological assessments of palladium nanoparticles are inconclusive but suggest ecological impacts, including impacts on seed germination and plant growth, as well as toxic effects on human respiratory and other cells.

In response to these concerns, Metalmark's Liu said that the startup uses a very small amount of the nanometal and embeds it into the honeycombed nanostructures it creates to prevent the particles from being released into the environment.

"We're using structures informed by nature to do this, and we're embedding the nanoparticles to improve and stabilize them. On the one-hand, the stability brings longer durability to the material, second it holds it in place better, so we reduce the problems of flaking off of the nanoparticles."

Metalmark has published peer-reviewed studies documenting the stability of the particles in its structures.

"Clearly we want to do the right thing and test our materials at high flow rates so we know that they don't cause issues," added Lu.

Other biomimicry startups use the same strategy of bonding nanosized materials in their products to prevent their release into the environment. spotLESS Materials' coatings contain nanohairs mimicking a pitcher plant that are only a few nanometers in size. Such a product could be considered a nanomaterial, but Tak-Sing Wong, principal investigator at Pennsylvania State University and company co-founder, said that the nanohairs are chemically bonded into the surface coatings to prevent their release.

Similarly, Cypris Materials colorants are nanostructures built from polymers, but the structures are part of a continuous film and not considered a nanoparticle, according to CEO and co-founder Ryan Pearson.

In fact, the stabilization of nanomaterials within structures sets biomimicry innovations apart from traditional uses of nanomaterials as free particles, such as in food, cosmetics, drugs and sunscreen. Most research has focused on free nanomaterials, with a European Commission expert

panel concluding last month that three used in cosmetics pose risks to consumers.

"If we really want to do nanotech in a safe way…you can look at how nature is able to solve that. One of the overarching approaches that nature uses is to not to let nanoparticles become free. It aggregates them one way or another, whether through electrostatic forces or another way that acts like a glue," Mark Dorfman, a biomimicry chemist and senior principal with Biomimicry 3.8, a consultancy group, told EHN.

Of course, just because biomimicry innovations are tying up nanomaterials doesn't necessarily mean that they're safe, but it means that they're likely safer. Longer-term research could help ascertain whether nanostructures modelled on nature remain intact over time.

Biomimicry researchers can further avoid unintended health or environmental consequences by using materials based on green chemistry, Rattner told EHN.

"If the nanoparticles are biodegradable in and of themselves, whatever damage they do is going to be short-lived," agreed Warner, the green chemist, adding that the same property—high surface area—that can make nanomaterials highly reactive also makes them degrade faster.

"Nanoparticles and biodegradation go hand in hand in a really good way," he said.

What about synthetic biology?

Other biomimicry startups like Werewool use synthetic biology techniques, which alarms advocacy organizations like Friends of the Earth, ETC Group and FiberShed because of their reliance on genetically modified organisms (GMOs). Such groups worry about the unpredictable consequences of messing with the genetic code, and the potential for disruption of ecosystems should modified organisms escape into the environment. They also worry about social disruption should, say, startups creating alternative fibers displace Indigenous sheep farmers.

First, here's how synthetic biology works. Werewool identifies DNA sequences in proteins that confer the properties it desires, such as color in the red fluorescent protein in discosoma coral. Next, it modifies those sequences to create new proteins with the ability to assemble into a fiber. Then, it inserts the gene sequences into bacteria and, like beer brewing, ferments the bacteria to mass produce the protein. The final product, a protein, is purified and becomes the basis for a fiber. Though the fiber

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doesn't contain GMOs, genetically-modified bacteria are used to create it—similar to how vegetable rennet for cheese, and many drugs, are made today.

Todd Kulkein, senior research scholar, Genetic Engineering and Society Center at North Carolina State University, and a member of the U.N. Convention on Biological Diversity's ad-hoc group on synthetic biology, said there's not much to worry about from an environmental perspective.

"Once the thing is made, it's not like there's anything living in there," said Kulkein. "What you'd want to look at, are simple things like containment. Where are the organisms being held, what's being done with them once they're utilized?"

And, he added, "most of these organisms people are able to create, even if they're able to get them up to scale, don't survive very well once you get them out of the very controlled environment you need to produce these things."

Kulkein, however, agrees with groups that social disruption is a concern to consider, and he understands why some people object to GMOs on principle. But, "from a strict environmental standpoint, gene drive [intentional release of modified organisms] is what I'm much more worried about," he said.

The dream of every scientist

Meanwhile back in the Metalmark lab, Shirman's husband Elijah, vice president of technology at Metalmark Innovations, shows mounted specimens of metalmark butterflies, the source of the scientists' innovation. There's an electric blue and black butterfly from Peru, and an orange and brown one that doesn't seem remarkable until Elijah said, "This one was brought from the mountains of Kyrgyzstan, where I was born."

Tanya scrolls through black and white photographs on her computer of electron microscope views of butterfly wings: her labor of love over seven years as a post-doctoral student and now as co-founder of Metalmark.

Not all metalmark butterflies have the same hexagonal shape, and some of the images are more reminiscent of mountain ridges. "I think it's a dream of every scientist that your invention can one day become a real thing, a useful thing," she said.

Metalmark aims to get its air purification technology on the market this year, and the team is beginning to explore other applications for its

innovation, said Liu. "My passion, what drives me every day is, thinking about how we can take tech innovations that are really cutting edge and commercialize them to benefit the world."

ehn.org, 15 February 2021

https://www.ehn.org

Coke's newest bottle is made from paper

2021-02-12

In a year, Coca-Cola uses around three million metric tons of plastic packaging, much of which isn't recycled. While the company works to use more recycled material, increase recycling rates, and test new models such as refill stations that rely on reusable bottles, it's also beginning to test alternative packaging—including a new paper bottle that will roll out for a test run in Europe this summer.

The new bottle is made by Paboco ("Paper Bottle Company"), a Danish startup that has also spent years collaborating with the beer company Carlsberg on a paper bottle. It's formed out of a single sheet of paper fiber to help make it strong enough to withstand the pressure of the bottling process, with the label printed directly on the bottle itself. The first version in the pilot has a thin plastic liner to keep the paper dry, but eventually, the bottle will use a liner made from a plant-based material; the cap can be made from paper. The material avoids the carbon footprint of manufacturing plastic from fossil fuels, and the final product will be fully recyclable.

"Our vision is to create a paper bottle that can be recycled like any other type of paper, and this prototype is the first step on the way to achieving this," Stijn Franssen, R&D packaging innovation manager for Coca-Cola EMEA, said in a statement when the project was announced.

After several years of development, Coca-Cola will now test the bottle on one of its 500 brands—a drink called Adez sold in Hungary. The company is doing a small run of two thousand bottles to see how well they perform in the real world. The vodka brand Absolut will also test 2,000 of the bottles on its drinks in the U.K. and Sweden.

Paboco envisions that the material could be used for any type of plastic packaging and could someday replace other materials. "Imagine that all plastic packaging in your store one day has disappeared, and eventually all glass bottles and metal cans," the company writes on its site. "That

It's formed out of a single sheet of paper fiber to help make it strong enough to withstand the pressure of the bottling process, with the label printed directly on the bottle itself.

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all packages are made of renewable materials that can be recycled or returned to nature without harm."

fastcompany.com, 12 February 2021

https://www.fastcompany.com

Disgusted by spoiled food? You may be protecting yourself from disease

2021-02-15

Ask a man of the Shuar tribe in Ecuador's Amazon what disgusts him the most, and he might say eating raw meat; stepping in human feces; or drinking chicha, a traditional alcohol, made "with the spit of a toothless woman," says Lawrence Sugiyama, an anthropologist at the University of Oregon.

Feeling grossed out by potentially contaminated food or spit from an unhealthy person turns out to be a wise reaction for the Shuar, Indigenous people who hunt, gather, and grow crops in the rainforests of south-central Ecuador. In the first study of disgust and the health of Indigenous people, Sugiyama and his colleagues have found that the Shuar who felt the most revolted by raw or spoiled food, or other potential sources of pathogens, are less likely to be fighting a viral or bacterial infection. "Those individuals who scored higher on the Shuar disgust scale had lower levels of immune activation," says biological anthropologist Joshua Snodgrass of the University of Oregon, a co-author of the study.

In 1872, Charles Darwin proposed that disgust was an innate emotion that evolved because it helped our ancestors avoid eating tainted food. People with disgust thus had more chances to reproduce and so passed on the genes that make us feel revulsion. Researchers have since shown disgust does appear to protect the health of humans in relatively wealthy and sanitary cultures. But no one had studied whether disgust was protective for people living in traditional subsistence societies under conditions similar to those in which our hunter-gatherer ancestors evolved.

Tara Cepon-Robins, an anthropologist at the University of Colorado, Colorado Springs, surveyed 75 Shuar men and women in three Indigenous Ecuadorian Shuar communities as part of her dissertation at the University of Oregon. The Shuar she interviewed all lived in environments with many pathogens, such as roundworm, whipworm, and tuberculosis. Their communities had differing levels of economic development, ranging from open huts with dirt floors to government-built houses with concrete floors

"Those individuals who scored higher on the Shuar disgust scale had lower levels of immune activation."

and closer proximity to food markets. Cepon-Robins and her colleagues adapted a survey that ranks the objects of disgust, and then gave it to the Shuar. Individuals rated such events as seeing people vomit, touching raw meat, finding maggots in their food, and seeing a rodent where they stored their food.

The researchers then analyzed blood and fecal samples from their subjects that had been collected since 2005 by the Shuar Health and Life History Project. When they examined the samples for molecular markers of acute immune responses to bacterial or viral infections, they found that the Shuar who scored highest on the disgust scale had the lowest signals of infection, they report today in the Proceedings of the National Academy of Sciences. (The Shuar don't usually suffer from chronic inflammation like Americans and Europeans, so markers of an acute immune response are a reliable indicator that their immune systems are fighting an infection.)

In an interesting twist, the researchers also found that sensitivity to disgust can change with the environment. Those Shuar who lived in the most basic conditions—thatched huts with dirt floors, which often had direct exposure to soil pathogens, animal feces, and contaminated water—showed less disgust than Shuar who lived in homes with concrete floors, clean water, and easier access to food markets. "If you have an open house with chickens coming in, and you can't really clean up the animal feces in the dirt floor, you can't afford to be too disgusted," Cepon-Robins says. "But if you can afford to avoid those things, your disgust will elevate to allow you to avoid the exposure to pathogens."

Those findings are significant, say researchers not involved in the work. "This paper is so exciting because it's filled one of those missing pieces of evidence that is really difficult to gather in the Western world where parasite stress and exposure to infectious disease is relatively low," says evolutionary psychologist Josh Tybur of Vrije University, Amsterdam.

Evolutionary psychologist Debra Lieberman of the University of Miami agrees: "What I really like about this study is that it provides provocative evidence that disgust sensitivity evolved to adapt to the local environment." Even Shuar who grew up in huts with dirt floors have become more sensitive to disgust over their lifetimes as they moved into houses with concrete floors, and closer to markets where they could buy food, Sugiyama says.

sciencemag.org, 15 February 2021

https://www.sciencemag.org

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Tiny, sunlight-powered aircraft could soar beyond airplanes' reach

2021-02-12

Flight isn't easy at the edge of space. But tiny "microfliers" could soar high in Earth's atmosphere fueled only by sunlight, experiments suggest.

At heights between about 50 and 80 kilometers above Earth's surface, in what's known as the mesosphere, the atmosphere is so thin that airplanes and balloons can't stay aloft. But mechanical engineer Mohsen Azadi and colleagues at the University of Pennsylvania saw promise in a technique that uses light to levitate objects. The researchers cut disks of transparent Mylar 6 millimeters in diameter and coated the bottom sides with carbon nanotubes. When heated by light, the tiny aircraft floated inside a vacuum chamber with a pressure that mimicked the mesosphere, the researchers report February 12 in Science Advances.

Carbon nanotubes are key for the microfliers to achieve liftoff. The nanotubes absorb light, warming the flier. Air molecules gain energy when they collide with the warmed flier, ricocheting away from it at higher speeds. The molecules gain extra oomph from striking the carbon nanotubes on the bottom of the craft. That's thanks to the material's nooks and crannies: Air molecules collide multiple times with the nanotubes, getting even warmer and gaining more energy than those that strike the top. That extra energy translates to speedier molecules. As a result, air molecules ricochet away from the bottom of the microflier faster than from the top, generating lift.

Microfliers could run on sunlight or laser light and could someday carry small instruments to measure conditions in the relatively unexplored mesosphere, the researchers suggest.

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https://www.sciencenews.org

But mechanical engineer Mohsen Azadi and colleagues at the University of Pennsylvania saw promise in a technique that uses light to levitate objects.

Why do we breathe so loudly when we sleep?

2021-02-16

During the most peaceful sleep, some people snore obnoxiously loud, ruining the chances of slumber for anyone sharing their bedroom. But even those who don't snore do breathe louder when they nod off than when they're awake. Why do people breathe so loudly when they sleep?

The sound made when you breathe — whether awake or asleep — is caused by the vibration of air moving through the breathing tube, said Dr. Timothy Morgenthaler, a pulmonologist and sleep medicine specialist at the Mayo Clinic in Minnesota. How loud the breathing sounds depends on how narrow the breathing tube is and how fast air travels through it. "You can almost view it as a musical instrument," he said.

When you breathe in, rapid air movement flowing into your upper airway — the part of the respiratory system that extends from the mouth to the larynx — decreases pressure in the entire respiratory tract, also known as the airway. This pressure change can collapse the upper airway which obstructs breathing. A reflex in the upper airway prevents this collapse and keeps your pipes open when you're awake. "Because it's open, the flow through that airway is not turbulent, so the air moves without a lot of sound," Morgenthaler told Live Science. But when you're asleep, that reflex isn't as strong. The upper airway tends to partially collapse, and breathing becomes noisier.PLAY SOUND

Sleep, especially during rapid eye movement (REM), also leads to lower muscle tone around the airway, Morgenthaler added. In other words, the muscles that support the airway relax, allowing the breathing tube to constrict. When the airway gets narrower, the velocity of the air moving through it increases. The air vibrates more and creates more sound.

The narrowness also means your breaths become quick and shallow. The average person takes about 14 breaths per minute while awake and 15 or 16 while asleep, Morgenthaler said. Although you breathe more frequently while sleeping, you actually take in less oxygen and push out less carbon dioxide because your body's need for ventilation isn't as high as when you're awake. "We're not expecting to go off and run or chase an animal or gather crops," he said.

If a person's breathing tube becomes particularly narrow, they may begin to snore. This usually happens when the airway reaches the diameter of a McDonald's straw, which is slightly wider than regular straws, Morgenthaler said. When it's this small, not only does the air inside the airway vibrate, but so do tissues in the area, causing snoring.

If a person's airway narrows further during sleep, they may develop obstructive sleep apnea. The airway can become so narrow that breathing is impossible, and the person wakes up to gasp for air. Even in people without sleep apnea, the airway may narrow this much up to four times per hour. When it occurs more often, it becomes obstructive sleep apnea. Losing weight is often an effective treatment because excess fat around

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the airway can obstruct breathing. Morgenthaler also recommended skipping alcohol close to bedtime because it triggers the surrounding muscles to relax. If that doesn't help, the person may need a machine such as a continuous positive airway pressure (CPAP) to keep the airway open during sleep, he said.

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Firefighters' Catch-22: Protective gear full of carcinogens

2021-02-16

Firefighters are exposed to cancer-causing chemicals in the very clothing and gear that is meant to protect them, a paradox that stems from standards set under industry influence.

Cancer is already a leading killer of firefighters, yet the standards for water-resistant uniforms, known as turnout gear, call for them to contain per- and polyfluoroalkyl substances (PFAS) — a highly toxic class of chemicals linked to a wide variety of health problems even at very low doses.

In fact, all turnout gear must contain the chemical substances due to a requirement that the textiles be able to withstand 40 consecutive hours of harsh ultraviolet light.

That test — proposed by a consultant who has received funding from chemical manufacturers and equipment companies that use PFAS — has been questioned ever since it was adopted by the National Fire Protection Association.

But officials at the International Association of Fire Fighters union, as well as gear manufacturers, have continued to hold up NFPA standards as proof that PFAS in firefighting gear are not only safe but necessary, even as evidence mounts that the gear is exposing firefighters to the toxic substances.

Firefighters concerned about PFAS exposure like Nantucket, Mass., Fire Capt. Sean Mitchell say they have been "failed by our institutions."

"If you had asked me three years ago who looks out for firefighters and who has our backs, I would have said the IAFF and the NFPA," he said. "But they have not been doing that at all."

"If you had asked me three years ago who looks out for firefighters and who has our backs, I would have said the IAFF and the NFPA," he said. "But they have not been doing that at all."

Protective firefighting clothing has three layers: a thermal layer that sits next to the skin, a moisture barrier and an outer shell. Typically, water-resistant textiles made with PFAS are used for the moisture barrier and outer shell, though one major turnout gear brand also uses them in the thermal layer.

Textile and garment manufacturers are quick to justify use of the chemicals with the NFPA standards.

"If firefighting gear and the NFPA 1971 performance is essential, then with the current materials available, PFAS is essential," one moisture barrier manufacturer told Nantucket firefighters this summer. "Reactionary changes, based on emotional arguments, can lead to devastating outcomes."

Looking at the history of NFPA standards, it's not clear that's the case.

Gear 'must contain PFAS'

PFAS are a family of almost 5,000 chemicals. The most well-studied compound, perfluorooctanoic acid (PFOA), is linked to testicular and kidney cancer, as well as weakened immune systems and hormone problems.

After chemical manufacturers like DuPont and Chemours agreed to phase out PFOA by 2015, they flooded the marketplace with other types of PFAS, many of which pose similar health risks.

That agreement was made in 2006 — the same year the UV light test was proposed to certify the safety of moisture barriers, a layer of fabric that doesn't typically see daylight, as it is sandwiched between two other layers of textiles within turnout gear.

The test was proposed by Elizabeth Easter, a University of Kentucky textiles professor whose resume shows that between 2001 and 2004, she received $100,000 from Lion Apparel, the sole turnout gear manufacturer that uses textiles made with PFAS in all three layers of gear.

Easter also worked with DuPont in 2011 and has received funding in the past from other major textile and turnout gear companies that use PFAS.

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In an email, Easter said she proposed the UV light test based on studies she had conducted in response to a series of moisture barrier failures in the 1990s. Then, rapidly deteriorating fabrics were recalled because firefighters had suffered horrible burns when their water-soaked gear heated up.

"Results showed that exposure to ultraviolet light resulted in the degradation of moisture barriers, this failure replicated field results," she wrote in an email to E&E News.

After this article was published, Easter responded to follow-up questions about her research, saying that moisture barriers of gear could be exposed to sunlight or fluorescent light when turnout gear is cleaned. She said the only purpose of her work was to "prevent future failures." In response to a question about which grants listed on her resume may have funded the research, Easter only wrote that it was not funded by three groups — DuPont, textile manufacturer W.L. Gore & Associates and NFPA — but did not mention other manufacturers that have paid her in the past.

After this report was published, DuPont spokesman Dan Turner said the NFPA standards are "not related in any way" to DuPont's agreement to stop producing PFOA. He added he was "not aware of the Easter work" and the company was not involved in her UV light study.

Easter made her proposal to an NFPA volunteer committee consisting of industry consultants, textile and gear manufacturers, and representatives of fire departments. A representative of DuPont was an alternate member of the committee at the time.

NFPA rules state that each group cannot constitute more than one-third of the committee, to prevent any bias in the standards. But firefighters have long alleged that consultants who often contract with manufacturers can't be objective.

Jeffrey Stull was the only committee member to oppose adopting the UV light test.

The protective equipment consultant said there wasn't enough evidence to blame equipment failures on UV light, because "the moisture barrier would never be exposed to it."

"I didn't think they found the root cause of this failure," he said, adding that he believed the test was intended as "a genuine solution to a problem wreaking havoc on the industry."

But only textiles containing PFAS can pass the test, which knocked off the market other materials that didn't use the chemicals and hadn't been recalled.

"Once you have this test, all moisture barriers, and therefore all turnout gear, must contain PFAS," said Graham Peaslee, a researcher and professor of experimental nuclear physics at the University of Notre Dame.

Other NFPA standards that set levels of water absorbency in the outer layer of turnout gear have resulted in PFAS-containing fabrics dominating the market, but the standards themselves can be passed by other materials, and one manufacturer recently began producing a PFAS-free layer.

Research finds 'concern about absorption, ingestion and inhalation'

Peaslee has been testing turnout gear for PFAS since 2017. He released his first results a year later and published his first peer-reviewed study on the subject last summer.

His work shows PFAS in firefighting gear don't stay there.

Though industry and the firefighting union have said that use of PFAS in gear is safe because they are used in solid polymers, Peaslee's research has shown that the chemicals can actually break away, migrating out of the moisture barrier and through the thermal layer, where they can connect with firefighters' skin. They also rub off the outer shells of both used and new garments at extremely high levels.

The research raises concerns that firefighters could accidentally be ingesting PFAS that rub onto their hands or that the compounds could be soaking in through their skin. That's of particular concern in the field because high-heat environments are known to increase dermal absorption of chemicals.

Another study Peaslee published with environmental health scientists at Harvard University earlier this year shows PFAS from firefighting gear make their way into station dust, particularly in areas where the garments are stored. The findings mean firefighters could also be inhaling or even accidentally eating PFAS released by their protective equipment.

"Ninety-nine percent of the material could be tied up as a polymer in the textile, but there is enough free PFAS material that there should be a concern about absorption, ingestion and inhalation," Peaslee said. "This isn't just oozing — it's flooding out."

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His research has many firefighters wondering whether their gear could be contributing to cancer rates within the fire service, where the disease accounts for 66% of deaths between 2002 and 2019.

Firefighters are twice as likely as the general population to be diagnosed with testicular cancer, and they have significantly higher rates of prostate cancer and non-Hodgkin lymphoma.

Other research has found PFAS present in firefighters' blood at greater levels than the general population. But because firefighters are also exposed to PFAS in firefighting foam and in smoke released when furniture treated with the chemicals burns, more research is needed to determine exactly which source poses the greatest threat.

It's also not clear what portion of firefighter cancers can be attributed to PFAS, versus the soup of other toxic substances, including carcinogens, they are routinely exposed to in smoke.

Union: 'We don't want a regrettable substitute'

The firefighters union says Peaslee's research isn't enough to prove a change is needed for turnout gear.

After his peer-reviewed study was published this summer, IAFF released a statement calling for more research.

Asked whether the dust studies changed that stance, an IAFF official again called for "more data and additional research."

IAFF is funding its own studies on PFAS in firefighter blood, turnout gear and station dust. The union has also expressed an interest in the industry's development of PFAS-free outer shells.

Union officials — some of whom sit on NFPA standard-setting committees — are also quick to warn that removing PFAS from gear too quickly could leave firefighters in danger.

"The durable water repellency is designed to protect the firefighter from the chemicals and other materials that are produced in the fires and prevent steam burns, and we don't want a regrettable substitute," the official told E&E News.

That statement closely echoes one made in a January 2020 PFAS presentation from IAFF occupational health specialist Racquel Segall, who said PFAS used in protective equipment are crucial to keeping firefighters safe.

"This is what is protecting you from your liquids, your oils, your bloodborne pathogens and heat," she said. "When you look at it, at this point, your PFAS chemicals are needed to meet the NFPA standard."

She also said the chemicals posed a limited threat because they were included in gear as larger polymers and thus could not easily be absorbed by skin.

Comparing cells to a volleyball net, she likened stand-alone PFAS to "golf balls" that might be able to breach the net but called polymers using PFAS "volleyballs, the ones that can't pass through the cell membrane."

IAFF said in a statement that industry money does not affect what it tells firefighters about PFAS in their gear. The union's "dedication and drive to protect firefighters and keeping them healthy and safe is influenced only by data and science," the statement said.

"Sponsorships have never affected union policy or decision making and any assertion otherwise is reckless and baseless."

Since 2016, turnout gear and textile manufacturers have donated more than $480,000 to IAFF, according to the union's federal financial disclosures. Cumulative annual donations jumped from five to six digits in 2018, the same year Peaslee released his first tests.

A union fact sheet released in 2017 only mentions the presence of PFOA in older gear — not any other PFAS — and advises firefighters worried about the chemicals to "regularly decontaminate their turnout gear" by washing it to rid it of toxic soot.

That document closely mirrors a contemporaneous one issued by Lion Apparel, which similarly only focused on PFOA and went so far as to quote the union to make its case.

"The IAFF has reviewed the science and stated that 'it is unlikely that PFOA is present in any significant concentrations in uncontaminated new or recently US manufactured turnout gear' and that 'even if present on outer shell treatments or within the moisture barrier of legacy turnout gear the exposure contribution from any such PFOA content is likely to be minimal since volatilization from the manufactured product would be required,'" the industry document says.

A need for 'better answers'

Firefighter Jason Burns, from Fall River, Mass., said he expected more from his union.

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When he first learned about PFOA in firefighting gear four years ago, he said, he called his state union representative and two weeks later was put on the phone with IAFF national officials.

"They started to rattle off what they told me they knew about PFOA, and the bulk of the conversation was more geared towards, you know, the stuff is in the smoke, but as far as the gear, we don't have anything to say it's a danger to you," he recalled.

IAFF did not respond to questions about the call.

While he was on the phone, Burns said, he felt proud that national union officials were paying attention to a lone firefighter from coastal Massachusetts.

"But I look back, and they should have had better answers for me," he said. "I know science is fairly complex, but it's fairly easy, too. They could have just said, like, 'Listen, this stuff is in the gear but we don't have alternatives right now, and here's how you do your job safely.' There was none of that."

Peaslee, in contrast, has been advising firefighters that although they must continue wearing their protective equipment to fire scenes, until more research is done, they should avoid wearing it for nonessential activities like trips to the grocery store, demonstrations for schoolchildren, family photos or exercise.

"These guys are not stupid; they understand risk and would understand perfectly well if there were no alternatives and this was what they had to wear to be safe in a fire," Peaslee said. "But not telling them about the risks is another story."

Burns and Mitchell, the Nantucket fire captain, say they have attended IAFF cancer seminars sponsored by the turnout gear industry that focus on the dangers of toxic soot and the importance of washing it off turnout gear without mentioning PFAS in the equipment.

The two firefighters became so concerned about industry money in the union that last month, they sponsored a resolution at the IAFF annual convention to stop taking funds from chemical, textile or gear manufacturers. Delegates at the convention passed the resolution 1,536-10.

Nantucket Fire Capt. Nate Barber, who was diagnosed with testicular cancer two years ago, said he was happy that his own delegate voted to get industry money out of IAFF.

Advocating for nontoxic gear and a change to NFPA standards, he said, should be a clear part of IAFF's mission.

"I do blame the union; they should be working to get this stuff out of our gear, not telling us not to worry about it," he said. "We pay our dues so our members are protected. Their health and safety should be No. 1, and it hasn't been."

eenews.net, 16 February 2021

https://www.eenews.net

A rare bird sighting doesn't lead to seeing more kinds of rare birds

2021-02-16

It was a cold, overcast Saturday morning in Salem, Ore., when Jesse Laney set out to catch a glimpse of a painted bunting. He'd heard earlier that week through a birding WhatsApp group that this vibrant, rainbow-colored bird was in the area. Painted buntings (Passerina ciris) are common in places like Texas and the northern parts of Mexico, but a rarity in Oregon. Laney and his sons raced to the site and began searching — but the bird eluded them.

He wasn't too disappointed, though. Just the chance of seeing a rare bird "scratches the ever-present itch of participating in a small bit of discovery," says Laney, an ecologist at Oregon State University in Corvallis.

That itch has now inspired research debunking a popular myth among birders: That a rare bird sighting leads to more sightings of other rare bird species because birders flock to an area to find the initial bird. This phenomenon is called the Patagonia Picnic Table Effect.

This phenomenon is called the Patagonia Picnic Table Effect.

Its origin story dates back to sometime in the 1960s or '70s. Though details are a bit unclear, birders saw a rare black-capped gnatcatcher, or a pair of rose-throated becards, in Patagonia, a town near the Arizona-Mexico border. Word got around and birders descended on the town, which led to sightings of other rare birds, including a five-striped sparrow and a yellow grosbeak, according to some accounts.

To determine if such discovery bonanzas are one-off events or a common occurrence, Laney and his colleagues analyzed data from 2008 to 2017 from the online database eBird. Avid birders typically upload their checklists — that is, birds they have spotted on an outing — to the site.

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The team identified 273 so-called mega-rarities mostly in the continental United States; these are the hardest-to-find birds, either because there are so few of them or because they rarely show up in some geographical locations. The researchers then evaluated rare bird discovery rates before and after crowds raced to where those ultra-uncommon birds were spotted.

The rates remained essentially the same, the team reports January 21 in PeerJ, at 8 detections per 1,000 checklists. Birders had no better chance of finding a second species of rare bird in an area where there was a recent rare bird sighting than they did during routine birding.

This belief that one success can lead to more isn't limited to the birding community. When an athlete magically makes one shot after another, that streak is referred to as the hot hand effect (SN: 1/12/12). We want to believe such patterns exist, says Andreas Wilke, a psychologist at Clarkson University in Potsdam, N.Y. That thinking once gave humans an evolutionary advantage when it came to such survival skills as finding food, he says. "It's a very adaptive thing to do but it can misfire in modern environments when we look at very random distributions of things and start to see patterns that don't exist."

sciencenews.org, 16 February 2021

https://www.sciencenews.org

Planet 9 probably doesn't exist, new paper argues

2021-02-19

Does the solar system have a big, dark ninth planet drifting somewhere far beyond the orbit of Neptune?

Since 2016, many astronomers have said it's possible, pointing to evidence for a large gravity source in deep solar space. But a new paper argues that this gravity source is nothing more than a statistical mirage, the consequence of where in the night sky astronomers point their telescopes. The first physical (CK) hint of this hypothetical Planet Nine was a group of space rocks with similar orbits that seemed to be clustered unusually close together. These dim, distant, hard-to-spot objects orbit beyond Neptune and are known as "trans-Neptunian objects" (TNOs).

These dim, distant, hard-to-spot objects orbit beyond Neptune and are known as "trans-Neptunian objects" (TNOs).

Because these frigid little worlds in the far-outer solar system reflect such little sunlight, they tend to blend into the brighter background of stars and galaxies that occupy most astronomers' attention, and only a handful have ever been identified and catalogued. (The most famous of these is

the demoted dwarf planet Pluto, which orbits relatively close to the sun compared with many of its TNO cousins.)

But in 2016, astronomers Konstantin Batygin and Mike Brown of the California Institute of Technology noticed that six TNOs, including the dwarf planet Sedna, all had long elliptical and "eccentric" orbits oriented in the same direction. Eccentric here means that their aphelions, or most-distant points, are much further from the sun than their perihelions, or closest points to the sun. And all six had aphelions on roughly the same side of the solar system. In a 2016 paper published in The Astronomical Journal Batygin and Brown wrote that a planet with a mass of around 10 times that of Earth, way further out than Pluto, and following a long elliptical path around the sun, could explain the apparent clustering. Over time, they argued, its large gravity would have pulled these six TNOs into their clustered orbits.

But in this new paper, published Feb. 12 to the arXiv database, but not yet peer-reviewed, a large collaboration of researchers suggest that the TNOs aren't particularly clustered — they just look that way because of where Earthlings are pointing their telescopes. The researchers took a sample of 14 known "extreme" (meaning very distantly orbiting, belonging to the family of objects that has most influenced Planet Nine research) TNOs and assumed they were part of a mostly unseen larger family of objects, which they almost certainly are. Then they analyzed how much time telescopes had spent pointing at different parts of the sky. They found that astronomers might detect this particular collection of objects if all the TNOs on the outermost fringes of the solar system actually had a fairly uniform distribution — anywhere from 17% to 94% uniform. (A 100% uniform distribution would mean that TNO orbits are evenly spaced around the sun.) In other words, the extreme TNOs (ETNOs) might seem to be clustering, but that's only because telescopes have, on average, concentrated their attention on that part of space. Such uniform distribution would not fit the Planet Nine hypothesis.

This statistical analysis is similar to the sort of gut checks opinion pollsters do all the time. If a survey of a few hundred Americans found that country music was the favored genre of 55% of people, but then a closer look at the data revealed that 40% of respondents happened to be from Nashville, the pollster might adjust the data to account for the fact that that the sample was so heavily weighted toward one area of the country. In doing so, the pollster might find that the huge preference for country music disappears.

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Dave Tholen, a University of Hawaii astronomer who searches for TNOs using the Subaru telescope on the summit of Mauna Kea in Hawaii, and who was not involved in the study, said there's still too little data for anyone to be drawing any firm conclusions about Planet Nine.

"We have a classic situation that I might describe as 'the statistics of small numbers.' One discovery can't align with anything. Two aligned orbits could easily be a coincidence. Three aligned orbits might raise the question, but certainly isn't enough on which to hang your hat," Tholen told Live Science in an email. "How many aligned orbits do you need before the chances of it being a coincidence drop to a convincingly small number? And what constitutes 'alignment'? Do they need to be within 10 [degrees] of each other? 30 [degrees]? 90 [degrees]? My own feeling is that we're still in the 'suggestive' stage."

The clustering of TNOs suggests there might be a planet tugging on them, making it a hypothesis worth exploring. But the clustering seen so far is not strong evidence. On the flip side, the new study can't rule out Planet Nine either, Tholen said.

Efforts underway right now will dramatically expand the catalog of known TNOs, and provide firmer ground for any claims on the subject, Tholen said.

"Progress comes slowly," he said. "Any paper reporting on simulated surveys will always be out-of-date as long as we continue our observational work, because they won't include our latest sky coverage."

His team, Tholen said, works to observe the sky uniformly "specifically to avoid the sort of… bias" at the heart of the new paper's argument.

Scott Sheppard, an astronomer who studies TNOs at the Carnegie Institution for Science in Washington, D.C., and was one of the first researchers to propose that a large planet might exist in the far-outer solar system, largely agreed with Tholen's take.

"We just do not have enough bona-fide distant ETNOs to have a good statistical argument for or against the clustering," he told Live Science.

The new paper ignores certain well-studied objects, like Sedna, and said that this makes the results less convincing, Sheppard noted. And some of the objects the new paper studied are likely influenced by Neptune's gravity, making them bad candidates for studying Planet Nine, he added.

"I would say we need to triple the current sample size of very distant ETNOs to have reliable statistics on the angles of these object's orbits," Sheppard said. "If you do not have a large enough sample size, even if things are strongly clustered, the statistics will still be consistent with a uniform distribution simply because the sample size is too small."

Kevin Napier, a University of Michigan astronomer and lead author of the new paper, told Science magazine he agreed somewhat with concerns about his paper's sample size. Napier told Science that the statistical power of their methods is inherently weak with only 14 objects involved, and that when the sensitive Vera C. Rubin Observatory in Chile comes online in 2023, it should reveal hundreds of new TNOs that can shine some light on the Planet Nine question.

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Dogs know where their paws end and the world begins

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Dogs know where their paws end and the world begins, a new study shows, adding our furry companions to a group of animals that, like humans, recognize themselves as distinct entities from their environment.

Called body awareness, this ability is one of the most basic manifestations of self-representation (also known as self-awareness). Humans develop body awareness very early in life: 5-month-old babies can distinguish their own moving legs from a video recording of the same action, for example. This ability then develops into more complex forms of distinguishing oneself from those around them.

Previous research mainly tested species on more complex forms of the ability. For example, one of the most famous tests of self-representation is the "mirror-mark task," in which animals are thought to possess a more advanced form of self-representation, if they can recognize themselves in a mirror. PLAY SOUND

Great apes, elephants, dolphins, corvid birds and a "constantly growing list" of species pass this test, said senior author Péter Pongrácz, an associate professor in the department of ethology at Eötvös Loránd University in Budapest, Hungary. But dogs had not.

"Therefore, body awareness would be theoretically important for them when negotiating various obstacles, for example."

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Scientists lost interest in studying species that didn't show these complex forms of self-representation, Pongrácz said. But in the new study, he and his team decided to take a "bottom-up approach" and investigate whether dogs show a lower level of self-representation — one that would be ecologically relevant to them.

"Dogs are intelligent, large-bodied, fast-moving creatures that move in a complex environment," Pongrácz told Live Science. "Therefore, body awareness would be theoretically important for them when negotiating various obstacles, for example."

To test canine body awareness, the researchers recruited 32 dogs and conducted a "body as an obstacle" task. This test had previously been conducted only on elephants and toddlers.

The dogs had to pick up and give an object to their owner while standing on a small mat; however, the object was attached to the mat such that the dog had to get off the mat in order to lift the object (and the mat). In other words, their bodies served as an obstacle to the task at hand, and the dogs needed to deliberately move that obstacle to complete the task. The researchers accounted for other factors, such as fear-inducing conditions, that might otherwise lead the dog to get off the mat or give up on the task, Pongrácz said.

"When dogs pulled on the toy, it also started to lift the mat — thus the dog felt that the mat was jerking under its paws as it was pulling the toy," Pongrácz said. "In this scenario, the dogs quickly left the mat, usually still holding the toy in their mouth; then they gave it to the owner."

The researchers found that the dogs came off the mat more frequently and more quickly when the object was attached to the mat than when the object was attached to the ground, which the researchers used for comparison purposes. This is "the first evidence that dogs may be capable of understanding the connection between their own body and the environment through the feedback effect of their own actions," Pongrácz said. Dogs have also shown other basic components of self-representation, including the ability to recognize their own odor, body-size awareness and episodic memory,or personal memories of specific events, according to the study.

Now, the team hopes to continue investigating self-representation in dogs — for example, by seeing whether other factors influence this ability in individual animals.

The findings were published Thursday (Feb. 18) in the journal Scientific Reports.

livescience.com, 21 February 2021

https://www.livescience.com

Brain cell clusters, grown in lab for more than a year, mirror changes in newborn's brain

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Put human stem cells in a lab dish with the right nutrients, and they'll do their best to form a little brain. They'll fail, but you'll get an organoid: a semiorganized clump of cells. Organoids have become a powerful tool for studying brain development and disease, but researchers assumed these microscopic blobs only mirror a brain's prenatal development—its earliest and simplest stages. A study today reveals that with enough time, organoid cells can take on some of the genetic signatures that brain cells display after birth, potentially expanding the range of disorders and developmental stages they can recreate.

"Things that, before I saw this paper, I would have said you can't do with organoids … actually, maybe you can," says Madeline Lancaster, a developmental geneticist at the Medical Research Council's Laboratory of Molecular Biology. For example, Lancaster wasn't optimistic about using organoids to study schizophrenia, which is suspected to emerge in the brain after birth, once neural communication becomes more complex. But she now wonders whether cells from a person with this disorder—once "reprogrammed" to a primitive, stem cell state and coaxed to mature within a brain organoid—could reveal important cellular differences underlying the condition.

Stanford University neurobiologist Sergiu Pașca has been making brain organoids for about 10 years, and his team has learned that some of these tissue blobs can thrive in a dish for years. In the new study, they teamed up with neurogeneticist Daniel Geschwind and colleagues at the University of California, Los Angeles (UCLA), to analyze how the blobs changed over their life spans.

The researchers exposed human stem cells to a specific set of growth-promoting nutrients to create spherical organoids containing neurons and other cell types found in the outer layers of the brain. They periodically removed cells to sequence their RNA, which indicates which genes are active in making proteins. Then they compared this gene expression

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with a database of RNA from cells of human brains of different ages. They noticed that when an organoid reached 250 to 300 days old—roughly 9 months—its gene expression shifted to more closely resemble that of cells from human brains soon after birth. The cells' patterns of methylation—chemical tags that can affix to DNA and influence gene activity—also corresponded to increasingly mature human brain cells as the organoids aged, the team reports today in Nature Neuroscience.

The researchers documented other signals of maturity in their organoids. Around the time of birth, some brain cells gradually shift to make more of one variant of a protein and less of another. A component of a brain cell receptor called NMDA, key to neuronal communication, is among the proteins that switch forms. And organoid cells, just like their counterparts in the developing brain, made the NMDA switch.

The findings don't mean the blob itself is comparable to a postnatal brain, Pașca cautions. Its electrical activity doesn't match that of a mature brain, for example, and the clump of cells lacks key features, including blood vessels, immune cells, and sensory inputs. Yet what's striking is that, even in the unnatural conditions of a lab dish, "the cells just know how to progress," Pașca says.

Organoid cells and real brain cells might not mature in perfect lockstep, notes Aparna Bhaduri, a developmental neurobiologist at UCLA who was not involved in the new work. In a previous study, she and her colleagues found that organoid cells showed important genetic differences from fetal brain cells, along with signs of metabolic stress. She says it's reassuring that in the new study, key changes seen at birth seem to happen in an organoid right when scientists would expect—at about 9 months.

Pașca's team also looked at the expression of genes associated with brain disorders, including autism, schizophrenia, epilepsy, and Alzheimer's disease. The scientists identified clusters of these genes whose activity rose and fell in step, reaching their peak expression at the same time. The crests could indicate when those genes are most relevant to brain development—and at what time point an organoid might be most useful for modeling a given disorder.

Now that it's clear the cells of an organoid can walk through some of the human brain's normal postbirth developmental routines, Pașca's team is exploring ways of "pushing [the organoids] back and forth in time to get the right period for a disease model," he says. That could allow his

group and others to study brain diseases in mature organoids without babysitting cells for years on end.

sciencemag.org, 22 February 2021

https://www.sciencemag.org

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