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*** While Chemwatch has taken all efforts to ensure the accuracy of information in this publication, it is not intended to be comprehensive or to render advice. Websites rendered are subject to change.**

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ASIA PACIFIC

Opportunity to share information on Stockholm Convention chemicals

2022-10-10

We are inviting industry sectors and governments to share information on how they use and dispose of per and poly fluoroalkyl substances (PFAS) chemicals listed on the Stockholm Convention on Persistent Organic Pollutants (POPs).

This input will inform decisions about the future management of PFAS chemicals under the Industrial Chemicals and Environmental Management Standard (IChEMS).

IChEMS consultation on perfluorooctanesulfonic acid (PFOS), perfluorohexanesulfonic acid (PFHxS), perfluorooctanoic acid (PFOA) and related substances is open from 19 October 2022.

The IChEMS is focused on stronger, more consistent management of industrial chemicals to minimise harm to the environment in the first place. This industry-focused call for information is different to the current public consultation regarding the PFAS National Environmental Management Plan (NEMP). The PFAS NEMP provides information on how to investigate, assess, and manage PFAS once it has entered the environment.

IChEMS aims to prevent pollution by providing nationally consistent standards to help industry and governments manage the environmental risks associated with industrial chemicals. This IChEMS consultation is seeking information on the import, use and disposal of PFAS substances listed on the Stockholm Convention, to inform beginning of supply chain management of these chemicals.

This call for information is most relevant to chemical importers, chemical manufacturers, the hazardous waste industry, and businesses that handle PFAS substances. This includes businesses that import, manufacture or use goods containing PFAS substances.

To have your say, visit our consultation hub before submissions close on 14 December 2022.

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Read More

Department of Climate Change, Energy, the Environment and Water, 10-10-22

<https://www.dcceew.gov.au/environment/protection/chemicals-management/national-standard>

PFAS National Environmental Management Plan (PFAS NEMP)

2022-10-10

The PFAS NEMP 3.0 is currently open for public consultation.

The Heads of EPAs of Australia and New Zealand (HEPA) have released the draft per- and poly-fluoroalkyl substances National Environmental Management Plan (PFAS NEMP) version 3.0 for public consultation. This version 3.0 contains important new guidance and standards, which builds on version 2.0 published in 2020.

All states, territories and the Australian Government have collaborated to develop the PFAS National Environmental Management Plan (PFAS NEMP) version 2.0. The final PFAS NEMP 2.0 was agreed by Heads of EPAs in October 2019 and published in May 2020.

The PFAS NEMP 2.0 is now being implemented in the Commonwealth and other jurisdictions, subject to Ministerial approvals as set out in the plan.

It has incorporated feedback from the public consultations held in 2019 on the draft PFAS NEMP 2.0.

Read More

Department of Climate Change, Energy, the Environment and Water, 10-10-22

<https://www.dcceew.gov.au/environment/protection/chemicals-management/pfas>

New hazardous substances separation distances calculation tool

2022-10-27

We have developed a tool to help businesses calculate the separation distances required for the hazardous substances they use, manufacture or store.

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This tool is based on the Health and Safety at Work (Hazardous Substances) Regulations 2017, which requires some hazardous substances to be separated from protected and public places by distances, based on the hazard classification of the substance, the quantity on site and the nature of the site.

[Read More](#)

New Zealand Worksafe, 27-10-22

<https://engage.ubiquity.co.nz/mail/view/71cng8jw65c4k6hn13fbpmw47n00v8fj9nx1b6bdllly0knrgj12vcd9xcp8pysdm9g4nb26vn5jk6s9k6ccs2>

Preventing harm from hydrogen sulphide

2022-10-27

Hydrogen sulphide (H₂S) is a highly toxic, colourless gas which occurs in a variety of natural and industrial settings. This quick guide provides information on the risks and effects of exposure to hydrogen sulphide, where it can be found, and how to manage the risks.

What this guide is about

This quick guide is for any persons conducting a business or undertaking (PCBUs) whose work may expose workers and other people to hydrogen sulphide.

PCBUs must ensure, so far as is reasonably practicable, the health and safety of workers and other people are not put at risk by their work.

In this quick guide, 'you' means the PCBU.

What is hydrogen sulphide and where can it be found?

What is hydrogen sulphide?

Hydrogen sulphide (H₂S) is a highly toxic, colourless (transparent) gas which is heavier than air. The gas is corrosive and flammable.

Hydrogen sulphide can paralyse a person's breathing system and kill in minutes. Even in small amounts, it can be dangerous to health.

Where can hydrogen sulphide be found?

Hydrogen sulphide is naturally occurring in geothermal areas and is emitted from volcanoes, undersea vents, swamps and stagnant bodies of water.

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It is often a by-product of some industrial processes (see Table 1 below). It is important for PCBUs and workers to understand the risks or likelihood of exposure to hydrogen sulphide.

[Read More](#)

New Zealand Worksafe, 27-10-22

<https://www.worksafe.govt.nz/topic-and-industry/hazardous-substances/guidance/substances/preventing-harm-from-hydrogen-sulphide/>

AMERICA

Members Of The House Science Committee Introduce Methane Emissions Research Bills

2022-10-21

On September 28, 2022, three House Science Committee members introduced legislation to address methane emissions and strengthen emissions research:

- Chair Eddie Bernice Johnson (D-TX) introduced the Methane Emissions Research Act (H.R. 8991), which would create a pilot study at EPA to quantify methane emissions from oil and gas infrastructure in the United States.
- Representative Don Beyer (D-VA) introduced a bill (H.R. 8992) to address methane "super-emitters" in oil and gas operations. Beyer's September 28, 2022, press release states that the bill "addresses a finding of the Committee on Science, Space, and Technology's investigation into oil and gas sector methane leaks and June 8, 2022 hearing on the same topic, which determined that oil and gas companies are failing to address super-emitting leaks."
- Representatives Sean Casten (D-IL) and Peter Meijer (R-MI) introduced the Methane Emissions Mitigation Research and Development Act (H.R. 8993) to reduce methane emissions. According to Casten's September 28, 2022, press release, the bill directs the Department of Energy (DOE) to coordinate a technical assistance program to work with state and local governments, as well as private industry, to reduce methane emissions and protect public safety.

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JDSupra, 21-10-22

<https://www.jdsupra.com/legalnews/wrap-up-of-federal-and-state-chemical-8193947/>

The plastics industry says advanced recycling is a solution to the plastic waste crisis. But environmental groups disagree.

2022-10-22

The plastics industry says there is way to help solve the crisis of plastic waste plaguing the planet's oceans, beaches and lands— recycle it, chemically.

Chemical recycling typically uses heat or chemical solvents to break down plastics into liquid and gas to produce an oil-like mixture or basic chemicals. Industry leaders say that mixture can be made back into plastic pellets to make new products.

“What we are trying to do is really create a circular economy for plastics because we think it is the most viable option for keeping plastic out of the environment,” said Joshua Baca, vice president of the plastics division at the American Chemistry Council, the industry trade association for American chemical companies.

ExxonMobil, New Hope Energy, Nexus Circular, Eastman, Encina and other companies are planning to build large plastics recycling plants. Seven smaller facilities across the United States already recycle plastic into new plastic, according to the ACC. A handful of others convert hard-to-recycle used plastics into alternative transportation fuels for aviation, marine and auto uses.

But environmental groups say advanced recycling is a distraction from real solutions like producing and using less plastic. They suspect the idea of recyclable plastics will enable the steep ramp up in plastic production to continue. And while the amount produced globally grows, recycling rates for plastic waste are abysmally low, especially in the United States.

Plastic packaging, multi-layered films, bags, polystyrene foam and other hard-to-recycle plastic products are piling up in landfills and in the environment, or going to incinerators.

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Judith Enck, the founder and president of Beyond Plastics, says plastics recycling doesn't work and never will. Chemical additives and colorants used to give plastic different properties mean that there are thousands of types, she said. That's why they can't be mixed together and recycled in the conventional, mechanical way. Nor is there much of a market for recycled plastic, because virgin plastic is cheap, she said.

Read More

Chicago Tribune, 22-10-22

<https://www.chicagotribune.com/nation-world/ct-aud-nw-advanced-plalstic-recycling-20221021-7yohlsmsevg7jgzodt43uqeeva-story.html>

Congress Passes Bill Funding Federal Government Through December 16, 2022

2022-10-21

On September 29, 2022, the Senate passed an amended bill (H.R. 6833) to appropriate funding at the levels and under the conditions provided in fiscal year 2022 appropriations acts for continuing projects and activities, with exceptions including for technical budgetary issues and certain extensions and authorities. The House agreed to the amended bill on September 30, 2022. Spending under the continuing resolution will be charged to the full-year appropriations bills when such bills are enacted. The appropriations and authorities provided by the continuing resolution will continue through the earlier of December 16, 2022, or the enactment of the applicable appropriations act.

Read More

JDSupra, 21-10-22

<https://www.jdsupra.com/legalnews/wrap-up-of-federal-and-state-chemical-8193947/>

Only 5% of plastic waste generated by US last year was recycled, report says

2022-10-24

Only 5% of the mountains of plastic waste generated by US households last year was recycled, according to new research by Greenpeace.

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Americans discarded 51m tons of wrappers, bottles and bags in 2021 – about 309lb of plastic per person – of which almost 95% ended up in landfills, oceans or scattered in the atmosphere in tiny toxic particles.

The plastics problem is not just down to wanton consumerism or laziness – in fact the situation would still be bad even if every household separated every piece of plastic and disposed of it in a dedicated recycling plant, according to Greenpeace.

Not a single type of plastic packaging in the US meets the definition of recyclable used by the Ellen MacArthur Foundation's new plastic economy initiative, the report found.

Even plastics long considered recyclable – bottles and jugs (PET #1 and HDPE #2) – fall far short of the 30% recycling rate needed to meet the definition of recyclable by the foundation. The reprocessing rate for the rest of the plastics used by millions of people everyday to wrap leftovers, eat takeout or return unwanted online purchases is less than 5%.

The recycling sham will anger those who have spent time diligently washing out plastic containers and bottles, in the belief that they'd end up reprocessed and repurposed into another plastic package the world probably didn't need.

Read More

The Guardian, 24-10-22

<https://www.theguardian.com/us-news/2022/oct/23/us-plastic-waste-recycled-2021-greenpeace>

EUROPE

France becomes latest country to leave controversial energy charter treaty

2022-10-22

France has become the latest country to pull out of the controversial energy charter treaty (ECT), which protects fossil fuel investors from policy changes that might threaten their profits.

Speaking after an EU summit in Brussels on Friday, French president, Emmanuel Macron, said: "France has decided to withdraw from the energy

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charter treaty." Quitting the ECT was "coherent" with the Paris climate deal, he added.

Macron's statement follows a recent vote by the Polish parliament to leave the 52-nation treaty and announcements by Spain and the Netherlands that they too wanted out of the scheme.

Earlier on Friday, an ally of Macron's in Brussels, the French MEP Pascale Canfin, said: "We need to exit the energy charter treaty because we end up being sued by multinational companies through private tribunals which prevent us carrying out our climate policies."

The European Commission has proposed a "modernisation" of the agreement, which would end the writ of the treaty's secret investor-state courts between EU members. That plan is expected to be discussed at a meeting in Mongolia next month.

A French government official said Paris would not try to block the modernisation blueprint within the EU or at the meeting in Mongolia. "But whatever happens, France is leaving," the official said.

Read More

The Guardian, 22-10-22

<https://www.theguardian.com/world/2022/oct/21/france-becomes-latest-country-to-leave-controversial-energy-charter-treaty>

EFSA Goal to Improve Food Safety Risk Assessment with Better Chemical Exposure Science by 2030

2022-10-27

Through a project called ExpoAdvance, by 2030, the European Food Safety Authority (EFSA) and its EU partners aim to be ready for the routine implementation of human health risk assessments regarding aggregate, dietary and non-dietary exposure to chemicals. Within the same time frame, the agency also strives to improve its exposure assessment for mixtures of multiple chemicals, and developed a roadmap for action.

According to the EU Chemical Strategy for Sustainability, chemical risk assessment must evolve to account for different routes and sources of exposure. The objective of ExpoAdvance is to improve EFSA's chemical exposure assessments—which are not currently conducted in a consistent manner—to better address human health risk assessment needs. Dietary chemical exposure assessments are a regular part of EFSA's food and

Quitting the ECT, which protects fossil fuel investors from policy changes that might threaten their profits, was 'coherent' with Paris climate deal, Macron said.

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feed risk assessment; however, exposure through all routes (aggregate exposure) is rarely quantified, despite the fact that non-dietary exposure is often acknowledged.

[Read More](#)

Food Safety Magazine, 27-10-22

<https://www.food-safety.com/articles/8099-efsa-goal-to-improve-food-safety-risk-assessment-with-better-chemical-exposure-science-by-2030>

INTERNATIONAL

Protected bike lanes can help cities cut emissions. Bogota's \$130 million investment proves it

2022-10-24

If you want to ride a bike from one side of Bogotá, Colombia, to the other, it's possible to make the entire trip on protected bike lanes—paths that are fully separated from car traffic. The city has 368 miles of protected lanes, and a new report calculates what that means for carbon emissions: Each year, it eliminates around 22,000 metric tons of CO₂, or roughly as much carbon as could be captured by planting between 300,000 and 400,000 new trees.

Researchers from the nonprofit Institute for Transportation and Development Policy counted how many people were riding in protected lanes in Bogotá, and did the same thing in Guangzhou, China, another city with a large network of this type of bike lane. Then they surveyed riders to find out how many would have driven if the lanes didn't exist. Around 6% said they would have used a car.

The climate benefit would likely be much bigger in an American city since more Americans own cars, and most car trips are relatively short and could be replaced by biking. But that hasn't been possible to test yet. "Unfortunately, no cities in the U.S. have yet built a network of bicycle lanes that are large enough to analyze," says Taylor Reich, a senior research associate at the Institute for Transportation and Development Policy (ITDP).

To make biking seem like a viable, safe alternative to more people, cities need a full network of protected lanes. "The larger the network, the greater the impact," Reich says. "The important thing is for the maximum number of people, jobs, services, and other destinations to be [less than a fifth of

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a mile] from a protected bicycle lane. A bicycle lane on a single street will only be useful if it becomes part of a larger network."

[Read More](#)

Fast Company, 24-10-22

<https://www.fastcompany.com/90799071/protected-bike-lanes-can-help-cities-cut-emissions-bogotas-130-million-investment-proves-it>

Are you climbing Mount Everest, or just going to work?

2022-10-24

I've spent a lot of time discussing the importance of chemical substitution at different meetings and conferences, and pretty much heard all the arguments.

But one thing I heard an industry rep say recently that really stuck to my mind was that "substitutes shall only be accepted if they have the exact same performance".

"Oh my God", I thought to myself. With this way of thinking, no chemical will ever be substituted.

Many companies view performance and functionality as something sacred, and to intentionally lower the performance of a product is completely out of the question. "Our customers expect this level of performance and functionality from our products", companies often argue.

Well, perhaps that's true. But even if they expect their normal everyday raincoat to have a water-repellent function, they do not assume they should be able to climb Mount Everest with it.

And they certainly do not expect the jacket to contain toxic chemicals.

Unfortunately, gear used to climb high mountains often contain PFAS but, hopefully, these toxic chemicals can soon be phased out from these high-performance products as well.

[Read More](#)

Chemsec, 24-10-22

<https://chemsec.org/are-you-climbing-mount-everest-or-just-going-to-work/>

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What the F-gases!?

2022-10-24

“What are F-gases?”, you might ask. Although you may not have heard this term before, you surely know of them. They’ve acted as cooling chemicals in air conditioners and refrigerators since they were first developed in the 1930’s. But the question is to what cost?

Freons. You know the ones that were in your fridge when you were young but later got banned when it was found out that freons lead to depletion of the ozone layer? This was the first generation of fluorinated and chlorinated refrigerants — or F-gases — developed back in the 1930’s to solve the world’s cooling needs.

History repeats itself

When they were targeted by the Montreal Protocol in 1987 due to their environmental impact, a second generation of F-gases was born — the so-called HFCs. The old-timers were replaced with the newcomers, but it turned out to be a very unfortunate substitution since HFCs have a very high global warming potential (GWP).

Having tried two fluorinated ways to destroy the planet via air conditioning, it was time to try a third one — HFOs — when it was decided to phase out HFCs through the F-gas regulation in 2015. And, as sad as it seems, we now have yet another regrettable substitution on our hands.

[Read More](#)

Chemsec, 24-10-22

<https://chemsec.org/what-the-f-gases>

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REACH Update

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EEA countries can soon notify to SCIP database

2022-10-26

From 7 November, companies from Iceland, Liechtenstein and Norway can submit notifications on their products containing substances of very high concern to ECHA.

Helsinki, 25 October 2022 - The obligation to submit notifications to ECHA’s database of substances of concern in products (SCIP) has been extended to also cover companies supplying articles in the European Economic Area (EEA): Iceland, Liechtenstein and Norway. From 7 November, the database will be ready to receive their notifications. This change comes as the amendment to the Waste Framework Directive has been incorporated into the EEA Agreement.

For EU countries, the duty to submit SCIP notifications started in January 2021. The database now includes 8.7 million searchable article notifications, from over 8 600 companies across the EU.

SCIP is the EU’s first public database of products with substances of very high concern. It was established under the Waste Framework Directive. The database enables consumers to make more informed purchasing choices and helps waste operators to further develop the re-use of articles and the recycling of materials.

[Read More](#)

ECHA, 26-10-22

<https://echa.europa.eu/pt/-/eea-countries-can-soon-notify-to-scip-database>

Call for evidence: screening report on six sodium perborates

2022-10-26

We are looking for relevant information on the uses in products (articles), and release potential from articles of six sodium perborates. As required by REACH Article 69(2), we are investigating whether the use of these substances in articles is adequately controlled, and if a restriction is needed.

The deadline for comments is 7 December 2022.

Assessment of regulatory needs reports published

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REACH Update

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Reports have been published for groups of:

- Polyol amines; and
- Ditrizaine stilbenedisulfonic acid dyes (optical brighteners).

You can filter the list with the group name to get a full list of the substances within each group and access the reports.

Testing proposals

We have launched 34 new consultations on testing proposals. The deadline for comments is 12 December 2022.

There are currently 64 open consultations on testing proposals.

Read More

ECHA, 26-10-2022

<https://echa.europa.eu/>

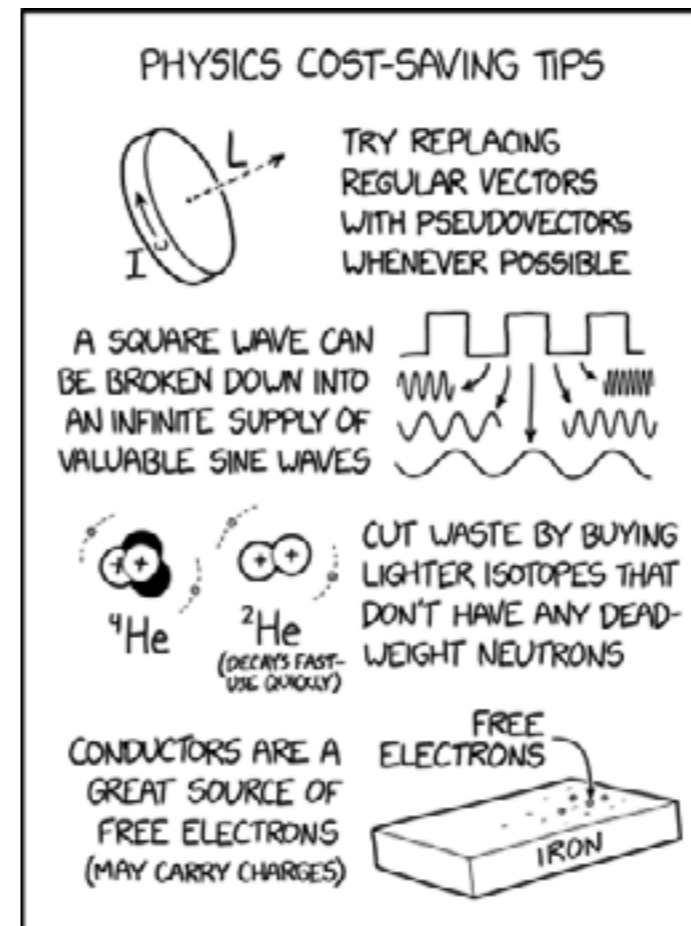
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Physics Cost-Saving Tips

2022-11-04



<https://xkcd.com/2649/>

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Hazard Alert

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Zinc Oxide

2022-11-04

Zinc oxide is an inorganic compound with the formula ZnO. Synthetic ZnO is primarily used as a white powder that is insoluble in water, or naturally as the mineral zincite. The powder is widely used as an additive in numerous materials and products including plastics, ceramics, glass, cement, rubber (e.g., car tires), lubricants, paints, ointments, adhesives, sealants, pigments, foods (source of Zn nutrient), batteries, ferrites, fire retardants, and first aid tapes. ZnO occurs as white powder known as zinc white or as the mineral zincite. The mineral usually contains manganese and other impurities that confer a yellow to red colour. Crystalline zinc oxide is thermochromic, changing from white to yellow when heated and in air reverting to white on cooling. This colour change is caused by a small loss of oxygen to the environment at high temperatures to form the non-stoichiometric $Zn_{1-x}O$, where at 800 °C, $x = 0.00007$. Zinc oxide is also an amphoteric oxide. It is nearly insoluble in water and alcohol, but it is soluble in (degraded by) most acids, such as hydrochloric acid. [1]

USES [1]

There are many applications for zinc oxide powder. Most applications exploit the reactivity of the oxide as a precursor to other zinc compounds. For material science applications, zinc oxide has high refractive index, high thermal conductivity, binding, antibacterial and UV-protection properties. Consequently, it is added into materials and products including plastics, ceramics, glass, cement, rubber, lubricants, paints, ointments, adhesive, sealants, pigments, foods, batteries, ferrites and fire retardants.

Rubber Industry

About 50% of ZnO use is in the rubber industry. Zinc oxide along with stearic acid is used in the vulcanisation of rubber. In addition, ZnO additive protect rubber from fungi and UV light.

Concrete Industry

Zinc oxide is widely used for concrete manufacturing. Addition of ZnO improves the processing time and the resistance of concrete against water.

Medical Uses

Medical uses of zinc oxide include the production of calamine via a mixture of zinc oxide with about 0.5% iron (III) oxide (Fe₂O₃). Calamine is then used to produce calamine lotion. There are also two minerals,

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zincite and hemimorphite, which have been historically called calamine. When mixed with eugenol, a ligand, zinc oxide eugenol is formed, which has applications as a restorative and prosthodontics in dentistry. Reflecting the basic properties of ZnO, fine particles of the oxide have deodorising and antibacterial properties and for that reason are added into materials including cotton fabric, rubber, and food packaging. Enhanced antibacterial action of fine particles compared to bulk material is not intrinsic to ZnO and is observed for other materials, such as silver. This property is due to the increased surface area of the fine particles. Zinc oxide is widely used to treat a variety of other skin conditions, in products such as baby powder and barrier creams to treat diaper rashes, calamine cream, anti-dandruff shampoos, and antiseptic ointments. In addition, it is a component in tape (called "zinc oxide tape") used by athletes as a bandage to prevent soft tissue damage during workouts. Zinc oxide can be used in ointments, creams, and lotions to protect against sunburn and other damage to the skin caused by ultraviolet light. When used as an ingredient in sunscreen, zinc oxide sits on the skin's surface and is not absorbed into the skin, and blocks both UVA (320–400 nm) and UVB (280–320 nm) rays of ultraviolet light.

Cigarette Filters

Zinc oxide is a constituent of cigarette filters for removal of selected components from tobacco smoke. A filter consisting of charcoal impregnated with zinc oxide and iron oxide removes significant amounts of HCN and H₂S from tobacco smoke without affecting its flavour.

Food Additive

Zinc oxide is added to many food products, including breakfast cereals, as a source of zinc, a necessary nutrient. Some pre-packaged foods also include trace amounts of ZnO even if it is not intended as a nutrient.

Pigment

Zinc white is used as a pigment in paints and is more opaque than lithopone, but less opaque than titanium dioxide. It is also used in coatings for paper. Chinese white is a special grade of zinc white used in artists' pigments. It is also a main ingredient of mineral makeup.

Coatings

Paints containing zinc oxide powder have long been utilised as anticorrosive coatings for metals. They are especially effective for galvanized iron. Iron is difficult to protect because its reactivity with

Zinc oxide is an inorganic compound with the formula ZnO.

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organic coatings leads to brittleness and lack of adhesion. Zinc oxide paints retain their flexibility and adherence on such surfaces for many years. Plastics, such as polyethylene naphthalate (PEN), can be protected by applying zinc oxide coating. The coating reduces the diffusion of oxygen with PEN. Zinc oxide layers can also be used on polycarbonate (PC) in outdoor applications. The coating protects PC from solar radiation and decreases the oxidation rate and photo-yellowing of PC.

Corrosion prevention in nuclear reactors

Zinc oxide depleted in the zinc isotope with the atomic mass 64 is used in corrosion prevention in nuclear pressurised water reactors. The depletion is necessary, because ^{64}Zn is transformed into radioactive ^{65}Zn under irradiation by the reactor neutrons.

ROUTES OF EXPOSURE [2]

Exposure to zinc oxide can occur through inhalation, ingestion, and eye or skin contact.

HEALTH HAZARDS [2]

Zinc oxide dust is primarily a nuisance dust, but exposures to high concentrations can result in respiratory system effects in humans. Volunteers inhaling 600 mg/m³ zinc oxide dust for 10 minutes exhibited persistent rales, decreased vital capacity, coughing, upper respiratory tract irritation and substernal pain. Studies have reported that exposures to concentrations up to 430 mg/m³ zinc oxide resulted in chest pain [ACGIH 1991, p. 1755]. Inhalation of zinc oxide fume can result in metal fume fever. In itself, this is a self limiting condition characterised by flu-like symptoms, which resolve within 24 to 48 hours. Repeated exposures to zinc oxide by skin contact have resulted in papular-pustular skin eruptions in the axilla, inner thigh, inner arm, scrotum and pubic areas. Epidemiologic studies of zinc refinery workers found no correlation between industrial zinc exposures and lung or other types of cancer.

Signs and symptoms of exposure

- Acute exposure: Acute exposure to zinc oxide can result in coughing, substernal pain, upper respiratory tract irritation, rales, chills, fever, nausea, and vomiting.

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- Chronic exposure: Chronic exposure to zinc oxide by skin contact may result in papular-pustular skin eruptions in the axilla, inner thigh, inner arm, scrotum and pubic areas.

SAFETY

Exposure Sources and Control Methods

Exposure to zinc oxide may occur through the following operations:

- The manufacture and transportation of zinc oxide
- Use as a white pigment in rubber formulations and as a vulcanising agent
- Use in cosmetics, ointments, and electronic devices
- Use as a UV absorber in plastics, ceramics, floor tile, and glass
- Use in seed treatments, food additives, photoconductors, and in colour photography

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.
- Ingestion: Do NOT induce vomiting unless directed to do so by medical personnel. Never give anything by mouth to an unconscious person. Loosen tight clothing such as a collar, tie, belt or waistband. Get medical attention if symptoms appear.

Exposure Control/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: Safety glasses, lab coat, dust respirator (Be sure to use an approved/certified respirator or equivalent), gloves.

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- Personal Protection in Case of a Large Spill: Splash goggles, full suit, dust respirator, boots, gloves. A self contained breathing apparatus should be used to avoid inhalation of the product. Suggested protective clothing might not be sufficient; consult a specialist BEFORE handling this product.
- Exposure Limits: TWA: 5 STEL: 10 (mg/m³) from ACGIH (TLV) [United States] Inhalation TWA: 15 (mg/m³) from OSHA (PEL) [United States] Inhalation Total. TWA: 5 STEL: 10 CEIL: 25 (mg/m³) from NIOSH Inhalation TWA: 5 STEL: 10 (mg/m³) from OSHA (PEL) [United States] Inhalation Respirable.

REFERENCES

1. http://en.wikipedia.org/wiki/Zinc_oxide
2. <http://www.osha.gov/SLTC/healthguidelines/zincoxide/recognition.html>
3. <http://www.sciencelab.com/msds.php?msdsId=9927329>

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Scientists map key protein structure of hepatitis C virus

2022-10-20

A team led by scientists at Scripps Research and the University of Amsterdam has achieved an important goal in virology: mapping, at high resolution, critical proteins that stud the surface of the hepatitis C virus (HCV) and enable it to enter host cells.

The discovery, reported in Science on October 21, 2022, details key sites of vulnerability on the virus—sites that can now be targeted effectively with vaccines.

“This long sought-after structural information on HCV puts a wealth of previous observations into a structural context and paves the way for rational vaccine design against this incredibly difficult target,” says study co-senior author Andrew Ward, Ph.D., professor in the Department of Integrative Structural and Computational Biology at Scripps Research.

The study was the product of a multi-year collaboration that included the Ward laboratory, the lab of Gabriel Lander, Ph.D. (also a professor in the Department of Integrative Structural and Computational Biology at Scripps Research); the lab of Rogier Sanders, Ph.D., of the University of Amsterdam; and the lab of Max Crispin, DPhil, at the University of Southampton.

It is projected that roughly 60 million people globally—including about two million Americans—have chronic HCV infections. The virus infects liver cells, typically establishing a “silent” infection for decades until liver damage becomes severe enough to cause symptoms. It is a leading cause of chronic liver disease, liver transplants and primary liver cancers.

The origins of the virus are uncertain, but it is thought to have emerged at least several hundred years ago, and then eventually spread globally—especially via blood transfusions—in the latter half of the 20th century. While the virus was mostly eliminated from blood banks after its initial discovery in 1989, it continues to spread chiefly via needle-sharing among intravenous drug users in developed countries, and by the use of unsterilized medical instruments in developing countries. The leading HCV antiviral drugs are effective but far too expensive for large-scale treatment.

An effective vaccine could eventually eliminate HCV as a public health burden. However, no such vaccine has ever been developed—largely because of the extraordinary difficulty in studying HCV’s envelope protein complex, which is made of two viral proteins called E1 and E2.

The virus infects liver cells, typically establishing a “silent” infection for decades until liver damage becomes severe enough to cause symptoms.

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“The E1E2 complex is very flimsy—it’s like a bag of wet spaghetti, always changing its shape—and that’s why it’s been extremely challenging to image at high resolution,” says co-first author Lisa Eshun-Wilson, Ph.D., a postdoctoral research associate in both the Lander and Ward labs at Scripps Research.

In the study, the researchers found that they could use a combination of three broadly neutralizing anti-HCV antibodies to stabilize the E1E2 complex in a natural conformation. Broadly neutralizing antibodies are those that are able to protect against a broad range of viral strains, by binding to relatively non-varying sites on the virus in ways that interrupt the viral life cycle.

The researchers imaged the antibody-stabilized protein complex using low-temperature electron microscopy. With the help of advanced image-analysis software, the researchers were able to generate an E1E2 structural map of unprecedented clarity and extent—at near-atomic scale resolution.

Details included most of the E1 and E2 protein structures, including the key E1/E2 interface, and the three antibody-binding sites. The structural data also illuminated the thicket of sugar-related “glycan” molecules atop E1E2. Viruses often use glycans to shield themselves from the immune system of an infected host, but in this case, the structural data showed that HCV’s glycans apparently have another key role: in helping to hold the flimsy E1E2 complex together.

Having these details of E1E2 will help researchers rationally design a vaccine that powerfully elicits these antibodies to block HCV infection.

“The structural data also should allow us to discover the mechanisms by which these antibodies neutralize HCV,” says co-first author Alba Torrents de la Peña, Ph.D., a postdoctoral researcher in the Ward lab.

Phys Org, 20 October 2022

<https://phys.org>

Adult Brain Structure Is Not Fixed: Scientists Discover Depression Treatment Increases Brain Connectivity

2022-10-20

Most scientists believe that the structure of the adult brain is generally rigid and incapable of rapid changes. However, new research has now revealed that this is not true. In a new study, German scientists have shown that in-patient treatment for depression can lead to an increase in

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brain connectivity. Moreover, those individuals who respond well to this treatment show a greater increase in connectivity than those who don’t.

Presenting the work at the European College for Neuropsychopharmacology Congress in Vienna, lead researcher, Professor Jonathan Repple said:

“This means that the brain structure of patients with serious clinical depression is not as fixed as we thought, and we can improve brain structure within a short time frame, around 6 weeks. We found that if this treatment leads to an increase in brain connectivity, it is also effective in tackling depression symptoms. This gives hope to patients who believe nothing can change and they have to live with a disease forever, because it is “set in stone” in their brain.”

Working at the University of Muenster in Germany, the scientists studied 109 patients with serious depression (Major Depressive Disorder) and compared them with 55 healthy controls. Participants’ brains were scanned using an MRI scanner that had been set up to identify which parts of the brain were communicating with other parts as a way of measuring the level of connections within the brain. The patients were then treated for depression, some with electroconvulsive therapy (ECT), some with psychological therapy or medication, and some with a combination of all therapies. After treatment, the study participants were then rescanned using MRI to measure the number of brain connections. They were also retested for symptoms of depression.

Professor Repple (now Professor of Predictive Psychiatry at the University of Frankfurt) said:

“We found that treatment for depression changed the infrastructure of the brain, which goes against previous expectations. Treated patients showed a greater number of connections than they had shown before treatment. Moreover, those who showed the most response to treatment developed a greater number of new connections than those who showed little response. A second scan showing that there are no time effects in healthy controls supports our findings that we see something that is related to the disease and more importantly the treatment of this disease.

“We found these changes took place over a period of only around 6 weeks, we were surprised at the speed of response. We don’t have an explanation as to how these changes take place, or why they should happen with such different forms of treatment.”

This gives hope to patients who believe nothing can change and they have to live with a disease forever, because it is “set in stone” in their brain.

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Commenting, Dr. Eric Ruhe, Rabdoud University Medical Center, Nijmegen, the Netherlands said:

“This is a very interesting and difficult-to-perform study in which the authors repeated MRI scans to reveal changes in structural connectivity over time in patients treated for depression.

“The results align very much with our current belief that the brain has much more flexibility in adaptation over (even short) time than was previously thought. Indeed a major idea of what treatment of depression (and other psychiatric illnesses) invoke is plastic changes over time. This has been proposed as a common mechanism for antidepressants, psychotherapy, and electroconvulsive therapy. However, the amount of research to elucidate what changes are necessary or specific for response to treatment or remission of depression is limited. Moreover, the next question is whether different treatments have the possibility to specifically change targeted brain networks or vice versa whether we can use the disturbances in brain-networks as measured in the present study to choose which therapy will be helpful.

“The fact that the observed changes over time could not be associated with a form of treatment is a pity, but as the authors themselves suggest a topic for further research. First these results should be replicated in independent samples which hopefully is going to happen soon. Second further elaboration on this approach would be daunting and should be supported firmly as this work might help to bridge the current gap between neuroscience and evidence-based patient care.”

This is an independent comment, Dr. Ruhe was not involved in this study.

This work was presented at the 35th European College of Neuropsychopharmacology annual conference, which took place in Vienna. The ECNP is Europe’s main organization working in applied neuroscience.

Sci Tech Daily, 20 October 2022

<https://scitechdaily.com>

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For the first time, natural gas production linked to lower birth weights in a national study

2022-10-21

Across the U.S., birth weights have declined as rates of natural gas production have increased, according to a new, first-of-its-kind national study.

While previous studies linked increases in fracking and natural gas production to lower birth weights in high-producing states like Texas and Pennsylvania, this is the first to examine associations across states where extraction occurs.

“Those single-state studies are important, but you have to consider whether that information is generalizable to other parts of the country,” Summer Sherburne Hawkins, an associate professor at the Boston College School of Social Work and senior author of the study, told EHN. “With our study, we’re able to say that this is not unique to a specific state, but is true across the country.”

The study, published in the journal Preventive Medicine Reports, found that every 10% increase in natural gas development in U.S. counties is associated with a corresponding decrease in average birth weight of 1.48 grams, or 0.003 pounds. Among women of color, the impact was more significant: With every 10% increase in natural gas production, Asian babies’ average birth weight decreased by 2.76 grams, or 0.006 pounds; and Black babies’ average birth weight decreased by 10.19 grams, or 0.02 pounds.

“That might not seem like a lot, but in some parts of the U.S. rates of natural gas production are increasing by thousands of percentage points over a very short period of time,” Hawkins said. “Lots of states are considering increasing production and this research allows us to predict the potential implications for public health.”

Low birth weight is associated with higher rates of infant mortality, poor lung development, problems with growth and cognitive development, and increased risk of health problems later in life, including diabetes, heart disease, high blood pressure and developmental disabilities.

The study didn’t look at how natural gas production could cause lower birth weight, but previous research shows harmful chemicals emitted from wells increase levels of air pollution in nearby communities. Exposure to air

“We know communities of color and low-income communities bear a disproportionate burden of environmental hazards.”

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pollution has also been linked to low birth weight. Water contamination caused by spills on and near well pads could also be a contributing factor.

Environmental justice concerns

To conduct the research, Hawkins and her colleagues looked at more than 33.8 million birth records from 2005 to 2018 from 1,984 counties in the 28 states where natural gas production occurred. They compared birth weights during that period with nine-month county-level averages of natural gas production at both conventional and fracking wells.

Jill Johnston, an associate professor at the University of Southern California Los Angeles who has researched the health impacts of fracking but was not involved in this study, said the findings are significant.

“There have been very few national scale studies that look at these kinds of health impacts,” Johnston told EHN. “It’s a real strength to be able to look more broadly across the U.S. and see that these impacts are happening in many different communities, even if they haven’t been the focus of prior research like places with more intensive shale development.”

Johnston noted that previous investigations on racial disparities in the health impacts of oil and gas development have been limited.

“I think this adds to the evidence that the adverse health impacts associated with these kinds of activities should be taken into account, particularly when permitting new wells in environmental justice communities,” she said. “We should be thinking about the cumulative burden and considering more health protective policies for these vulnerable populations.”

While the study didn’t examine why women of color could be more susceptible to birth weight impacts from natural gas development, previous research suggests that women of color are more likely to experience other environmental and social factors that negatively impact birth outcomes.

“We know communities of color and low-income communities bear a disproportionate burden of environmental hazards,” Hawkins said. “Our study indicates that adding new oil and gas development to communities that already face environmental injustice may be compounding these

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effects — not just for the current population, but also for the next generation.”

Environmental Health News, 21 October 2022

<https://ehn.org>

You might think solar panels have been perfected – but we can still make them even better and cheaper

2022-10-24

The cost of turning sunlight into electricity has fallen more than 90% over the last decade. Solar is now the cheapest form of newly built energy generation.

Job done? Not quite. Right now, solar works well at cost-competitive prices and can help us cut emissions significantly. But with less than 5% of the world’s electricity delivered by solar, we are just at the start.

The solar panels of 2022 are like the chunky mobile phones of the 1990s. Much more is possible with the same underlying technology.

Australia is likely to play a key role in global progress. For decades, we’ve been at the forefront of solar technology development and deployment. We’ve held the performance record for silicon solar cells for 30 of the last 40 years. We now have more solar deployed per capita than any other OECD country, meeting close to 15% of our electricity needs. More than 80% of the world’s new solar panels rely on the PERC cell, a technology developed in Australia.

So what’s next for solar? Hundreds of researchers across Australia are focused on two goals: cutting costs even further and generating the most electricity possible out of incoming sunlight.

Why does solar need to improve?

Solar has the potential to transform our industries, transport and the way we live – if we push the technology as far as it can go.

Ultra-cheap electricity unlocks huge possibilities, from turning water into green hydrogen to serve as energy storage or to use in industrial processes, through to electrifying transport, energy systems and everything else we use fossil fuels for.

Last year, Australia’s renewable energy agency laid out its vision for ultra low-cost solar. The goal is ambitious but achievable.

The solar panels of 2022 are like the chunky mobile phones of the 1990s. Much more is possible with the same underlying technology.

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By 2030, the agency wants commercial solar cells to hit 30% efficiency, up from 22% today. It wants large scale full system costs (panels, inverters and transmission) to fall by 50% to 30 cents per watt.

It will take intensive research. More than 250 Australian researchers are working towards these goals at the Australian Centre for Advanced Photovoltaics, a collaboration between six universities and the CSIRO.

Can silicon really keep on giving?

Solar cells convert sunlight into electricity with no moving parts. When sunlight hits silicon – the material commonly used in solar cells – its energy frees up an electron able to move within the material, just as electrons move in wires or batteries.

The solar panels on your roof probably began as desert sand, melted down to silica, refined into silicon and refined again to form 99.999% pure polysilicon. For decades, this versatile material has been at the heart of solar's success. Importantly, it's scaleable – from the size of a pin head to arrays covering square kilometres.

But to get the absolute maximum out of sunlight falling on these panels, we need to go beyond silicon. We can't reach efficiencies of 30% with silicon alone.

Meet the tandem cell – a solar sandwich. Because silicon can only absorb a maximum of 34% of visible light, researchers are focused on adding layers of other materials to capture different wavelengths of light.

Perovskites are one option. This family of materials can be printed or coated from a liquid source, making them cheap to process. When we stack this material atop silicon, we see a major jump in the solar cell efficiency.

While promising, there are still problems to iron out – specifically, ensuring perovskites can last the 20 plus years we've come to expect from silicon panels.

Researchers are also looking at other materials, such as polymers and chalcogenides, a group of common minerals including sulfides which have shown promise in thin, flexible solar cells.

Any new material must not only work well at converting sunlight to electrons, but be abundant in the earth's crust, available at low cost and stable enough to ensure long lifetimes. Chalcogenides, for example, are made of common elements such as copper, tin, zinc and sulphur.

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If we can get to 30% efficiency, it would pay enormous dividends. The costs of establishing a large solar farm would be slashed. With more efficient solar cells, you need fewer panels and less land for the same power output.

It would also make fossil fuels even less competitive. Coal-fired power and car engines are around 33–35% efficient, meaning most of the energy embodied in fossil fuels is actually lost as heat and noise. You also have to pay to continuously supply the fuel. Solar and wind come at no cost once you've established the plant.

How can we cut costs further?

At present, the cost of power from new solar in Australia is A\$50 per megawatt hour. (Black coal is around \$100/Mwh.) That's according to the CSIRO's 2021–22 assessment of energy costs.

By 2030, our renewable energy agency wants to slash that to just \$15/Mwh, or 1.5 cents per kilowatt hour. Solar energy at this cost – coupled with storage – would deliver low-cost, reliable power 24/7.

Costs will come down as we increase efficiency of the solar cells, as the modules last longer, and as we come up with more cost effective ways to manufacture and deploy the solar technologies.

Ultra-low-cost solar electricity will be transformative, allowing Australia to build new capability in current and emerging industries, such as turning hydrogen and ammonia into fuel sources, the green processing of steel and aluminium and even the processing of silicon itself, so we can make more solar panels.

Even with today's technology, demand for solar is expected to double and double again in the next ten years. That means there will also be a need to figure out how the solar industry can grow sustainably – and how to recycle solar panels as early solar panels reach the end of their useful lifetimes and need renewing.

Australian innovation kickstarted the solar boom. As climate change intensifies – and the need for clean, locally produced energy grows – the sun-drenched country may once again be able to help speed up the world's transition away from fossil fuels.

The Conversation, 24 October 2022

<https://theconversation.com>

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Scientists Discover Mechanism of Hearing in Near-Atomic Detail

2022-10-21

For the first time and in near-atomic detail, scientists at Oregon Health & Science University (OHSU) have revealed the structure of the key part of the inner ear responsible for hearing.

“This is the last sensory system in which that fundamental molecular machinery has remained unknown,” said senior author Eric Gouaux, Ph.D. He is a senior scientist with the OHSU Vollum Institute and a Howard Hughes Medical Institute investigator. “The molecular machinery that carries out this absolutely amazing process has been unresolved for decades.”

Until now.

Through years of meticulous research to isolate the process that enables the inner ear to convert vibrations into sound, known as the mechanosensory transduction complex, scientists were about to painstakingly piece together the structure.

Published on October 12 in the journal *Nature*, the study revealed the structure of the key part of the inner ear responsible for hearing through cryo-electron microscopy. This discovery could point the way toward developing fresh treatments for hearing impairments, which affect more than 460 million people worldwide.

“The auditory neuroscience field has been waiting for these results for decades, and now that they are right here — we are ecstatic.” — Peter Barr-Gillespie, Ph.D.

Revealed in the study is the detailed architecture of the inner ear complex that converts vibrations into electrical impulses that the brain translates as sound. Known as mechanosensory transduction, the process is responsible for the sensations of balance and sound.

To make the discovery, scientists exploited the fact that the roundworm *Caenorhabditis elegans* harbors a mechanosensory complex very similar to that of humans.

Resolving the basic structure is the first step, according to Gouaux.

“It immediately suggests mechanisms by which one might be able to compensate for those deficits,” Gouaux said. “If a mutation gives rise to a

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defect in the transduction channel that causes hearing loss, it’s possible to design a molecule that fits into that space and rescues the defect. Or it may mean we can strengthen interactions that have been weakened.”

Hearing loss can be inherited through gene mutations that alter the proteins comprising the mechanosensory transduction complex. Or it can occur from damage, including sustained exposure to loud noise. In either case, OHSU researchers’ discovery allows scientists to visualize the complex for the first time.

The finding is an extraordinary achievement, said one leading neuroscience researcher at OHSU who was not directly involved in the research.

“The auditory neuroscience field has been waiting for these results for decades, and now that they are right here — we are ecstatic,” said Peter Barr-Gillespie, Ph.D., an OHSU research scientist and national leader in hearing research. “The results from this paper immediately suggest new avenues of research, and so will invigorate the field for years to come.”

Barr-Gillespie also serves as the chief research officer and executive vice president at OHSU.

Researchers resolved the puzzle through careful cultivation and isolation techniques involving 60 million worms over almost five years.

“We spent several years optimizing worm-growth and protein-isolation methods, and had many ‘rock-bottom’ moments when we considered giving up,” co-first author Sarah Clark, Ph.D., a postdoctoral fellow in the Gouaux lab, wrote in a research brief published by *Nature*.

Sci Tech Daily, 21 October 2022

<https://scitechdaily.com>

Big study shows that lowering blood pressure lowers risk of dementia

2022-10-26

A study across 20 countries has strengthened a link between lowering blood pressure, and reducing the risk of dementia.

The meta-analysis, published in the *European Heart Journal*, draws on clinical trial data from 28,008 participants, to show the strongest link

Dementia affects 50 million people worldwide: a number projected to triple by 2050.

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to date between medication that lowers blood pressure, and reduced dementia risk.

“We know that high blood pressure is a risk factor for dementia – especially high blood pressure in midlife, so say 40 to 65 years of age,” says lead author Dr Ruth Peters, an associate professor at the University of New South Wales and program lead for dementia in the George Institute’s Global Brain Health Initiative.

“But there has been some uncertainty about whether lowering blood pressure, especially in older adults, would reduce risk of dementia.

“What we’ve done is take five really high-quality clinical trials and combine them into one dataset, which gave us the ability to really look at this question and look at the relationship between blood pressure-lowering tablets – antihypertensives – and dementia.”

The five studies were all double-blind, randomised clinical trials – the ‘gold standard’ in medical research – with participants hailing from 20 different countries.

The average age of the participants was 69, and participants were followed up an average of four years after doing the trial.

Participants who took antihypertensives had a significantly lower chance of being diagnosed with dementia than those who took placebos.

Dementia affects 50 million people worldwide: a number projected to triple by 2050.

According to The Lancet’s 2020 Commission on dementia, treatment for hypertension (high blood pressure) is “the only known effective preventive medication for dementia,” all other methods of reducing your risk come from lifestyle and environment.

“The strength of this study is the use of individual patient data in a meta-analysis of data drawn from randomised controlled trials of blood pressure medication. This is the first time such data has been meta-analysed,” says Professor Kaarin Anstey, a senior principal research scientist at Neuroscience Research Australia and the UNSW.

“This is important for informing clinical practice,” adds Anstey, who was not involved with the study.

Professor Nicolas Cherbuin, head of the Australian National University’s Centre for Research on Ageing, Health and Wellbeing, says that the study

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is “well-designed”, and reflects research by his team showing that higher blood pressure is linked to lower brain volumes and poorer brain health.

“The diagnostic procedure and criteria used are well-established, the sample size is large, those with dementia at baseline were excluded,” says Cherbuin.

But he points out that the study didn’t find an effect of blood pressure medication on cognitive decline, and nor did it include participants with mild cognitive impairment, who would be “more likely to convert”.

Anstey points out that “inevitably” the participants in the cohort are now quite old, and thus may be different to populations developing dementia now.

“Clinical trials involve highly selected samples and often exclude diverse ethnic groups,” she adds.

“I hope that this reinforces the importance of blood pressure control for brain health,” says Peters.

But she emphasises that, while this is useful news for preventing dementia in mid-life, people of all ages can improve their brain health by other means.

“It’s not just blood pressure lowering – it has to be taken in the context of a healthy lifestyle.”

Cosmos, 26 October 2022

<https://cosmosmagazine.com>

Life on Mars: Ancient Bacteria Might Lurk Beneath Mars’ Surface

2022-10-25

A new study finds the chances of uncovering life on Mars are better than previously expected.

- Researchers simulated Mars’ harsh ionizing radiation conditions to see how long dried, frozen bacteria and fungi could survive.
- Previous studies found ‘Conan the Bacterium’ (Deinococcus radiodurans) could survive over a million years in Mars’ harsh ionizing radiation.
- A new study shatters that record, finding the hearty bacterium could survive 280 million years if buried.

Researchers simulated Mars’ harsh ionizing radiation conditions to see how long dried, frozen bacteria and fungi could survive.

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- This means evidence of life could still be dormant and buried below Mars' surface.

When the first samples from Mars are returned to Earth, scientists should be on the lookout for ancient sleeping bacteria, according to the findings of a new study.

In a first-of-its-kind study, a team of researchers has found that ancient bacteria could survive close to the surface on Mars much longer than previously assumed. Furthermore, they can survive much longer when the bacteria are buried and, thus, shielded from galactic cosmic radiation and solar protons.

These findings strengthen the possibility that if life ever evolved on Mars, its biological remains might be revealed in future missions. These future missions include ExoMars (Rosalind Franklin rover) and the Mars Life Explorer, which will carry drills to extract materials from 2 meters below the surface.

Because the scientists proved that certain strains of bacteria can survive despite Mars' harsh environment, this also means that future astronauts and space tourists could inadvertently contaminate Mars with their own hitchhiking bacteria.

The paper will be published today (October 25) in the journal *Astrobiology*. The research team included Northwestern University's Brian Hoffman and Ajay Sharma.

"Our model organisms serve as proxies for both forward contamination of Mars, as well as backward contamination of Earth, both of which should be avoided," said Michael Daly, a professor of pathology at Uniformed Services University of the Health Sciences (USU) and member of the National Academies' Committee on Planetary Protection, who led the study.

"Importantly, these findings have biodefense implications, too, because the threat of biological agents, such as Anthrax, remains a concern to military and homeland defense."

"We concluded that terrestrial contamination on Mars would essentially be permanent — over timeframes of thousands of years," said Hoffman, a senior co-author of the study. "This could complicate scientific efforts to look for Martian life. Likewise, if microbes evolved on Mars, they could be capable of surviving until present day. That means returning Mars samples could contaminate Earth."

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Hoffman is the Charles E. and Emma H. Morrison Professor of Chemistry and professor of molecular biosciences in Northwestern's Weinberg College of Arts and Sciences. He also is a member of the Chemistry of Life Processes Institute.

Simulating Mars

Mars has a harsh and unforgiving environment. The arid and freezing conditions, which average -80 degrees Fahrenheit (-63 degrees Celsius) at mid-latitudes, make the Red Planet seem inhospitable to life. Even worse: Mars is also constantly bombarded by intense galactic cosmic radiation and solar protons.

To explore whether or not life could survive in these conditions, Daly, Hoffman, and their collaborators first determined the ionizing radiation survival limits of microbial life. Then, they exposed six types of Earthling bacteria and fungi to a simulated Martian surface — which is frozen and dry — and zapped them with gamma rays or protons (to mimic radiation in space).

"There is no flowing water or significant water in the Martian atmosphere, so cells and spores would dry out," Hoffman said. "It also is known that the surface temperature on Mars is roughly similar to dry ice, so it is indeed deeply frozen."

Ultimately, the researchers determined that some terrestrial microorganisms potentially could survive on Mars over geologic timescales of hundreds of millions of years. In fact, the scientists discovered that one specific robust microbe, *Deinococcus radiodurans* (affectionately known as "Conan the Bacterium"), is particularly well-suited to surviving Mars' harsh conditions. In the novel experiments, Conan the Bacterium survived astronomical amounts of radiation in the freezing, arid environment — far outlasting *Bacillus* spores, which can survive on Earth for millions of years.

Radical radiation

To test the effects of radiation, the team exposed samples to large doses of gamma radiation and protons — typical to what Mars receives in the near subsurface — and far smaller doses, which would occur if a microorganism was deeply buried.

Then, Hoffman's team at Northwestern used an advanced spectroscopy technique to measure the accumulation of manganese antioxidants in the radiated microorganisms' cells. According to Hoffman, the size of the

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radiation dose that a microorganism or its spores can survive correlates with the amount of manganese antioxidants it contains. Therefore, more manganese antioxidants means more resistance to radiation — and more enhanced survival.

In earlier studies, previous researchers found that Conan the Bacterium, when suspended in liquid, can survive 25,000 units of radiation (or “grays”), the equivalent of about 1.2 million years just below Mars’ surface. But the new study found that when the hearty bacterium is dried, frozen, and deeply buried— which would be typical to a Martian environment — it could weather 140,000 grays of radiation. This dose is 28,000 times greater than what would kill a human.

Although Conan the Bacterium could only survive for a few hours at the surface while bathed in ultraviolet light, its lifetime improves dramatically when its shaded or located directly below Mars’ surface. Buried just 10 centimeters below the Martian surface, Conan the Bacterium’s survival period increases to 1.5 million years. And, when buried 10 meters down, the pumpkin-colored bacterium could survive a whopping 280 million years.

Looking to future missions

This astonishing survival feat is partially thanks to the bacterium’s genomic structure, the researchers found. Long suspected, the researchers discovered that Conan the Bacterium’s chromosomes and plasmids are linked together, keeping them in perfect alignment and ready for repair after intense radiation.

That means that if a microbe, similar to Conan the Bacterium, evolved during a time when water last flowed on Mars, then its living remains could still be dormant in the deep subsurface.

“Although *D. radiodurans* buried in the Martian subsurface could not survive dormant for the estimated 2 to 2.5 billion years since flowing water disappeared on Mars, such Martian environments are regularly altered and melted by meteorite impacts,” Daly said. “We suggest that periodic melting could allow intermittent repopulation and dispersal. Also, if Martian life ever existed, even if viable lifeforms are not now present on Mars, their macromolecules and viruses would survive much, much longer. That

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strengthens the probability that, if life ever evolved on Mars, this will be revealed in future missions.”

Sci Tech Daily, 25 October 2022

<https://scitechdaily.com>

New Findings Rewrite the Evolutionary Story of “Fish to Human”

2022-10-26

Researchers from the Chinese Academy of Sciences’ Institute of Vertebrate Paleontology and Paleoanthropology (IVPP) have recently found two fossil repositories in the early Silurian strata of southwest Guizhou and Chongqing that are rewriting the “from fish to human” evolutionary story.

Four different papers describing their findings were recently published in the journal *Nature*.

Humans are one of the 99.8% of species of extant vertebrates that are gnathostomes, or jawed vertebrates. The basic body plan and several key organs of humans can be traced back to the origin of gnathostomes. One of the most significant developments in the evolution of vertebrates is the emergence of jaws.

However, how this innovation occurred remains a mystery, owing to the fact that fossils of early jawed vertebrates were not discovered in large numbers until the beginning of the Devonian (419 million years ago), despite molecular data indicating that the origin of jawed vertebrates should have occurred earlier than 450 million years ago. As a result, there is a significant gap in the fossil record of early jawed vertebrates, lasting at least 30 million years from the Late Ordovician to the Silurian.

The latest findings of Zhu Min’s team from IVPP are unearthed from two new fossil depositories, shedding light on the rise of jawed vertebrates: These jawed fishes were already thriving in the waters of the South China block, at least 440 million years ago, and by late Silurian, more diverse and larger jawed fishes had evolved and began to spread around the world, opening the saga of fish landing and our humans eventually evolved.

Discoveries of fish fossils from the two depositories help to trace many human body structures back to ancient fishes, some 440 million years ago and fill some key gaps in the evolution of “from fish to human,” and provide further iron evidence to the evolutionary path.

The discovery of a fossil “treasure hoard” illuminates the rise of fishes.

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The Chongqing fish fossil depository in the Upper Red Beds of the Silurian system dates back to 436 million years ago. It is the world's only early Silurian Lagerstätte (fossil depository with exceptional preservation) which preserves complete, head-to-tail jawed fishes, providing a peerless chance to peek into the proliferating "dawn of fishes". This fossil "treasure hoard" stands among other great Chinese Lagerstätten: Chengjiang Biota and the Jehol Biota, all provide key jigsaw puzzles previously missing in the tree of life.

Sci Tech Daily, 26 October 2022

<https://scitechdaily.com>

Solar panels reduce CO2 emissions more per acre than trees, and much more than corn ethanol

2022-10-27

On September 21, the New York Times published an essay by Gabriel Popkin titled "Are There Better Places to Put Large Solar Farms Than These Forests?" Popkin describes a recently approved 4,500-acre solar project in Virginia that will remove approximately 3,500 acres of forest and asks whether such projects could be sited instead on rooftops, parking lots, and other degraded land. This blog post provides some additional information and context to Popkin's essay.

First, only a very small percentage of solar projects in the United States are currently being sited on forested lands. While Popkin correctly notes that approximately 50% of solar energy facilities, as measured by land area, are sited in deserts, the assertion that "more than four-fifths of the rest go on farmland, forestland or grasslands" requires additional context.

Specifically, it is important to understand that solar is not being sited in equal quantities on these three types of land, as farmland hosts far more solar projects (33%) than either grassland (6%) or forests (4%). For comparison, nearly 3% of solar power is currently sited in urban areas.

Second, while Popkin correctly notes that forests, like solar farms, offer climate-change benefits, the essay does not provide any information on the relative emissions benefits of forested land versus solar farms. To be clear, forests offer immense benefits that have nothing to do with carbon sequestration, including by serving as critical habitat for native flora and fauna, filtering drinking water, preventing erosion, and providing scenic and recreational benefits to millions of people. However, on the narrow but important issue of carbon dioxide emissions, an acre of solar panels

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appears to offset more emissions each year than an acre planted with trees can sequester.

In Virginia, where the primary source of electricity is natural gas, the emissions intensity of electricity is 679 pounds of carbon dioxide per megawatt-hour (MWh), not including other greenhouse gases. According to the Lawrence Berkeley National Laboratory, utility-scale solar power produces between 394 and 447 MWh per acre per year. Thus, an acre of solar panels producing zero-emissions electricity saves between 267,526 to 303,513 pounds, or 121 to 138 metric tons, of carbon dioxide per year.

By comparison, according to the EPA, the average acre of forest in the United States sequesters 0.84 metric tons of carbon dioxide per year. Thus, an acre of solar panels in Virginia reduces approximately 144 to 166 times more carbon dioxide per year than an acre of forest.

What about the carbon that is released when an acre of forest is removed? According to the EPA, the average acre of forest contains 81 metric tons of carbon, although the exact figure depends heavily on the species of trees in the forest. Approximately half of that amount is sequestered in the soil. Even if all 81 metric tons of carbon, comprising 297 metric tons of carbon dioxide, were released upon conversion to a solar farm, those emissions would be offset within 2–3 years of operation.

Third, Popkin suggests that siting solar projects on farmland may interfere with an "obvious an important use: growing food." However, solar projects can coexist with and complement agriculture, including by improving pollinator habitat and allowing animals to graze between rows of panels. The Great Plains Institute has found, for example, that "utility-scale solar can be compatible with other forms of non-cultivated agriculture like pasture and grasslands." In addition, recent research has shown that growing crops, such as tomatoes, in between rows of solar panels in hot, dry climates may increase yields by creating shade, which conserves water, increases humidity, and lowers temperatures.

Likewise, the Michigan Department of Agriculture and Rural Development has determined that "the placement of structures for commercial solar energy generation ... is consistent with farming operations," provided that certain measures are taken to maintain the integrity of agricultural land at the site, including by planting pollinator habitat and conservation cover. In addition, the income that farmers can earn by leasing out parts of their land for renewable energy projects allows them to keep the rest of their land in production while insulating them against low harvest years.

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Moreover, any discussion of a purported conflict between agriculture and energy production must also acknowledge that more than one-third of all corn grown in the United States is used not for food—or even to feed livestock—but for energy. In total, more than 30 million acres of farmland, covering an area roughly the size of Louisiana, are currently used to grow corn for ethanol. All of that land could be redeployed to solar energy production without affecting food production.

Importantly, converting the land currently used for growing corn ethanol to solar energy would greatly increase the amount of energy produced on that land. Indeed, an analysis from PV Magazine recently found that converting the land currently used for corn ethanol to solar power could meet all of the nation's electricity needs.

Likewise, a U.K.-based analysis from Carbon Brief found that “a hectare of solar panels delivers between 48 and 112 times more driving distance, when used to charge an electric vehicle, than that land could deliver if used to grow biofuels for cars.”

Based on my own calculations (below), an acre of solar panels produces roughly 40 times more energy than an acre devoted to growing corn for ethanol—and this is without taking into account the fact that electric vehicles use energy more efficiently than gas-powered cars:

- As noted above, solar power produces between 394 and 447 megawatt hours (MWh) per acre per year.
- According to the University of Nebraska-Lincoln, one acre of corn produces approximately 462 gallons of ethanol.
- With a heat content of 76,300 BTU per gallon of ethanol, 462 gallons of ethanol contains 35,250,600 BTU.
- Applying a standard conversion factor of 3,412,000 BTU per MWh, one acre of corn produces a quantity of ethanol equivalent to 10.3 MWh.
- Thus, an acre of solar panels produces roughly 38 to 43 times more energy per acre than corn ethanol, even assuming a relatively high output per acre of corn.

Fourth, as Popkin correctly acknowledges, rooftops and parking lots are “generally more expensive to develop than forest or farmland.” However, Popkin does not explain how much more expensive it is to build solar on rooftops or parking lots. According to the National Renewable Energy Laboratory, the average cost per watt of installing rooftop solar projects is approximately 1.75-3 times as expensive as utility-scale solar. The average

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cost per watt of a utility-scale solar system is \$0.89, compared to \$1.56 for a commercial rooftop project and \$2.65 for a residential rooftop project.

Constructing solar canopies over parking lots also appears to be more expensive than utility-scale solar. The industry publication PV Magazine has used \$3 per watt as a back-of-the-envelope figure, while Energy Sage has estimated, based on data from its solar energy marketplace, that the average installation cost is \$3.31 per watt.

To provide one real-world example, the 12.3-megawatt solar canopy under construction at JFK International Airport will cost \$56 million, or \$4.55 per watt. While the construction costs of solar canopies may be offset in some cases by charging a premium for the shaded parking spots underneath, it will be more challenging to recoup such costs in places where parking is free. And these are just the installation costs; it is also more expensive to maintain small, widely dispersed units than one large system.

Ultimately, achieving net-zero carbon dioxide emissions by the early 2050s to limit warming to 1.5 degrees Celsius will require siting an unprecedented number of renewable energy facilities in a very short time. At this time, siting solar projects on forested land remains relatively rare; in the rare instances when solar is sited on forested land, those projects appear to offset more emissions on a per-acre basis than trees can sequester; the 30 million acres of farmland that are currently being used to produce corn ethanol could produce much more energy as solar farms without affecting food production; and utility-scale solar projects remain significantly cheaper to install and maintain than rooftop and parking lot solar projects.

Tech Xplore, 27 October 2022

<https://techxplore.com>

Novel rule-breaking material behaves like “conductive Play-Doh”

2022-10-26

Scientists working with an experimental class of materials have made a breakthrough that could shape a new generation of electronic devices. The researchers' creation is likened to a conductive “Play-Doh” that can be easily shaped, combining two characteristics in a way they say defies a theoretical explanation.

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Materials that conduct electricity such as aluminum, copper or other metals tend to have some things in common. They consist of neat rows of atoms or molecules arranged in a tight configuration, which was thought to be crucial to allow electrons to travel freely through the material.

University of Chicago researcher Jiaze Xie had been exploring other possibilities. He was experimenting with materials based on molecular strings made of carbon and sulfur, interspersed with nickel atoms, and produced some unexpected results. To his and the team's surprise, the material turned out to be a very efficient conductor of electricity, and was able to maintain its performance in a range of inhospitable conditions.

"We heated it, chilled it, exposed it to air and humidity, and even dripped acid and base on it, and nothing happened," said Xie, who is now at Princeton University.

The material's conductive abilities appear in conflict to its disordered molecular structure. After testing and simulations, the researchers believe this is due to a lasagna-like configuration in which the material forms layers like sheets of pasta, which allows electrons to travel both horizontally and vertically, even when those layers rotate out of alignment.

"From a fundamental picture, that should not be able to be a metal," said senior author John Anderson. "There isn't a solid theory to explain this."

The scientists say the conductive material is unprecedented in the way it can both be pliable and conduct electricity, with Anderson likening it to "conductive Play-Doh – you can smush it into place and it conducts electricity."

Through chemical treatments, scientists have been able to make conductors with organic materials that are easier to process and offer some flexibility, but their conductivity typically wanes under high temperatures or when exposed to moisture. With an ability to withstand these factors, the scientists believe they've laid the groundwork for a new class of conductive materials.

"In principle, this opens up the design of a whole new class of materials that conduct electricity, are easy to shape, and are very robust in everyday conditions," said Anderson.

Working in its favor is the fact that the material can be made at room temperature, unlike metals or typical conductor materials that need to be melted into shapes to suit different electronic devices. And the team

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hopes to further expand the capabilities by experimenting with different forms and functions.

"We think we can make it 2D or 3D, make it porous, or even introduce other functions by adding different linkers or nodes," said Xie.

The research was published in the journal Nature.

New Atlas, 26 October 2022

<https://newatlas.com>

The material turned out to be a very efficient conductor of electricity, and was able to maintain its performance in a range of inhospitable conditions.

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Fatty acids on the skin explain why some people are “mosquito magnets”

2022-10-19

If you're one of the unlucky ones that seems to get ravaged by mosquitoes while others around you escape unscathed, a new study offers an explanation as to why. Scientists have examined what makes mosquitoes more attracted to some humans over others, and uncovered a strong association between being a so-called mosquito magnet and elevated levels of fatty acids on the skin.

Mosquitos are known to track down their human victims through a range of sensory cues that include body heat, CO2 exhalation and body odor. Research in this area has produced some interesting insights of late, including a paper published earlier this year that showed how viruses can change the skin microbiome to alter the odor of person, luring in mosquitos to hitch a ride to their next host.

This new work from scientists at The Rockefeller University also focused on the skin and the way its odors may attract mosquitoes. The scientists tasked participants with wearing nylon sleeves on their forearms to capture the scent of their skin, with the sleeves then paired up and placed in tubes to face off in a round robin-style tournament of mosquito attractiveness.

This saw *Aedes Aegypti* mosquitoes, which are the primary vector for diseases like Zika and dengue, placed in a chamber with access to two tubes, each containing a nylon sleeve. Ultimately this enabled the scientists to profile the attractiveness of 64 human subjects to mosquitoes, which produced some compelling results.

The team found one target, which they've called Subject 33, was much more attractive to the mosquitoes than the others. This subject was four times more attractive to the mosquitoes than the next best, and 100 times more attractive than the subject at the bottom of the mosquitoes' hit list. In any of the team's experiments, the mosquitoes swarmed toward this sample.

“It would be obvious within a few seconds of starting the assay,” said study author Maria Elena De Obaldia. “It's the type of thing that gets me really excited as a scientist. This is something real. This is not splitting hairs. This is a huge effect.”

Scientists have examined what makes mosquitoes more attracted to some humans over others.

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Chemical analysis followed and revealed 50 molecular compounds that were heightened in the skin of the more attractive subjects. One type in particular was produced at much higher levels than less attractive subjects. Called carboxylic acids, these fatty substances help give the skin a distinct odor that appears to be much to the liking of blood-hungry mosquitoes.

“There's a very, very strong association between having large quantities of these fatty acids on your skin and being a mosquito magnet,” said study author Leslie Vosshall.

And apparently being a mosquito magnet is not an easy tag to shake. Some of the participants in the research were studied over several years, and their body odor seemed to continue attracting mosquitoes, no matter what else about their behavior had changed.

In follow-up experiments, the scientists attempted to engineer mosquitos that couldn't distinguish between attractive and less attractive humans in this way. This involved creating mutant mosquitos missing key odor receptors, but the insects were still able to hunt down their favored victims.

“The goal was a mosquito that would lose all attraction to people, or a mosquito that had a weakened attraction to everybody and couldn't discriminate Subject 19 from Subject 33. That would be tremendous,” Vosshall says, as it could lay the groundwork for new and improved mosquito repellents. “And yet that was not what we saw. It was frustrating.”

For now, it's back to the drawing board, with the scientists now pondering the idea that manipulating the skin microbiome to alter its odor could create a mosquito-masking effect. They also hope the research leads to experiments on other mosquito species, such as *Anopheles*, which spreads malaria.

“I think it would be really, really cool to figure out if this is a universal effect,” said Vosshall.

The research was published in the journal *Cell*.

New Atlas, 19 October 2022

<https://newatlas.com>

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Not Science Fiction: Methane-Eating “Borgs” Have Been Assimilating Earth’s Microbes

2022-10-22

A newly discovered type of transferable DNA structure with a sci-fi name appears to play a role in balancing atmospheric methane.

In Star Trek, the Borg are a ruthless, hive-minded collective that assimilate other beings with the intent of taking over the galaxy. Here on nonfictional planet Earth, Borgs are DNA packages that could help humans fight climate change.

Last year, a team of scientists discovered DNA structures within a methane-consuming microbe called *Methanoperedens* that appear to supercharge the organism’s metabolic rate. They named the genetic elements “Borgs” because the DNA within them contains genes assimilated from many organisms. In a study published on October 19 in the journal *Nature*, the researchers, who were led by Jill Banfield, describe the curious collection of genes within Borgs. They also begin to investigate the role these DNA packages play in environmental processes, such as carbon cycling.

First contact

Methanoperedens are a type of archaea (unicellular organisms that resemble bacteria but represent a distinct branch of life) that break down methane (CH₄) in soils, groundwater, and the atmosphere to support cellular metabolism. Although *Methanoperedens* and other methane-consuming microbes live in diverse ecosystems around the world, they are believed to be less common than microbes that use photosynthesis, oxygen, or fermentation for energy. However, they play an outsized role in Earth system processes by removing methane – the most potent greenhouse gas – from the atmosphere. Methane traps 30 times more heat than carbon dioxide and is estimated to account for about 30 percent of human-driven global warming. The gas is emitted naturally through geological processes and by methane-generating archaea; however, industrial processes are releasing stored methane back into the atmosphere in worrying quantities.

Banfield is a faculty scientist at Lawrence Berkeley National Laboratory (Berkeley Lab) and professor of Earth & Planetary Science and Environmental Science, Policy & Management at the University of California, Berkeley (UC Berkeley). She studies how microbial activities shape large-scale environmental processes and how, in turn,

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environmental fluctuations alter the planet’s microbiomes. As part of this work, she and her colleagues regularly sample microbes in different habitats to see what interesting genes microbes are using for survival, and how these genes might affect global cycles of key elements, such as carbon, nitrogen, and sulfur. The team looks at the genomes within cells as well as the portable packets of DNA known as extra-chromosomal elements (ECEs) that transfer genes between bacteria, archaea, and viruses. These elements allow microbes to quickly gain beneficial genes from their neighbors, including those that are only distantly related.

The scientists discovered evidence of an entirely new type of ECE while studying *Methanoperedens* sampled from seasonal wetland pool soil in California. Unlike the circular strands of DNA that make up most plasmids, the most well-known type of extra-chromosomal element, the new ECEs are linear and very long – up to one-third the length of the entire *Methanoperedens* genome. After analyzing additional samples from underground soil, aquifers, and riverbeds in California and Colorado that contain methane-consuming archaea, the researchers uncovered a total of 19 distinct ECEs they dubbed Borgs. Using advanced genome analysis tools, the team determined that many of the sequences within the Borgs are similar to the methane-metabolizing genes within the actual *Methanoperedens* genome. Some of the Borgs even encode all the necessary cellular machinery to eat methane on their own, so long as they are inside a cell that can express the genes.

“Imagine a single cell that has the ability to consume methane. Now you add genetic elements within that cell that can consume methane in parallel and also add genetic elements that give the cell higher capacity. It basically creates a condition for methane consumption on steroids, if you will,” explained co-author Kenneth Williams, a senior scientist and Banfield’s colleague in Berkeley Lab’s Earth and Environmental Sciences Area. Williams led research at the Rifle, Colorado site where the best characterized Borg was recovered, and is also chief field scientist of a research site on the East River, near Crested Butte, Colorado, where some of Banfield’s current sampling takes place.

The East River field site is part of the Department of Energy’s Watershed Function Scientific Focus Area, a multidisciplinary research project led by Berkeley Lab that aims to link microbiology and biochemistry with hydrology and climate science. “Our expertise is bringing together what are often thought of and treated as completely disparate fields of inquiry – big science that links everything from genes all the way up to watershed and atmospheric processes.”

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Resistance is futile a disadvantage

Banfield and her fellow researchers at UC Berkeley's Innovative Genomics Institute, including co-author and longtime collaborator Jennifer Doudna, hypothesize that the Borgs could be residual fragments of entire microbes that were engulfed by Methanoperedens to aid metabolism, similar to how plant cells harnessed formerly free-living photosynthetic microbes to gain what we now call chloroplasts, and how an ancient eukaryotic cell consumed the ancestors of today's mitochondria. Based on the similarities in sequences, the engulfed cell could have been a relative of Methanoperedens, but the overall diversity of genes found in the Borgs indicates that these DNA packages were assimilated from a wide range of organisms.

No matter the origin, it is clear that Borgs have existed alongside these archaea, shuttling genes back and forth, for a very long time.

Notably, some Methanoperedens were found with no Borgs. And, in addition to recognizable genes, the Borgs also contain unique genes encoding other metabolic proteins, membrane proteins, and extracellular proteins almost certainly involved in electron conduction required for energy generation, as well as other proteins that have unknown effects on their hosts. Until the scientists can culture Methanoperedens in a laboratory environment, they won't know for sure what capabilities the different Borgs confer, why some microbes use them, and why others don't.

One likely explanation is that Borgs act as a storage locker for metabolic genes that are only needed at certain times. Ongoing methane monitoring research has shown that methane concentrations can vary significantly throughout the year, usually peaking in the fall and dropping to the lowest levels in early spring. The Borgs therefore provide a competitive advantage to methane-eating microbes like Methanoperedens during periods of abundance when there is more methane than their native cellular machinery can break down.

Plasmids are known to serve a similar purpose, quickly spreading genes for resistance to toxic molecules (like heavy metals and antibiotics) when the toxins are present in high enough concentrations to exert evolutionary pressure.

"There is evidence that different types of Borgs sometimes coexist in the same host Methanoperedens cell. This opens the possibility that Borgs could be spreading genes across lineages," said Banfield.

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Boldly exploring the (microbial) universe

Since posting their article as a pre-print last year, the team has begun follow-up work to better understand how Borgs may affect biological and geological processes. Some researchers are combing through data sets of genetic material from other microorganisms, looking for evidence that Borgs exist in association with other species.

While her colleagues are using lab-based methods, co-author Susan Mullen, a graduate student in Banfield's lab, will be getting her feet wet with some very picturesque field work. She recently started a project to sample microbes from the floodplains of the East River throughout the year to assess how seasonal changes in Borg abundance and other microbes known to be involved in methane cycling correlate to seasonal fluxes of methane.

According to the authors, years down the line, carefully cultured microbes chock full of Borgs could be used to reduce methane and curb global warming. It's all to benefit the collective – life on Earth.

Sci Tech Daily, 22 October 2022

<https://scitechdaily.com>

Gene-Edited Butterfly Mutants Reveal Secrets of Ancient "Junk" DNA

2022-10-23

According to new research, butterfly wing patterns have a basic plan to them, which is manipulated by non-coding regulatory DNA to create the diversity of wings seen in different species.

A new study explains how DNA that sits between genes – called 'junk' DNA or non-coding regulatory DNA – accommodates a basic plan conserved over tens to hundreds of millions of years while at the same time allowing wing patterns to evolve extremely quickly. "Deep cis-regulatory homology of the butterfly wing pattern ground plan" was published as the cover story in the October 21 issue of the journal Science.

The research supports the idea that an ancient color pattern ground plan is already encoded in the butterfly genome and that non-coding regulatory DNA works like switches to turn up some patterns and turn down others.

An ancient color pattern ground plan is already encoded in the butterfly genome and that non-coding regulatory DNA works like switches to turn up some patterns and turn down others.

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“We are interested to know how the same gene can build these very different looking butterflies,” said Anyi Mazo-Vargas, Ph.D. '20, the study's first author and a former graduate student in the lab of senior author, Robert Reed, professor of ecology and evolutionary biology in the College of Agriculture and Life Sciences. Mazo-Vargas is currently a postdoctoral researcher at George Washington University.

“We see that there's a very conserved group of switches [non-coding DNA] that are working in different positions and are activated and driving the gene,” Mazo-Vargas said.

Previous work in Reed's lab has uncovered key color pattern genes: one (WntA) that controls stripes and another (Optix) that controls color and iridescence in butterfly wings. When the researchers disabled the Optix gene, the wings appeared black, and when the WntA gene was deleted, stripe patterns disappeared.

Pattern Details of Gulf Fritillary Butterfly Wing

Pattern details of a gulf fritillary (*Agraulis vanilla*) butterfly wing with alterations caused by modification of a non-coding DNA sequence using the gene-editing tool CRISPR/cas9. Credit: Anyi Mazo-Vargas

This study focused on the effect of non-coding DNA on the WntA gene. Specifically, the researchers ran experiments on 46 of these non-coding elements in five species of nymphalid butterflies, which is the largest family of butterflies.

In order for these non-coding regulatory elements to control genes, tightly wound coils of DNA become unspooled, a sign that a regulatory element is interacting with a gene to activate it, or in some cases, turn it off.

In the study, the researchers used a technology called ATAC-seq to identify regions in the genome where this unraveling is occurring. Mazo-Vargas compared ATAC-seq profiles from the wings of five butterfly species, in order to identify genetic regions involved in wing pattern development. They were surprised to find that a large number of regulatory regions were shared across very different butterfly species.

Mazo-Vargas and colleagues then employed CRISPR-Cas gene editing technology to disable 46 regulatory elements one at a time, in order to see the effects on wing patterns when each of these non-coding DNA sequences were broken. When deleted, each non-coding element changed an aspect of the wing patterns of the butterflies.

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The researchers found that across four of the species – *Junonia coenia* (buckeye), *Vanessa cardui* (painted lady), *Heliconius himera*, and *Agraulis vanillae* (gulf fritillary) – each of these non-coding elements had similar functions with respect to the WntA gene, proving they were ancient and conserved, likely originating in a distant common ancestor.

They also found that *D. plexippus* (monarch) used different regulatory elements from the other four species to control its WntA gene, perhaps because it lost some of its genetic information over its history and had to reinvent its own regulatory system to develop its unique color patterns.

“We have progressively come to understand that most evolution occurs because of mutations in these non-coding regions,” Reed said. “What I hope is that this paper will be a case study that shows how people can use this combination of ATAC-seq and CRISPR to begin to interrogate these interesting regions in their own study systems, whether they work on birds or flies or worms.”

“This research is a breakthrough for our understanding of the genetic control of complex traits, and not only in butterflies,” said Theodore Morgan, a program director at the NSF. “Not only did the study show how the instructions for butterfly color patterns are deeply conserved across evolutionary history, but it also revealed new evidence for how regulatory DNA segments positively and negatively influence traits such as color and shape.”

Sci Tech Daily, 23 October 2022

<https://scitechdaily.com>

Scientists Answer – Did the Pandemic Change Our Personalities?

2022-10-23

According to a recent study by Angelina Sutin of Florida State University College of Medicine and colleagues, the COVID-19 pandemic may have changed the trajectory of personality across the United States, especially in younger adults, despite the long-held belief that personality traits are largely impervious to environmental pressures.

The study was recently published in the journal PLOS ONE.

In general, previous research has not shown any links between widespread stressful events—like earthquakes and hurricanes—and personality

Between pre-pandemic and 2022, a study of thousands of Americans revealed minor changes in extraversion, agreeableness, openness, and conscientiousness.

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change. The coronavirus pandemic, however, has impacted practically every facet of life and the whole world.

The new study utilized longitudinal personality tests from 7,109 adults who participated in the online Understanding America Study. They examined five-factor model personality traits—neuroticism, extraversion, openness, agreeableness, and conscientiousness—between pre-pandemic measures (May 2014 – February 2020) and evaluations early in the pandemic (March – December 2020) or later (2021-2022). A total of 18,623 evaluations were analyzed, with a mean of 2.62 per participant. 41.2% of the participants were male and ranged in age from 18 to 109.

Consistent with other studies, there were relatively few changes between pre-pandemic and 2020 personality traits, with only a small decline in neuroticism. However, there were declines in extraversion, openness, agreeableness, and conscientiousness when the 2021-2022 data was compared to pre-pandemic personality. The changes were about one-tenth of a standard deviation, which is equivalent to about one decade of normative personality change. The changes were moderated by age, with younger adults showing disrupted maturity in the form of increased neuroticism and decreased agreeableness and conscientiousness, and the oldest group of adults showing no statistically significant changes in traits.

The authors conclude that if these changes are enduring, it suggests that population-wide stressful events can slightly bend the trajectory of personality, especially in younger adults.

The authors add: "There was limited personality change early in the pandemic but striking changes starting in 2021. Of most note, the personality of young adults changed the most, with marked increases in neuroticism and declines in agreeableness and conscientiousness. That is, younger adults became moodier and more prone to stress, less cooperative and trusting, and less restrained and responsible."

Sci Tech Daily, 23 October 2022

<https://scitechdaily.com>

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Jellyfish-like tentacles lets robot grasp soft objects without crushing them

2022-10-24

Our hands are pretty incredible appendages. They can pick up a ceramic mug in one hand and a delicate piece of cake in the other – both with equal ease and almost no thought to the matter.

Robots on the other hand, haven't managed to master the second one. Soft, delicate objects require an exact understanding of what the object is, embedded sensors, complex feedback loops, or advanced machine learning algorithms if these machines are to be able to successfully pick them up.

"Securely grasping an object typically requires some knowledge of its size, shape, and mechanical properties. In the natural world, this is done, seemingly without effort, [for example] by elephants whose trunks can pick up a peanut or uproot a tree," researchers from Harvard University write in their new paper, published in PNAS.

"In the engineered world of robotic grasping, much work has focused on understanding how to design the mechanics and dynamics of gripper hardware, as well as how to control such devices to interact with objects in the desired way."

To avoid having to understand exactly what the object is, and create perfectly co-ordinated fine feedback control before the item is grasped, new research has created a robot which uses soft filaments that tangle around the object instead.

Think of this like a mix between the tentacles of a jellyfish, and a hairbrush getting stuck in curly hair.

"With this research, we wanted to reimagine how we interact with objects," said Kaitlyn Becker, lead author and microrobotics researcher at Harvard.

"By taking advantage of the natural compliance of soft robotics and enhancing it with a compliant structure, we designed a gripper that is greater than the sum of its parts, and a grasping strategy that can adapt to a range of complex objects with minimal planning and perception."

The new type of soft, robotic gripper uses thin tentacles to entangle and ensnare objects, similar to how jellyfish collect stunned prey. Alone, individual tentacles, or filaments, are weak. But together, the collection of

"Securely grasping an object typically requires some knowledge of its size, shape, and mechanical properties."

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filaments can grasp and securely hold heavy and oddly shaped objects. The gripper doesn't require sensing, planning, or feedback control.

This is done through inflation. The filaments or tentacles are hollow, rubber tubes that can pressurise and curl up. The curls knot and entangle with each other and the object, with each entanglement increasing the strength of the hold. While the collective hold is strong, each contact is individually weak and won't damage even the most fragile object. To release the object, the filaments are simply depressurised.

This is a different design but a similar solution to an octopus tentacle-like glove with suckers designed by a team at Virginia Tech, although that was built to be used to help humans, not robots.

Although it's still in its early stages, this pink tangled mess might one day be used in real-world applications to grasp soft fruits and vegetables for agricultural production and distribution, delicate tissue in medical settings, even irregularly shaped objects in warehouses, such as glassware.

"This new approach to robotic grasping complements existing solutions by replacing simple, traditional grippers that require complex control strategies, with extremely compliant, and morphologically complex filaments that can operate with very simple control," said Harvard roboticist Professor Robert Wood. "This approach expands the range of what's possible to pick up with robotic grippers."

Cosmos, 24 October 2022

<https://cosmosmagazine.com>

Insects contribute to atmospheric electricity

2022-10-24

By measuring the electrical fields near swarming honeybees, researchers have discovered that insects can produce as much atmospheric electric charge as a thunderstorm cloud. This type of electricity helps shape weather events, aids insects in finding food, and lifts spiders up in the air to migrate over large distances. The research, appearing on October 24 in the journal *iScience*, demonstrates that living things can have an impact on atmospheric electricity.

"We always looked at how physics influenced biology, but at some point, we realized that biology might also be influencing physics," says first author Ellard Hunting, a biologist at the University of Bristol. "We're

Insects can produce as much atmospheric electric charge as a thunderstorm cloud.

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interested in how different organisms use the static electric fields that are virtually everywhere in the environment."

As with most living creatures, bees carry an innate electric charge. Having found that honeybee hive swarms change the atmospheric electricity by 100 to 1,000 volts per meter, increasing the electric field force normally experienced at ground level, the team developed a model that can predict the influence of other species of insects.

"How insect swarms influence atmospheric electricity depends on their density and size," says co-author Liam O'Reilly, a biologist at the University of Bristol. "We also calculated the influence of locusts on atmospheric electricity, as locusts swarm on biblical scales, sizing 460 square miles with 80 million locusts in less than a square mile; their influence is likely much greater than honeybees."

"We only recently discovered that biology and static electric fields are intimately linked and that there are many unsuspected links that can exist over different spatial scales, ranging from microbes in the soil and plant-pollinator interactions to insect swarms and perhaps the global electric circuit," says Ellard.

"Interdisciplinarity is valuable here—electric charge can seem like it lives solely in physics, but it is important to know how aware the whole natural world is of electricity in the atmosphere," says co-author Giles Harrison, an atmospheric physicist from the University of Reading.

Phys Org, 24 October 2022

<https://phys.org>

Extreme Miyake radiation events captured in tree rings stump scientists

2022-10-26

The most intense solar storm in recorded history, known as the Carrington event, damaged nascent power and communication networks in the Victorian era.

But Earth has been hit by radiation levels that were up to 100 times greater than this, according to a new study of spikes in radiocarbon stored in tree rings.

Tree ring data reveals spikes in radiation occurred at least six times in Earth's relatively recent history.

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The prevailing hypothesis has been that these spikes, known as Miyake events — after the Japanese scientist that first discovered them — were caused by solar storms.

“There are six known [Miyake] events spanning nearly 10,000 years,” said astrophysicist Benjamin Pope of the University of Queensland.

The most recent spikes occurred in 774 AD and 993 AD during the early Medieval period.

But new research by Dr Pope and colleagues, published today in *Proceedings of the Royal Society A: Mathematical and Physical Sciences*, reveals that the origin of these extreme bursts of radiation appears to be more complex.

“There’s a kind of extreme astrophysical phenomenon that we don’t understand and it actually could be a threat to us,” Dr Pope said.

While a radiation event of this scale wouldn’t directly harm us, it could knock out everything we rely on in our modern world — not just for days, but months or longer.

Space weather written in wood

Many species of trees, especially those in temperate climates, lay down a new ring each year that reads like a barcode of its age.

These markers of time also help scientists pin down when the tree absorbed radioactive carbon-14, produced by the interaction of high energy particles, caused by cosmic rays and solar storms interacting with the atmosphere.

Radiation coming from the Sun can vary throughout the solar cycle, but strong solar storms are four times more likely to occur every 11 years when sunspot activity peaks.

Dr Pope wanted to analyse all the studies of tree rings to find out how strong the Miyake events were, and when they occurred in the solar cycle.

He asked his undergraduate students, led by Qingyuan Zhang, to develop a program to crunch all the data ever published on the events and model how carbon had been locked up in tree rings as it cycled through Earth’s biosphere for the past 10,000 years.

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“We just thought it would be very interesting if we can confirm any of the existing hypotheses [about the origin of Miyake events], or just maybe challenge some of them,” Mr Zhang said.

Data from the study showed that these mysterious radiation storms occurred roughly once in 1,000 years and happened right across the solar cycle, not just solar maximum.

Many of the spikes lasted longer than normal solar storms. At least one event in 663 BC lasted up to three years, and another in 5480 BC built up across a decade.

“At least two, maybe three of these events ... took longer than a year, which is surprising because that’s not going to happen if it’s a solar flare,” Dr Pope said.

Solar flares are also accompanied by aurora at the poles and sometimes, if they are strong enough, at mid-latitudes.

Yet, despite the length and intensity of some of these events, there is scant evidence of anything out of the ordinary in historical texts around the time of the Miyake events, apart from a brief mention of a “red crucifix” in the summer of 774 AD in the *Anglo Saxon Chronicles*, and an aurora documented in 775 AD in the Chinese chronicle *Jiutangshu*.

“We thought we were going to have a big slam dunk where we could prove that [Miyake events were caused by] the Sun,” Dr Pope said.

“This is the most comprehensive study ever made of these events and the big result is a big shrug; we don’t know what’s going on.”

Unusual radiation spikes are not just seen in tree rings; they also appear in ice core data, says physicist Andrew Smith, who is working on separate research at ANSTO.

Dr Smith is studying fluctuations in beryllium-10 and chlorine-36 isotopes in cores from Antarctica that overlap with the 774 and 993 Miyake, and 1859 Carrington events.

The Earth is constantly bombarded by high-energy cosmic rays that produce these isotopes along with radiocarbon-14, but lower-energy particles from the Sun also produce these isotopes during solar storms.

While all the data is yet to be analysed, Dr Smith said the beryllium recorded in ice cores appeared to mirror the tree ring data for 993 and 774.

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“There is the strong suggestion in [the beryllium data] that the 993 event was multiple events, not a single event, whereas the 774 event appeared to be more constrained in time,” Dr Smith said.

So what could be happening?

Over the years scientists have debated a number of sources for these mysterious events.

Along with solar storms, other galactic phenomena including gamma-ray bursts, supernova explosions and blasts from nearby neutron stars have been put forward as options

While Dr Pope said no evidence of these other galactic phenomena had been detected nearby, they couldn't be conclusively ruled out.

And if the phenomenon behind Miyake events comes from left field, we have no way of predicting them.

“It's really important that we resolve this question because the Carrington Event was 100 times smaller in terms of radiation output than these Miyake events,” Dr Pope said.

The high spikes in the data could simply be from aspects of plant physiology or the carbon cycle we don't understand.

But Dr Pope's best guess is that the longer duration spikes may come from a series of outbursts from the Sun.

“Not just one solar flare, but recurrent solar flares going off again and again.”

Solar physicist Hannah Schunker of the University of Newcastle said this scenario was highly plausible.

“We have absolutely no idea how to predict when or where an explosion will occur,” said Dr Schunker, who was not involved in the study.

“There's no reason why we couldn't have many complex magnetic regions close by and they all flare one after the other.”

Dr Schunker said it was also possible that shorter events could be caused by solar storms and longer ones could be caused by other galactic phenomena, depending upon when in the solar cycle the spike happened.

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“When the Sun is quieter [towards solar minimum], there is less magnetic field in the heliosphere to protect the Earth from external sources,” Dr Schunker said.

“But when the magnetic field has higher magnetic activity [towards solar maximum]. it's a lot more likely to produce stronger flares.”

Carbon, born inside stars, catalysed life on Earth — but lately it's been getting a bad rap. This is carbon's journey from cosmic wonder to global pariah.

ANSTO's Dr Smith said he was not surprised there was no obvious relationship with the solar cycle because solar storms can happen anytime.

But, he said, future analysis of the chlorine isotope, which is produced in higher quantities than beryllium in solar events, may shed more light on Miyake events.

“We do need to really understand the severity of these events,” Dr Smith said.

“If we had an event like that, even on the short scale ... we'd be thrown into chaos.”

ABC News, 26 October 2022

<https://abc.net.au>

Horrible – New Study Indicates That Popular Sugar Substitutes Worsen Your Memory

2022-10-25

Using laboratory models, scientists discovered that ingesting FDA-approved levels of saccharin, ACE-K, and stevia early in life may result in many changes to the body, including brain areas linked to memory and reward-motivated behavior.

Early-life high-sugar diets have been linked to impaired brain function, but what about low-calorie sugar substitutes? According to recent research, they could have a negative impact on the developing gut and brain.

The News

Researchers from the University of Southern California Dornsife College of Letters, Arts, and Sciences report that adolescents who consumed the low-calorie sweeteners saccharin, ACE-K, and stevia showed long-term

Consuming low-calorie sweeteners also had an impact on the body's metabolic signaling, which may result in diabetes and other metabolism-related diseases.

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memory impairments in a study that was recently published in the journal JCI Insight.

- The results are consistent with other studies that demonstrated sustained memory impairment in adolescent rats who consume sugar.
- Consuming low-calorie sweeteners also affected metabolic signaling in the body, which can lead to diabetes and other metabolism-related diseases.
- Rats that ate low-calorie sweeteners as adolescents were less inclined to work for sugar as adults, but they ate more sugar if it was readily accessible, which is another factor that may influence the chance of developing metabolic disease.

Why It Matters

There is a broad range of advice on what to eat and when to consume it. According to the researchers, information from studies like these may aid consumers and medical professionals in making better decisions at all stages of life.

“While our findings do not necessarily indicate that someone should not consume low-calorie sweeteners in general, they do highlight that habitual low-calorie sweetener consumption during early life may have unintended, long-lasting impacts,” said Scott Kanoski, associate professor of biological sciences at USC Dornsife.

What It Means for Humans

While most studies of low-calorie sweeteners focus on one substance and use amounts far exceeding the norm, the researchers made sure the study was in line with real-life conditions for people.

- Sweeteners tested include saccharin, acesulfame potassium (ACE-K) and stevia — which are commonly used in sweetened foods.
- The amount of sweetener consumed fell within FDA-approved guidelines for humans.

In Their Words

“Research using rodent models and low-calorie sweeteners has typically involved consumption levels that far exceed the FDA ‘acceptable daily intake’ (ADI) levels and used only a single sweetener. To design our research to be more applicable to humans, we kept consumption levels within the ADI and used multiple low-calorie sweeteners to determine if effects were specific to a given sweetener or general across sweeteners.” —

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Lindsey Schier, Gabilan Assistant Professor of Biological Sciences at USC Dornsife

The Experiment

To determine the effect of low-calorie sweetener consumption on memory, the researchers used methods that test object recognition and spatial recognition.

Rats were provided water sweetened with either stevia, ACE-K or saccharin or plain water, along with their normal food.

After a month, the rats’ memory was tested using two different methods — one tests if they remember an object they’ve seen before and the other is a maze.

In the end, rats consuming sweetener were less likely to remember an object or the path through the maze than those that drank only plain water.

What Else?

The scientists also found other effects among the rats after they consumed sweeteners.

- They had fewer receptors on their tongues that detect sweet taste.
- The biological mechanism in their intestines that transports glucose into the blood was altered.
- Their brains had changed, specifically in regions associated with memory control and reward-motivated behavior.

What’s Next?

Kanoski and Schier say the findings reveal more questions worth exploring, including:

- How do sweetener substitutes cause a reduction in sweet taste receptors and how does that affect later dietary behavior?
- What does the change in the nutrient transport in the gut mean for health?
- What biological mechanisms link sweetener consumption with the changes to the brain?

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The researchers say they intend to explore ways to reverse the long-lasting effects of adolescent low-calorie sweetener consumption and to study how it influences food choices and preferences later in life.

Sci Tech Daily, 25 October 2022

<https://scitechdaily.com>

New Discovery Expands Tree of Life

2022-10-26

Researchers have found a number of very rare species of microorganisms, some of which have never been observed before and others which have eluded the attention of researchers for more than a century.

Professor Genoveva Esteban of Bournemouth University and James Weiss, an independent researcher working in his own lab in Warsaw, Poland, with his two cats, made the discovery of these elusive species and published their findings in the scientific journal *Protist*.

Their approach to research and the discovery of these new and rare species will aid in the public's and scientists' understanding of life at the microscopic level. In addition, they believe it will demonstrate the significance of microscopic life to everyone in the world and inspire thousands of young people to be interested in science.

Microorganisms are at the bottom of the food chain and are made up of just one cell. They exist all around us and may be found in every environment, from little puddles to enormous oceans; there is still much to learn about them.

"Biodiversity at a microscopic level is not as widely understood as other areas of nature, despite the fact that whole ecosystems depend on it," explained Professor Esteban.

"Some of these species are completely new and others have not been seen for over a century. We documented many curious behaviors on them and carried out a DNA analysis of them for the first time. This means we can understand more about their relationships with other microbes and find new branches for them on the tree of life," Professor Esteban continued.

The very rare and new microorganisms include *Legendrea loyezae*.

Professor Esteban said, "We don't know what this organism is named after; the 100-plus-years-old French description doesn't include the origin of

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the name but we suspect that it was after a person since "Legendre" is a common French surname."

They have also discovered, a new *Lacerus*, meaning "having irregular edges" due to the serrated appearance of the cell edges, as well as a new *Apertospathula*, meaning "ventral mouth opening".

The new species have not been assigned names yet, but Weiss is hoping to name them with contemporary fictional references that will attract the attention of people of all ages.

"Most organisms on the tree of life are microscopic. In fact, most life on Earth has always been microscopic. Microorganisms were the first predators on Earth, their greedy appetites were one of the leading factors of the evolution of more complex life in the early ages of Earth," Weiss explained.

"As prey developed better defenses, predators needed to develop better ways of catching them. After the evolution of multicellular, complex life they became the main food source for others such as krill and plankton, which in turn are food for larger species. If the organisms at the very bottom were removed, all other parts of the food chain above them would collapse too," he added.

The duo worked together for the course of eighteen months, and investigated thousands of samples from water bodies, mainly from Poland, but also all over the world.

"We knew that no one else would be looking for these and no other research into microbes has involved such intensive searching," said Professor Esteban.

"As with all forms of wildlife spotting, the more you look, the more you find. By taking so many samples, almost every day, we knew we could find something new. The more we know about the microscopic world, the more we can learn about the rest of their habitats where all other forms of life survive."

After isolating the microorganisms in each sample, they were able to study their DNA and identify those that were new to science and others which were extremely rare, and they needed a specialist. Dr. Demetra Andreou, a

Scientists have discovered several elusive species of microorganisms.

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molecular ecologist at Bournemouth University also brought her expertise to the team.

Sci Tech Daily, 26 October 2022

<https://scitechdaily.com>

How many bees can you fit in an X-ray machine? That's not a joke

2022-10-26

The scans provide a deeper look at these humble insects: Bees, the group discovered, don't clump together in a random group. Instead, they seem to form dome-shaped structures following surprisingly sophisticated mathematical rules, or what researchers call a "scaling law." The results could one day help engineers design more resilient buildings, or even swarms of tiny robots that behave a lot like insects, said study senior author Orit Peleg.

And bees can achieve all this despite having brains the size of grains of sand.

"I'm trained in physics, and these laws aren't obvious to me," said Peleg, assistant professor in the BioFrontiers Institute and Department of Computer Science at CU Boulder. "But bees somehow know how to arrange themselves in order to maintain their mechanical stability."

The group published their results Oct. 17 in the journal *Scientific Reports*.

Getting bees to sit still for their X-rays took some work, noted Olga Shishkov, lead author of the study and a postdoctoral researcher in the Peleg Lab at BioFrontiers.

First, the researchers relied on honeybee queens to coax thousands of worker bees to join into swarms in the lab -- these structures, which often hang upside-down, look a bit like a wiggly Jell-O mold. Then, the team rotated those swarms in front of a small CT machine originally developed for veterinary hospitals.

The effort was a success: The group's method is so precise you can pick out individual bees in the 3D scans. The images could give scientists a new tool for understanding how bees and other social insects create such shapeshifting "superorganisms."

Researchers at CU Boulder have, for the first time, used X-ray computed tomography (also known as a CT scan) to peer inside swarms of honeybees.

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"One thing we want to know is how the bees respond to different temperatures," Shishkov said. "If it's cold outside, how do they keep the inside of the swarm warm? If it's hot, how do they stay cool?"

Peeking inside

It begins with an intrepid journey: Peleg explained that when honeybee hives become too crowded, bee queens will fly away to search for another place to live. The queens bring thousands of worker bees with them, which will occasionally cluster around the queen to keep her safe -- a buzzing, undulating security detail.

"You can find these swarms hanging from almost any kind of surface from trees to benches and cars," Peleg said. "They're magnificent little assemblies."

They're also really flexible. In a previous study, for example, Peleg and her colleagues shook swarms of bees to try to mimic the force of a gust of a wind. In response, the bees flattened out into a pancake shape, helping them stay stable amid the tumult.

One thing, however, has eluded Peleg's team: "Until now, we haven't been able to peek inside a swarm and see what's happening."

Put the weight on me

To do that, the group, including CU Boulder undergraduate students Claudia Chen and Claire Allison Madonna, scanned 11 swarms of bees containing anywhere from 4,000 to 10,000 insects.

Based on the researchers' calculations, a bee swarm works a bit like a cheerleading pyramid. More bees cluster around the base of the swarm, then thin out the farther up they get. Bees also seem to arrange themselves so that no one layer has to carry more than its fair share of weight. In mathematical terms, the structure follows a scaling law in which each layer supports a weight that equals roughly its own weight to the one-and-a-half power.

"What this scaling law means is that each layer winds up using the same amount of its available strength as every other layer," Shishkov said.

In the same study, Shishkov and her colleagues tested bees to calculate just how much weight a single honeybee could carry. A bee, it turns out, can lift about 35 other bees, on average. Bees in a swarm only lift a maximum of about four other bees.

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Scaling laws like the one the team discovered are common in nature, explained study co-author Kaushik Jayaram. Among human weightlifters, for example, how many dumbbells you can lift tends to vary based on how much you weigh -- a relationship that follows a surprisingly consistent mathematical formula.

"The same kind of laws seemingly apply to bees," said Jayaram, assistant professor in the Paul M. Rady Department of Mechanical Engineering. "The existence of this scaling law hints that there might be general principles of organization for structures like these that we don't know about yet."

Shishkov, for her part, enjoyed working with the bees -- without any supplies of honey to protect, the little insects didn't sting her (too much).

"They're surprisingly friendly in a swarm," Shishkov said.

Science Daily, 26 October 2022

<https://sciencedaily.com>

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