CHEMWATCH

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ASIA PACIFIC

Australia prioritizes reducing emissions and cheaper EVs

2022-07-02

Australia's new government is putting climate change at the top of its legislative agenda when Parliament sits next month for the first time since the May 21 election, with bills to enshrine a cut in greenhouse gas emissions and make electric cars cheaper, a minister said on Wednesday.

A bill will be introduced to commit Australia to reducing its emissions by 43% below 2005 levels by 2030 when Parliament sits on July 26, Minister for Climate Change and Energy Chris Bowen told the National Press Club.

Another bill would abolish import tariffs and taxes for electric vehicles that are cheaper than the luxury car threshold of 77,565 Australian dollars ($53,580).

Only 1.5% of cars sold in Australia are electric or plug-in hybrid, and passenger cars account for almost 10% of the nation's emissions, the government said.

The new center-left Labor Party government expects EVs will account for 89% of Australian new car sales by 2030.

The government's fleet will be converted to 75% no-emission vehicles, bolstering a second-hand EV market as government vehicles are sold after three years.

The new government has already officially informed the United Nations of Australia's more ambitious 2030 target than the previous conservative Liberal Party-led administration had pursued, a reduction of 26% to 28%.

But Bowen said legislating the 43% target would create greater confidence.

"It's about certainty and stability, mainly for the business investment community," Bowen said.

The new center-left Labor Party government expects EVs will account for 89% of Australian new car sales by 2030.

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Valdosta Daily Times, 2-07-22

https://www.valdostadailytimes.com/news/business/australia-prioritizes-reducing-emissions-and-cheaper-evs/article_86871323-fd11-5a8f-89bd-896474a10baf.html

Inventory restoration notice - 14 July 2022

2022-07-14

On 8 October 2021, notice was given on the AICIS website that, on 5 October 2021, the terms of the Inventory listing for Oils, Callitris intratropica had been varied.

At that time, the CAS name was varied from Oils, Callitris intratropica to Oils, Callitris columellaris and the CAS number was varied from 187348-13-6 to 192526-11-7.

The Inventory listing of the chemical has now been restored to be consistent with the restored Chemical Abstracts Service (CAS) number and name for Oils, Callitris intratropica.

Previous chemical name	Previous CAS number	Restored chemical name	Restored CAS number	Listing restored on
Oils, Callitris columellaris **Other name:** Callitris columellaris intratropica oil	192526-11-7	Oils, Callitris intratropica	187348-13-6	13 July 2022

Read More

AICIS, 14-07-22

https://www.industrialchemicals.gov.au/news-and-notices/inventory-restoration-notice-14-july-2022

New chemical assessment statement published - 12 July 2022

2022-07-12

The assessment statement for the following industrial chemical is published in accordance with section 52 of the Industrial Chemicals Act 2019.

List of new chemical assessment statement published

Reference number	Chemical name or AICIS approved chemical name (AACN)	End use or generalised end use
VA-1039	Benzene, 1,1'-(1,2-ethanediyl) bis[2,3,4,5,6-pentabromo-	A flame retardant in articles, films and coatings used in electrical, electronic, building, and automotive applications

Read More

AICIS, 12-07-22

https://www.industrialchemicals.gov.au/news-and-notices/new-chemical-assessment-statement-published-12-july-2022

AMERICA

US EPA finds new risks for 3 solvents: methylene chloride, N-methylpyrrolidone (NMP), and perchloroethylene

2022-07-06

Three common solvents—methylene chloride, N-methylpyrrolidone (NMP), and perchloroethylene—pose unreasonable risks to human health under multiple use scenarios, the US Environmental Protection Agency concludes in separate draft risk evaluations released within days of each other.

The assessments replace previous ones finalized under the Donald J. Trump administration. They incorporate changes announced a year ago to the way the EPA evaluates the risks of high-priority chemicals in the US marketplace. The EPA says it made the changes to ensure its risk assessments are science-based and legally defensible.

The three solvents are among the first 10 chemicals the EPA is evaluating under the 2016 revisions to the Toxic Substances Control Act (TSCA). The agency is updating assessments for all 10 chemicals to reflect the policy changes.

The changes include no longer assuming workers wear personal protective equipment. For each of the three solvents, eliminating that assumption resulted in a slight increase in the number of uses with unreasonable risks. The EPA found five additional uses with unreasonable risks for methylene chloride, three for NMP, and one for perchloroethylene. The agency will address those and dozens of other uses that have unreasonable risks as it considers risk management options for the three solvents over the next few years.

The EPA is also screening six of the first 10 chemicals, including methylene chloride, NMP, and perchloroethylene, for potential risks from air and water. The agency ignored those exposures in previous assessments. That screening analysis is ongoing and not incorporated in the draft risk assessments for the three solvents. If the EPA finds additional risks associated with air or water, the agency says it will address them during the risk management process.

The EPA is also screening six of the first 10 chemicals, including methylene chloride, NMP, and perchloroethylene, for potential risks from air and water.

The EPA is behind schedule and will likely miss all of its deadlines for issuing final rules on the first 10 chemicals. The deadlines fall between now and early 2023. So far, the agency has proposed a rule for only one of them—asbestos. The EPA is seeking an additional $64 million and 200 full-time employees in its fiscal 2023 budget request for TSCA-related work.

"Without more money and staff, we won't get more than a handful of those rules on the books before 2025," Michal Freedhoff, assistant administrator of the EPA's office of chemical safety and pollution prevention, noted during a June 29 meeting to commemorate the 6th anniversary of TSCA reform. "With our current resources, we're facing some unavoidable delays in getting our work done. And these delays have real consequences for real people," she said. "The longer it takes for us to review chemicals and issue risk management rules, the longer workers, families, and communities have to wait for us to put protections in place. And the longer it takes for industry to get the regulatory certainty it needs."

Read More

C&en, 6-07-22

https://cen.acs.org/policy/chemical-regulation/US-EPA-finds-new-risks/100/web/2022/07

U.S. will consider limiting plastics in federal purchasing

2022-07-06

The Biden administration on Wednesday took a first step toward limiting single-use plastic in federal procurement following pressure from environmental groups.

The move by the U.S. government, which spends more than $650 billion on products and services each year, could accelerate efforts to find alternatives to a major source of U.S. waste.

In a public notice, the General Services Administration, which manages federal property and serves as the government's purchasing authority, said it was seeking input from the public on the use of plastic in shipping and packaging, as well as other uses in federal contracts. It said it intends to use the information to craft requirements and reporting mechanisms aimed at reducing single-use plastic.

The GSA will accept public comments for 60 days before considering a proposed rule.

"With single-use plastics being a significant contributor to the global plastic pollution concern, it is a logical step for the agency to examine this," the GSA said in the notice.

The effort comes five months after 180 conservation and community groups filed a petition calling on the GSA to ban federal agencies from buying single-use plastics. They argue that plastics, which are produced with fossil fuels, are contributing to climate change, harming public health and clogging the environment.

Read More

Reuters, 6-07-22

https://www.reuters.com/world/us/us-will-consider-limiting-plastics-federal-purchasing-2022-07-06/

The Biden administration on Wednesday took a first step toward limiting single-use plastic in federal procurement following pressure from environmental groups.

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Indiana widens child lead threshold, raises family support

2022-07-05

The Indiana Department of Health on Friday adopted an emergency rule expanding what it considers "elevated" lead levels in a child's blood, and introduced family education and case management for children with the neurotoxin in their blood.

"Reducing the blood lead threshold in Indiana has been a years-long process that has required partnerships with healthcare providers, local health departments and lawmakers to identify the resources and funding needed to ensure that more Indiana children not only were tested for lead, but that those with elevated levels could receive appropriate services," said State Health Commissioner Kris Box in a news release.

The department called it the "initial step toward a permanent change" in the release.

Box' department and the U.S. Centers for Disease Control and Prevention hold that there's no safe level of lead for children. But since 2012, when the CDC lowered its definition of "elevated" levels to 5 micrograms per deciliter, Indiana's definition remained double that used in federal guidance.

And in October 2021, the CDC lowered its threshold again to 3.5 micrograms per deciliter. Indiana's lining up with that number, effective July 1.

Read More

Indiana Capital Chronicle, 5-07-22

https://indianacapitalchronicle.com/briefs/indiana-widens-child-lead-threshold-raises-family-support

The department called it the "initial step toward a permanent change" in the release.

EPA Issues Annual Progress Report on Pesticide Reregistration Performance Measures and Goals

2022-07-05

On July 1, 2022, the U.S. Environmental Protection Agency (EPA) published a notice in the Federal Register announcing the availability of its progress report in meeting its performance measures and goals for pesticide reregistration during fiscal year (FY) 2019 (2019 Report). 87 Fed. Reg. 39517. Section 4(l) of the Federal Insecticide, Fungicide, and Rodenticide

Act (FIFRA) requires EPA to publish information about EPA's annual achievements in this area. The 2019 Report discusses the completion of tolerance reassessment and describes the status of various regulatory activities associated with reregistration. The 2019 Report also provides the total number of products reregistered and products registered under the "fast-track" provisions of FIFRA. The report is available at EPA-HQ-OPP-2014-0125. Comments can be submitted on or before August 30, 2022.

EPA's completed product reregistration actions totaled 161, short of EPA's goal of 400 actions. The table below details the actions completed in FY 2019.

Read More

FIFRA Blog, 5-07-22

https://pesticideblog.lawbc.com/entry/epa-issues-annual-progress-report-on-pesticide-reregistration-performa1

EUROPE

RSPB report criticises poor regulation of 150 pesticides

2022-07-03

The Royal Society for the Protection of Birds (RSPB) has attacked current risk assessments for chemicals used in UK farmland, claiming these are inadequate to guard wildlife.

The authors of the Pesticides and Wildlife: a decades old crisis study assert that, with more than half of farmland species in decline, urgent Government action is needed to persuade farmers to reduce their use of chemicals.

They add that the 150 chemicals employed in sufficient quantity to cover all UK farmland more than 10 times annually.

Said RSPB director for conservation Katie-Jo Luxton: "Many innovative farmers are finding ways to work with nature to reduce their reliance on pesticides while still producing healthy and profitable food.

"With the right support from Government many more farmers can be encouraged to do the same. With farmers' help, we can halt wildlife decline and keep common species common and avoid extinction."

The Royal Society for the Protection of Birds (RSPB) has attacked current risk assessments for chemicals used in UK farmland, claiming these are inadequate to guard wildlife.

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The report makes five recommendations to Whitehall, including:

- Government commitment to pesticide reduction targets, addressing volume of usage and overall toxicity
- Subsidy for farmers and finance for training them, making use of post-Brexit environmental initiatives
- More R&D funding for alternatives to pesticides
- An improved pesticides approvals process
- Encouragement of public lobbying of councils to apply pesticides-free policies

The society added that there was a lack of published literature regarding the negative impact of many pesticides. A study of information about the 30 most commonly used products revealed nearly three quarters related to just four chemicals, with 16 pesticides allegedly never subject to a literature review.

In addition, there was a dearth of information regarding the 'cocktail effects' of the use of multiple chemicals, said the RSPB.

Read More

Laboratory News, 3-07-22

https://www.labnews.co.uk/article/2091676/rspb-report-criticises-poor-regulation-of-150-pesticides

EU pollution and cancer — it doesn't have to be this way

2022-07-01

While Europe has made great gains in reducing pollution over past decades, we know all too well that we still live with too much pollution and environmental risks in our lives.

Exposure to air pollution, certain chemicals and ultraviolet radiation and other hazards in our environment and at the workplace is the cause of over 10 percent of all cancer cases in Europe, according to our latest European Environment Agency study.

While the percentage may seem small, the impact is enormous for European citizens, accounting for at least 270,000 cases per year.

The good news is that most of this environmental burden of disease can be avoided when we take action to improve the quality of the

While the percentage may seem small, the impact is enormous for European citizens, accounting for at least 270,000 cases per year.

environment around us, drastically reduce pollution as stated in the EU's Zero Pollution Action Plan and change our behaviour.

Some determinants of cancer like age and intrinsic factors cannot be modified, but most if not all environmental and occupational exposures can be prevented or seriously mitigated. Reducing exposure offers an effective way of reducing cancer cases and associated deaths.

And although citizens can make choices to reduce their exposure to environmental health risks, it is obvious that government regulation, like reducing air pollution in city centres through cleaner transport, by banning the most harmful chemicals in products and enforcing occupational health and safety standards is vital. Better implementation of the EU's tools and policies would also go a long way to addressing this huge challenge.

The European Green Deal is crucial in pushing this environmental health agenda further through its focus on Zero Pollution, the Chemicals Strategy which has the "Safe and Sustainable" principle at the core, and multiple other policies that address pollution, environmental quality and health issues.

This also includes the Farm to Fork strategy, which aims at reducing exposure to carcinogens by addressing the use of chemicals in the food system. These regulatory steps are pushing economic players towards innovation and sustainability in a much more essential and systemic way than previous legislation.

And there is good reason to do this.

Read More

EU Observer, 1-07-22

https://euobserver.com/opinion/155389

Europe proposal to classify lithium as toxic could hinder battery supply chain

2022-06-28

The European Commission is contemplating classifying lithium as toxic, which could hinder the EU's aims to create and support a domestic battery materials supply chain, market participants told S&P Global Commodity Insights.

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At the end of 2021, the European Chemicals Agency's Risk Assessment Committee agreed with French proposals to classify lithium carbonate, lithium hydroxide and lithium chloride as Category 1A reproductive toxicants, as they may damage fertility, unborn children and harm breastfed children.

Initial proposals were presented to the EC in March and are now under review and consultation, with the first draft of an act reclassifying lithium compounds to be published between October and December.

"The risk is that if lithium salts are incorrectly reclassified as 1a/SVHC it would introduce great uncertainty to long-term business viability planning of investments around these three salts," International Lithium Association Secretary General Roland Chavasse told S&P Global.

He added that, under EU chemical regulations, a category 1A classification makes a substance eligible as substance of very high concern, or SVHC, which results in its use being restricted by the EU's Chemical Strategy for Sustainability.

The imminent revision of the Registration, Evaluation, Authorisation and Restriction of Chemicals, or REACH, regulation could also further change the regulatory regime for SVHCs.

"Therefore, should any of these three lithium salts be classified incorrectly as 1a and be placed on the SVHC there could be significant unintended consequences for investments in their use in the EU, thereby putting in question the long-term viability of lithium being produced, refined, used and recycled in EU member states," Chavasse said.

Read More

S&P Global, 28-06-22

https://www.spglobal.com/commodityinsights/en/market-insights/latest-news/metals/062822-europe-proposal-to-classify-lithium-as-toxic-could-hinder-battery-supply-chain

"The risk is that if lithium salts are incorrectly reclassified as 1a/SVHC it would introduce great uncertainty to long-term business viability."

INTERNATIONAL

Why are pesticides banned overseas still used in Australia and what does it mean for the environment?

2022-07-11

Environmental campaigners in the UK have expressed concern that a trade deal could result in the importation of Australian food that is produced with pesticides banned there.

The Australia-UK free trade agreement, which was signed last December, has been criticised in the UK as being too liberalised on pesticides. A bill to implement the trade deal has not yet been passed by the UK parliament.

Josie Cohen of Pesticide Action UK told the Guardian last week that Australia uses toxic pesticides that are banned in the UK on health and environmental grounds. "They also permit residue levels many times more than in the UK," she said.

According to the organisation, Australia authorises the use of 144 highly hazardous pesticides, compared with 73 permitted in the UK.

How do Australia's pesticide regulations differ from the UK, what pesticides are used in Australia but banned overseas, and what health and environmental impacts do they have?

Banned overseas, permitted in Australia

All pesticides approved for use in Australia are regulated by the Australian Pesticides and Veterinary Medicines Authority (APVMA). Certain pesticides that are available in Australia are no longer in use overseas.

For example, paraquat, a herbicide used since the 1950s, has been banned in more than 50 countries including the UK. Research has linked it to negative impacts on aquatic ecosystems and it is highly toxic to humans. But in Australia paraquat has been under review by the APVMA since the 1990s and is still used commercially.

A class of substances called neonicotinoids have been used on Australian crops – including cotton, canola and fruit and vegetables – since 1994. Common neonicotinoid substances have been banned in the EU and UK, and restricted in the US and Canada, out of concern for negative impacts on insects – specifically European honeybee populations.

According to the organisation, Australia authorises the use of 144 highly hazardous pesticides, compared with 73 permitted in the UK.

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Read More

The Guardian, 11-07-22

https://www.theguardian.com/australia-news/2022/jul/11/why-are-pesticides-banned-overseas-still-used-in-australia-and-what-does-it-mean-for-the-environment

OECD Publishes New Test Guidelines for Nanomaterials

2022-07-08

On June 30, 2022, the Organization for Economic Cooperation and Development (OECD) published six new Test Guidelines (TG) and ten updated or corrected TGs. The new TGs include the first two harmonized methods for measuring certain nanomaterial-specific physical-chemical properties. According to OECD, these harmonized methods were developed to respond to regulatory needs in member and adhering countries, specifically for manufactured nanomaterials. The development of these TGs was supported financially by the European Commission (EC):

- Test Guideline 124 on Volume Specific Surface Area of Manufactured Nanomaterials: This TG describes a procedure to determine the Volume Specific Surface Area (VSSA) of powdered solid manufactured nanomaterials. According to the TG, this physical-chemical property may influence the behavior and biological effects of manufactured nanomaterials and thus can be requested for the safety testing of manufactured nanomaterials. The TG states that data on VSSA or (mass) specific surface area (SSA) may provide information on the characteristic structure of the nanomaterial and can: help identify potential hazards or hazard modifications associated with similar structures; help to estimate nanomaterial fate in the environment; and help to identify modification of exposure site-specific hazards related to the physico-chemical properties. Moreover, in some cases, VSSA or SSA data can be used to relate dose to observed fate, behavior, and effects of a specific nanomaterial, as the surface area may be the toxicologically relevant dose metric.
- Test Guideline 125 on Nanomaterial Particle Size and Size Distribution of Nanomaterials: The TG states that to address the specific needs of manufactured nanomaterials, the OECD TG No. 110, "Particle Size Distribution/Fibre Length and Diameter Distributions," was identified as one of the TGs to require an update. The current TG 110, adopted in 1981, is valid only for particles and fibers with sizes above 250 nanometers (nm). The OECD Working Party on Manufactured

On June 30, 2022, the Organization for Economic Cooperation and Development (OECD) published six new Test Guidelines (TG) and ten updated or corrected TGs.

Nanomaterials (WPMN) prioritized updating TG 110 to be applicable also to particles at the nanoscale or drafting a new nanomaterial-specific TG. The TG states that the WPMN eventually decided to develop a new TG that covers the size range from 1 nm to 1,000 nm, intended for particle sizes and particle size distribution measurements of nanomaterials. This TG overlaps with TG 110 in the size range from 250 nm to 1,000 nm. When measuring particulate or fibrous materials, the appropriate TG should be selected depending on the size range of particles tested. In line with TG 110, the new TG for nanomaterials includes separate parts for particles and fibers.

Read More

Nano and Other Emerging Chemical Technologies Blog, 8-07-22

https://nanotech.lawbc.com/2022/07/oecd-publishes-new-test-guidelines-for-nanomaterials/

Legacy chemicals are contaminating eggs around the world

2022-07-08

A recent global study found almost 90% of free-range egg samples from contaminated sites in developing nations exceeded the European Union (EU) maximum food limits for toxic pollutants. Plastic waste is a major contributor to the pollution.

Dioxins and dioxin-like polychlorinated biphenyls, commonly known as PCBs, are persistent organic pollutants, or POPs, that spread easily in the environment, accumulate in the food chain, and take years to biodegrade. They are linked to health effects such as cancer, hormone disruption, and alterations on brain development. While the global Stockholm Convention has regulated these kinds of chemicals since 2004, this study illustrates that dioxins and PCBs still pose major health threats to children and families around the world. The new study comes on the heels of a report that found most countries are failing to manage PCBs, and are far from achieving the Stockholm Convention goal of safe PCB management by 2028.

Food is the most common exposure pathway for POPs to humans. People are often exposed through fatty foods such as poultry, seafood, meat, milk, and eggs. Being the cheapest animal protein source with the lowest environmental impact, eggs are an important source of nutrition for poor people around the world. Yet, at the same time, the researchers describe

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them as the most sensitive exposure pathway because chickens feed on contaminated soil and ash every day, and transfer POPs to their eggs. People, especially children, eating just one egg a day, can easily exceed health-based values set by the World Health Organization and the EU.

For the study, researchers analyzed 113 groups of egg samples from free range chickens living near commercial and dump sites in developing countries, using sampling data from the International Pollutants Elimination Network and Arnika, a Czech environmental non-profit. "We have been collecting egg samples and mapping hotspots for almost 20 years with the International Pollutants Elimination Network, a network of more than 120 countries around the world," Jindrich Petrlik, the lead author and director of Arnika, told EHN.

Read More

Environmental Health News, 8-07-22

https://www.ehn.org/pollution-food-2657596238.html

Dioxins and dioxin-like polychlorinated biphenyls, commonly known as PCBs, are persistent organic pollutants.

EEB: At this pace, the EU will take centuries to regulate chemicals

2022-07-11

On July 11, 2022, the European Environmental Bureau (EEB), a coalition of European environmental civil organizations, published an analysis of European chemicals legislation that found it takes the EU about twenty years to regulate a chemical. At this pace it would take the EU "hundreds of years to process all outstanding dossiers and ensure all chemicals currently on the market are adequately controlled."

EEB summed the median times of each step of the regulatory process for "the 1,109 chemicals regulated or currently still undergoing regulation under Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH) and Classification, Labelling and Packaging (CLP) since 2007, when REACH entered into force." Specifically, they found that restricting one chemical that is dangerous takes 19 years and three months, "phasing out under the so-called Authorization process [takes] 22 years and 11 months while harmonizing classification and labelling [takes] 19 years and five months to be completed from start to finish."

EEB found three main bottlenecks in the chemical regulatory process:

- Industry groups submit dossiers without complete or reliable hazard and exposure data
- EU scientists "over-analyze" and regularly request more information because the EU cannot "act decisively on a precautionary basis" for either REACH or CLP
- And, the European Commission takes a "shockingly" long time to process dossiers sent to it despite the fact it is legally obligated to draft decisions within 3 months. In fact, "the Commission takes longer to decide than it takes the European Chemicals Agency (ECHA) to develop scientific opinions."

Because REACH and CLP are up for revision, EEB suggests incorporating binding decision deadlines into the process, adding sanctions on organizations that do not provide all the necessary hazard and exposure information, and using a precautionary approach chemical regulation.

In June 2022, ECHA released its fourth annual Integrated Regulatory Strategy report which showed that the agency has been increasing the speed at which it performs the chemical regulatory processes it is responsible for. In 2021, ECHA finalized 1900 chemical assessments, 30% more than it had in 2020. The agency has some of the same concerns as

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mentioned by EEB stating there has been a "steep increase in substances needing harmonized classification and labelling." ECHA further writes that "hazards need to be confirmed before risk management actions can start, and more data is often first needed [therefore] companies need to proactively update their registrations with up-to-date information."

Read More

Food Packaging Forum, 11-07-22

https://www.foodpackagingforum.org/news/eeb-at-this-pace-the-eu-will-take-centuries-to-regulate-chemicals

They found that restricting one chemical that is dangerous takes 19 years and three months.

Janet's Corner

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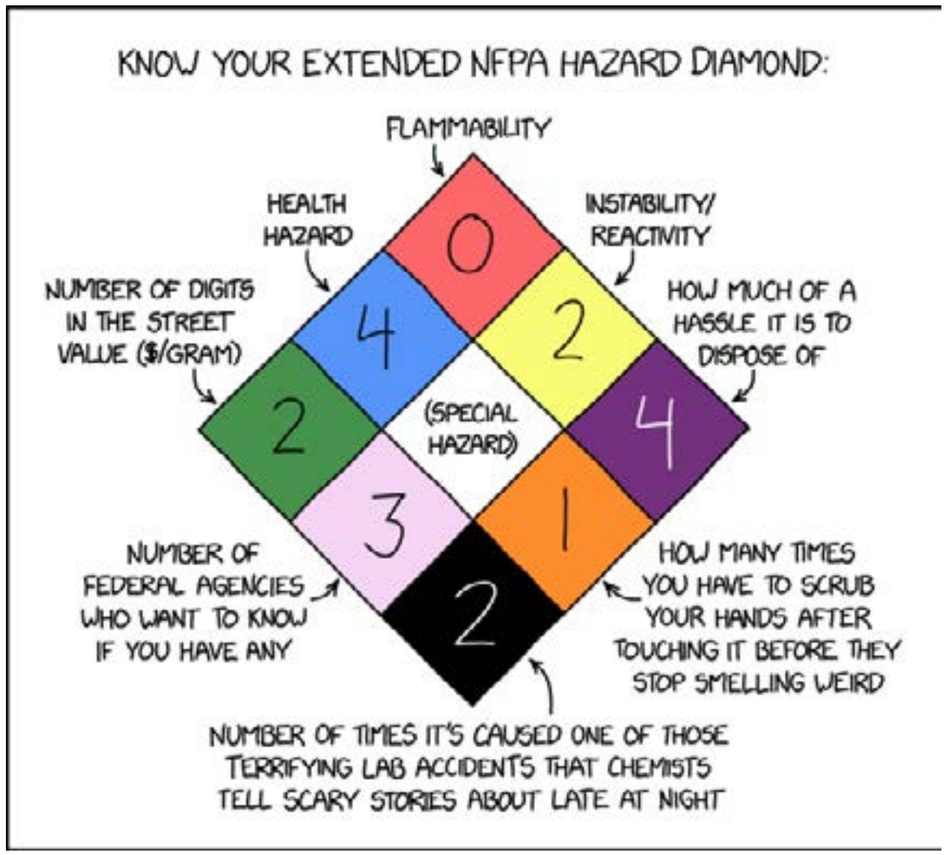
Extended NFPA Hazard Diamond

2022-07-22



https://xkcd.com/2638/

Hazard Alert

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Methyl Methacrylate

2022-07-22

Methyl methacrylate is an organic compound with the formula $CH_2=C(CH_3)COOCH_3$. It is the methyl ester of methacrylic acid (MAA) and is a monomer produced on a large scale for the production of poly(methyl methacrylate) (PMMA). [1] Methyl methacrylate is a colourless liquid with an acrid fruity odour. It is a flammable liquid and is slightly soluble in water and is soluble in some organic solvents. [2]

USES [3]

Methyl methacrylate is used in the manufacture of methacrylate resins and plastics e.g., Plexiglas. The principal uses of methyl methacrylate are: cast sheet and other grades (advertising signs and displays, lighting fixtures, glazing and skylights, building panels and sidings, and plumbing and bathroom fixtures), moulding/extrusion powder, and coatings (latex paints, lacquer, and enamel resins). It is also used in the impregnation of concrete to make it water-repellent, and also has uses in the fields of medicine and dentistry to make prosthetic devices and as a ceramic filler or cement.

IN THE ENVIRONMENT [4]

Methyl methacrylate evaporates when exposed to air. It dissolves when mixed with water. Most releases of methyl methacrylate to the environment are to air. Methyl methacrylate can also evaporate from water or soil exposed to air. Once in air, it breaks down to other chemicals. Microorganisms that live in water and in soil can also break down methyl methacrylate. Because it is a liquid that does not bind well to soil, methyl methacrylate that makes its way into the ground can move through the ground and enter groundwater. Plants and animals are not likely to store methyl methacrylate.

SOURCES & ROUTES OF EXPOSURE [3,4]

Sources of Exposure

Potential for exposure exists for employees of manufacturers of methyl methacrylate and its polymers, as well as doctors, nurses, dentists, and dental technicians. Individuals may also be exposed to methyl methacrylate via consumption of contaminated water. Exposure to methyl methacrylate can occur in the workplace or in the environment following

Methyl methacrylate is an organic compound with the formula CH2=C(CH3)COOCH3.

releases to air, water, land, or groundwater. In addition, exposure can occur when people use certain exterior latex house paints, adhesives, inks, and floor polishes.

Routes of exposure

Exposure to methyl methacrylate is primarily occupational, through dermal and inhalation routes. Methyl methacrylate enters the body when people breathe air or consume water or food contaminated with methyl methacrylate. It can also be absorbed through skin contact. Methyl methacrylate does not remain in the body due to its breakdown and removal.

HEALTH EFFECTS [3]

Acute Effects

Methyl methacrylate is irritating to the skin, eyes, and mucous membranes in humans. An allergic response to dermal exposure may develop. Respiratory symptoms reported in humans include chest tightness, dyspnea, coughing, wheezing, and reduced peak flow. Neurological symptoms, including headache, lethargy, lightheadedness, and sensation of heaviness in arms and legs, have occurred in humans following acute exposure to methyl methacrylate. In mice and rats acutely exposed to high concentrations of methyl methacrylate by inhalation, degenerative olfactory changes in the nasal passages and lung damage have been observed. High doses of methyl methacrylate may cause pulmonary oedema. Acute oral exposure of animals to methyl methacrylate has caused damage to the liver. Tests involving acute exposure of rats, mice, rabbits, and guinea pigs have demonstrated methyl methacrylate to have low to moderate acute toxicity by inhalation or oral exposure.

Chronic Effects

Respiratory and nasal symptoms and reduced lung function have been reported in chronically exposed workers. In one study, occupational exposure to high doses of methyl methacrylate was associated with cardiovascular disorders in humans. Chronic inhalation of methyl methacrylate by rats has resulted in respiratory effects (e.g., inflammation of the nasal cavity, degeneration/loss of olfactory epithelium in nasal turbinates, and lung congestion). Chronic inhalation of high levels of methyl methacrylate has resulted in degenerative and necrotic changes in the liver, kidney, brain, spleen, and bone marrow, decreased body weight gain, listlessness, prostration, and ocular and nasal discharge in

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animals. EPA has calculated a Reference Concentration (RfC) for methyl methacrylate of 0.7 milligrams per cubic metre (mg/m^3) based on respiratory effects in rats. EPA has calculated a Reference Dose (RfD) of 1.4 milligrams per kilogram body weight per day (mg/kg/d) based on no adverse effects in rats.

Reproductive/Developmental Effects

No adequate reproductive or developmental studies in humans are available. Inhalation exposure of rats to maternally toxic levels of methyl methacrylate resulted in foetal abnormalities (haematomas and skeletal anomalies) and decreased foetal weight and crown-rump length.

Cancer Risk

From a retrospective epidemiology study, a causal relationship between occupational exposure and increased incidences of colon and rectal cancers has been suggested; however, the causal relationship could not be established when relative accumulated total exposures and latency were considered. No carcinogenic effects were observed in several inhalation and oral animal studies. EPA considers methyl methacrylate not likely to be carcinogenic to humans.

SAFETY [5]

First Aid Measures

- Eye Contact: Check for and remove any contact lenses. Immediately flush eyes with running water for at least 15 minutes, keeping eyelids open. Cold water may be used. Do not use an eye ointment. Seek medical attention.
- Skin Contact: After contact with skin, wash immediately with plenty of water. Gently and thoroughly wash the contaminated skin with running water and non-abrasive soap. Be particularly careful to clean folds, crevices, creases and groin. Cold water may be used. Cover the irritated skin with an emollient. If irritation persists, seek medical attention. Wash contaminated clothing before reusing.
- Serious Skin Contact: Wash with a disinfectant soap and cover the contaminated skin with an anti-bacterial cream. Seek medical attention.
- Inhalation: Allow the victim to rest in a well ventilated area. Seek immediate medical attention.

- Serious Inhalation: Evacuate the victim to a safe area as soon as possible. Loosen tight clothing such as a collar, tie, belt or waistband. If breathing is difficult, administer oxygen. If the victim is not breathing, perform mouth-to-mouth resuscitation. Seek medical attention.
- Ingestion: Do not induce vomiting. Loosen tight clothing such as a collar, tie, belt or waistband. If the victim is not breathing, perform mouth-to-mouth resuscitation. Seek immediate medical attention.

Fire & Explosion Data

- Methyl methacrylate is flammable in presence of open flames and sparks.
- It is explosive in presence of heat.
- To extinguish small fires use dry chemical powder. For large fires use alcohol foam, water spray or fog.

Engineering Controls & Personal Protection

Engineering Controls

Provide exhaust ventilation or other engineering controls to keep the airborne concentrations of vapours below their respective threshold limit value. Ensure that eyewash stations and safety showers are proximal to the workstation location.

Personal Protective Equipment

The following personal protective equipment is recommended when handling methyl methacrylate:

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

Personal Protection in Case of a Large Spill:

- Splash goggles;
- Full suit;
- Vapour respirator;
- Boots;
- Gloves

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- A self contained breathing apparatus should be used to avoid inhalation of the product.
- Note: Suggested protective clothing might not be sufficient; consult a specialist BEFORE handling this product.

REGULATION [2,3]

United States

- American Conference of Governmental and Industrial Hygienists' threshold limit value is 410mg/m^3.
- National Institute of Occupational Safety and Health's recommended exposure limit is 410mg/m^3.
- NIOSH's immediately dangerous to life or health concentration is 4100mg/m^3
- Occupational Safety and Health Administration's permissible exposure limit expressed as a time-weighted average is 410mg/m^3.

Australia

- Safe Work Australia has set a limit for methyl methacrylate, of 100 parts per million over an eight hour workshift.

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Is It a Bird? Is It a Plane? No, It's a Flying Ferry

2022-07-14

THREE FEET ABOVE the waves, the Candela P-12 sprints across Lake Mälaren near Stockholm, Sweden. With only its hydrofoils cutting through the water, the boat leaves virtually no wake, noise, or emissions—a sea change from the hulking diesel-powered ferries that currently haul commuters through the archipelago that makes up the Swedish capital.

So far, it's a water-bound fantasy: While Swedish startup Candela is already manufacturing leisure versions of its electric flying boats, the P-12 hasn't yet been built. Candela CEO Gustav Hasselskog says the boat is in the "design for manufacturing stage" ahead of a November launch that will be followed by a trial next year. The aim is to have the flying ferry form a part of Stockholm's public transport fleet.

Cutting carbon emissions from ferries is a priority for a city surrounded by water. The city's existing fleet of 60 ferries emits 40,000 tons of carbon dioxide annually, making up 8 percent of total shipping emissions in Sweden—and they're spewing that air pollution in cities, raising public health concerns. "Shipping has to stop using fossil fuel, fast," says Simon Bullock, a researcher at the University of Manchester's Tyndall Centre for Climate Change Research. "For short journeys, electric ships can be a big part of the solution."

On that point Sweden is ahead of the curve, with Stockholm working toward emissions-free ferries by 2025. Electric ferries have previously been trialed in the Swedish capital, with local authorities testing another model from Green City Ferries alongside the flying P-12. Norway uses electric passenger ferries to tour its fjords, Belfast in Northern Ireland is trialing a similar "flying" style boat, and a project at the University of Plymouth in the UK is converting diesel ferries to electric. That's good news given that ferries, most of which are powered by diesel, are a major environmental headache: EU data shows ferries represent 3 percent of all vessels but make up 10 percent of carbon emissions, while more than 95 percent of US ferries are powered by diesel.

But Candela believes there's more to cleaning up Stockholm's commuter traffic than emissions-free energy: making ferries quick enough to persuade more people to ditch cars. Traveling from the suburb of Tappström to central Stockholm takes 50 minutes by car during rush hour, but the P-12, which can hit 30 mph, could navigate the waterways between the two in 25 minutes, Hasselskog says. Waxholmsbolaget, the agency that runs public transport boats in the archipelago, carries 1.2

An electric hydrofoil ferry could be the future of public transportation in Stockholm—and beyond.

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million passengers annually, but that's compared to 780,000 commuting trips by other forms of public transport each day in the city—in short, there's room to get more Swedes in the sea.

The problem with powering any form of transport with electricity is it requires heavy batteries. That's a particular problem for boats, as they suffer drag in the water. To address this Candela uses hydrofoils, legs that extend down into the water and act like wings, propelling the boat up into the air as it picks up speed like an aircraft during takeoff. "In harbor the foils are fully retracted, so they're protected," Hasselskog says. "But then you lower the foils and hit the throttle and off it goes. The control system takes care of the entire takeoff sequence, it's like an airplane."

Hydrofoil boats aren't new, but electric power and automated controls are. The carbon-fiber Candela P-12 will have twin propulsion systems powered by 180-kWh batteries, letting it run three hours before requiring charging. At 12 meters in length and 4.5 meters across, the 8.5 metric ton boat will carry 30 seated passengers.

A superfast flying boat sounds like a surefire way to lose your breakfast on the morning commute, but the Candela has sensors that feed into an automated control system to adjust the height and roll and pitch up to 100 times a second to ensure a smooth ride regardless of the weather. "Through the control system we can cut out any vertical movements of the boat," Hasselskog says, which is what tends to cause seasickness. "So far nobody has gotten seasick on our boats."

All of that means the Candela P-12, when built, should use less energy per passenger than a hybrid electric bus, go faster than a car, and bring down fuel and maintenance costs by 40 percent. And as it glides above the water it's less disruptive to the local environment both above and beneath the water.

Candela couldn't simply upsize its existing boat to build the P-12—regulations require a thicker hull, fire safety systems for the batteries, and, confusingly, separate toilets for passengers and the single member of crew, who will be driving all the time.

Toilets aside there's another regulatory challenge: Speed limits on inland waterways tend to be as low as six knots (7 mph), but hydrofoil boats are most efficient at top speed. Such speed limits are for safety and to reduce wake, which boats like the P-12 don't cause. "The solution is working with port authorities and ferry operators to get dispensation," says Charles Haskell, decarbonization program manager at maritime consultancy

Lloyd's Register. Around Stockholm that limit is 12 knots, though Candela has a temporary exemption during the trial.

Not all cities can use waterways as highways like this, but it could be an appealing idea for coastal conurbations. Rival flying boat maker Artemis is testing its version in Belfast, while Hasselskog has held talks with authorities in Istanbul and across the Middle East. Reps from the Water Emergency Transportation Authority (WETA), which operates ferry services in the San Francisco Bay Area, have visited Stockholm to see how the Candela P-12 works.

For coastal cities like Stockholm, ferries could become the watery equivalent of trams without having to lay infrastructure like rail, though charging systems will be needed. "If it's acting like a sea-based light rail facilitating hundreds of people who would have gone by car, then that's what we need more of," says Paul Chatterton, professor of urban futures at the University of Leeds. "The speed is a red herring … in a big urban river environment you need big large crafts that can take a lot of people short distances."

Hasselskog argues that a large fleet of smaller boats offers more flexibility than larger ferries and could mean they're used on demand, ditching the need for timetables or fixed stops. The idea is also being touted by hydrogen-powered hydrofoil water taxis made by SeaBubbles, which have been trialed in Lyon, France. Smaller boats have another use: ferrying maintenance staff and supplies out to offshore wind farms, says Haskell, solving a problem of getting staff to locations many miles offshore without them arriving seasick.

Even without top speeds, water taxis and boat buses offer promise to cities with waterways, Chatteron says, pointing to the popularity of Venice's vaporettos. And beyond passenger transport, slow, electric canal barges could take freight off of roads. "You can move a lot of things with little or no energy," Chatterton says, "and a lot of European cities have canals." Whether its electric-powered flying ferries or low-energy barges, making better use of urban waterways makes sense for sustainability, says Hasselskog. "You don't need any special infrastructure, the water is just there," he says. "That's probably why they were used back in the day—you just go."

Wired, 14 July 2022

https://wired.com

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Tiny shapeshifting robots brush and floss your teeth, kill bacteria

2022-07-05

Like many menial tasks, there may soon be a way to outsource brushing your teeth to robots. Engineers at the University of Pennsylvania have developed a system of microrobots that can change shape to form bristles or floss. They don't just brush plaque away, but release antimicrobials to kill bad bacteria.

Brushing and flossing every day can be annoying, and even people who stick to the routine can miss areas and wind up with trouble. Part of the problem is that toothbrushes don't account for differences in the shape or spacing of different people's teeth.

The new system solves that issue by effectively shapeshifting. It's made up of iron oxide nanoparticles, which can be assembled into different formations and controlled using magnetic fields. This way, the particles can be arranged into the shape of bristles to brush plaque from tooth surfaces, or thinner floss-like strands to scrub between teeth.

Brushing and flossing every day can be annoying. Part of the problem is that toothbrushes don't account for differences in the shape or spacing of different people's teeth.

But these microrobots don't just clean teeth mechanically. Iron oxide is known to activate hydrogen peroxide, triggering a reaction that produces free radicals that kill bacteria and the sticky biofilms they form on teeth.

The team first tested the system on a flat slab of artificial tooth-like material to get the motions of the microrobots down. Then, they moved on to controlling it over the more realistic terrain of 3D-printed tooth models. Finally, the microrobots were tested on real human teeth, mounted in a device that arranged them in the way they would sit in the mouth.

The tests showed that these microrobots could efficiently remove plaque and biofilms, reducing pathogenic bacteria below detectable levels. The team also showed that they could precisely control the bristle stiffness and length by adjusting the magnetic field, allowing the tips to be made firm enough to clean the teeth but still soft enough to be gentle on gums.

The researchers say that the customizability of this microrobot system could clean people's teeth better, while its hands-free potential could allow people with reduced fine motor skills to still take care of their oral health.

Exactly what form this system would take in a commercial device remains to be seen, but the researchers are investigating mouth-fitting devices that

could be similar to some other rapid tooth-cleaning systems we've seen. Other microrobots have been tested for cleaning teeth recently, clearing infections from inside for more effective root canals.

The new research was published in the journal ACS Nano.

New Atlas, 5 July 2022

https://newatlas.com

Skittles are 'unsafe' for consumers, lawsuit charges, because they contain 'a known toxin'

2022-07-16

A consumer is suing candy maker Mars, alleging Skittles contain a "known toxin" that makes the rainbow candies "unfit for human consumption."

In a lawsuit seeking class-action status filed in U.S. District Court for the Northern District of California on Thursday, attorneys for San Leandro resident Jenile Thames said that Skittles were unsafe for consumers because they contain "heightened levels" of titanium dioxide.

Mars Inc. uses titanium dioxide to produce Skittles' well-known array of artificial colors. In 2016, the candy maker publicly shared its intention to remove titanium dioxide from its products in the coming years, the Thursday complaint noted – but titanium dioxide is still used in products like Skittles today.

Mars Inc. uses titanium dioxide to produce Skittles' well-known array of artificial colors.

In a statement sent by Mars to TODAY and several other news outlets, the company said: "While we do not comment on pending litigation, our use of titanium dioxide complies with FDA regulations."

USA TODAY reached out to Mars for additional comment Saturday.

According to the FDA's Code of Federal Regulations, "The color additive titanium dioxide may be safely used for coloring foods generally," but there are several restrictions – such as the quantity of titanium dioxide not exceeding 1% of the food's weight.

While the regulated use of titanium dioxide in food products is still legal in the U.S., it has been banned in some other countries, including throughout Europe. In May 2021, the European Food Safety Authority announced that titanium dioxide "can no longer be considered safe as a food additive" – noting the importance of genotoxicity concerns, for example.

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Genotoxicity is the ability of chemicals to damage genetic information such as DNA. "After oral ingestion, the absorption of titanium dioxide particles is low, however they can accumulate in the body," said Maged Younes, chair of EFSA's expert Panel on Food Additives and Flavourings, in a statement at the time.

In the Thursday complaint, Thames' attorneys argued that, in addition to the continued use of titanium dioxide in its products like Skittles, Mars was not adequately warning consumers of these health risks.

"Based on Defendant's omissions, a reasonable consumer would expect that the Product can be safely purchased and consumed as marketed and sold," the complaint reads. "However, the Products are not safe and pose a significant health risk to unsuspecting consumers. Yet, neither before nor at the time of purchase does Defendant notify consumers like (Thames) that the Products are unsafe to consumers, contain heightened levels of titanium dioxide, and should otherwise be approached with caution."

The Thursday complaint also pointed to several Mars competitors who, according to the suit, do not use titanium dioxide to color their products – such as Sour Patch Kids and Nerds. In addition, Thames' attorneys noted that Mars has other confectionary products, such as M&Ms, "that do not rely" on titanium dioxide.

Thames seeks damages, to later be determined in sum at trial, for fraud and multiple violations of California consumer protection laws.

USA Today, 16 July 2022

https://usatoday.com

Banning artificial stone could prevent 100 lung cancers and 1,000 cases of silicosis, where dust scars the lungs

2022-07-12

Silica dust is a very fine dust produced when products such as bricks, concrete and pavers are cut or drilled. Artificial stone, which is used mainly for kitchen benchtops, is a particularly potent source of silica dust.

Breathing this dust into the lungs can cause severe long-term damage. This can result in breathing difficulties, scarring of the lungs (silicosis) and lung cancer.

In our recently published report, we estimate that without action, Australian workers would develop more than 10,000 future lung cancers

Australian workers would develop more than 10,000 future lung cancers and almost 104,000 silicosis cases during their lifetime due to their exposure to silica dust.

and almost 104,000 silicosis cases during their lifetime due to their exposure to silica dust. This is around 1% of all future lung cancers in the Australian adult population.

However, banning artificial stone would reduce silica exposure and could prevent 100 lung cancers and almost 1,000 silicosis cases over the lifetime of these workers.

Re-emergence of an old disease

Silica dust is a serious hazard in Australian workplaces. Around 7% of Australian workers are at risk of breathing it in. Exposure is most common in miners and construction workers.

For the last 60 years, silicosis was very rare in Australia. Due to the increased use of artificial stone, we are now seeing a re-emergence of this terrible disease.

In response to the resurgence of silicosis, the Australian government set up a taskforce to improve the health and safety of those working with silica dust. Its final report, from June 2021, recommended further analysis on how best to protect artificial stone workers.

This is now under way, with Safe Work Australia releasing a regulatory impact statement for consultation. This statement looks at a number of options to reduce exposure to silica and the cost of these over the next ten years.

Safe Work Australia concluded these measures would only need to save about five people a year from silicosis in order for these options to be cost effective.

While this is a good start, there's scope to do much more. Banning artificial stone is among the recommendations suggested by the taskforce but not currently supported by government and not being considered by Safe Work Australia.

Assessing the harm

To estimate the harm caused by silica dust at work, we used a method which calculates how many additional disease cases would occur in workers exposed to silica dust in one year – in this case, the year 2016.

We used past exposure surveys and recent reports from New South Wales and Victoria to estimate how many workers were exposed to silica dust nationwide.

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Then we modelled how many lung cancers and silicosis cases would occur during the lifetimes of these workers.

We then looked at possible ways to reduce exposure to silica dust, including wet cutting, reducing worker access to dusty areas, using good quality and well-fitted respirators, as well as banning artificial stone.

While this modelling isn't yet published in a peer-reviewed journal, it has been peer-reviewed by others in the field.

Reducing the harm

We found banning artificial stone could prevent 100 lung cancers and almost 1,000 silicosis cases.

We also looked at other control measures which could be implemented in the interim.

Setting up exclusion zones around areas where artificial stone is cut, using well-fitted respirators, wetting artificial stone while cutting it, and using on-tool dust extraction while cutting artificial stone could prevent cases of lung cancer and silicosis, but not as many as a complete ban.

Unfortunately, a ban on silica dust in other industries such as mining isn't possible. However, exposure can be reduced. Stopping workers from entering areas near crushers on mine sites would prevent 750 lung cancers and almost 7,500 silicosis cases.

If we were able to reduce exposure in the mining industry to that experienced by the general population, we could save more than 2,300 lung cancers and over 20,000 silicosis cases.

Reducing silica dust would save lives

Overall, ensuring compliance with engineering controls and respiratory equipment could prevent more than 400 workers from developing two terrible diseases.

These cases can only be prevented if there is 100% compliance with control measures. This is a level of compliance much higher than what we're currently seeing in Australian workplaces.

A licensing system for artificial stone businesses such as that underway in Victoria might go some way to improving compliance, but the effects of this remain to be seen.

However, if we banned artificial stone, we could save up to 700 more young workers from developing these diseases. If we tried to eliminate silica dust exposure in other industries, we could prevent even more disease.

Clearly, much more needs to be done to protect our workers from these ultimately preventable lung diseases.

The Conversation, 12 July 2022

https://theconversation.com

Algae biopanel windows make power, oxygen and biomass, and suck up CO2

2022-07-11

Beautifully designed, energy-generating bio-panels that suck up carbon dioxide and pump out biomass for use as fuel or fertilizer – that's the idea behind Mexican startup Greenfluidics and its nanotech-enhanced microalgae bioreactor building panels.

The idea of using flat algae tanks on the outside of buildings as part of a sustainability exercise is not new. Indeed, back in 2013, Splitterwerk Architects and engineering company Arup teamed up to create a full-scale demonstration building, called the BIQ, featuring no less than 200 sq m (2,150 sq ft) of algae bioskin panels.

These panels, tinted green by the biomass sandwiched within, serve several purposes. They take a stream of carbon dioxide, captured from what would otherwise be an emissions source, and bubble it through water impregnated with selected strains of algae, which absorb the CO2, as well as sunlight, and photosynthesize, increasing their mass and generating fresh oxygen. The more sunlight is available, the faster the algae will grow, capturing about two pounds of carbon dioxide for each pound of algae.

These panels also trap heat in their water, which serves two purposes in the BIQ – firstly, with the panels mounted outside, it shades the building, reducing air conditioner energy use in the summer. Secondly, that heat can be harvested – as can the biomass itself. The biomass generated by the BIQ is periodically filtered out as a mashy pulp, then taken away and reprocessed into combustible biofuel, which is then brought back into the building and fed into the burner that runs the building's hot water system. Between the biomass fuel and the heat captured from the water

Soaking up carbon dioxide, the panels will produce electricity, clean oxygen and a sludgy biomass that can be processed into combustion fuel, fertilizer or a range of other useful substances.

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in the panels, the BIQ is able to sustainably cover about a third of its water-heating energy requirements.

Greenfluidics wishes to make a couple of tweaks to this process. Chiefly, the innovation here is in the thermal capture and conversion. In an interview with Mexico Business News, Greenfluidics CEO Miguel Mayorga described how his company's system uses nanofluids – effectively, recyclable carbon nanoparticles are added to water, increasing its heat conductivity. This is run through one side of the panels, improving its heat capture, while the algae are grown on the other side. The heat in this case is transformed directly into electricity through a thermo-electric generator, and fed into the building, making these algae panels more analogous to traditional solar panels.

There seems to often be a bit of Photoshop involved when it comes to cool-looking algal devices. In the renders, as with this XBOX-style standalone bioreactor, they seem to glow a refreshing lime green, whereas in operation they seem to look a bit more drab and ... well, algal. Still, Greenfluidics wants to build its panels in a range of attractive designs that can elevate the architecture and provide a green focus. Founded in 2018, the company is hoping to have a product commercialized soon. In the meanwhile, it's won a fair swag of awards.

We still have reservations about the ultimate viability of the product here – after all, since the BIQ building has been open for some nine years now, one would expect the idea to have proven itself and taken off if it was indeed a game-changer for sustainable design. A feasibility review of the BIQ concept was published in 2016, collating feedback from a group of Australian engineers, architects, urban planners, bioengineers, surveyors, building sustainability managers and other potential stakeholders, and it echoes and expands on some of our concerns.

How long would these panels last? How often would you have to clean them out, and do people need to abseil down the walls to do it? Would the algae gunk up the valves and pipework? Would the green-tinted light they let through make people feel queasy? Since the BIQ has to shut down through winter, are there algal strains available that'll work year-round in a range of climates? Will they make people sick if there's a leak?

Then there's the economics; the BIQ was an early pilot project, but its panels increased the cost of the building facade by a factor of 10. Assuming economies of scale, what's the green premium on algae panels in a mass-market implementation? How much can you sell your sludgy biomass for once it's filtered out? What are the running costs? How much

will it bring your power bills down? Is there a minimum size for a viable deployment of this stuff?

Probably most importantly, how does the energy generation and building cooling compare against boring old solar panels, window tinting and insulation? Carbon capture and oxygen release are lovely, but they don't show up on the balance sheet for a building operator. These things will really need to sing for their supper if the idea of bubbling, green, transparent building panels is going to take off.

We fear this tech might end up falling into the "too complex, too expensive" category – but we'd be delighted to be surprised on this one and we'll be watching Greenfluidics' progress with interest.

New Atlas, 11 July 2022

https://newatlas.com

Nanoparticles can save historic buildings made from porous rock

2022-07-11

Many historical buildings were built of sandstone, including Vienna's St. Stephen's Cathedral. Sandstone is easy to work with, but does not withstand weathering. It consists of sand grains that are relatively weakly bonded to each other, which is why parts of the stone crumble away over the years, often requiring costly restoration.

However, it is possible to increase the resistance of the stone by treating it with special silicate nanoparticles. The method is already being used, but what exactly happens in the process and which nanoparticles are best suited for this purpose has been unclear until now. A research team from TU Wien and the University of Oslo has now been able to clarify exactly how this artificial hardening process takes place through elaborate experiments at the DESY synchrotron in Hamburg and with microscopic examinations in Vienna. The team also determined which nanoparticles are best suited for this purpose. Their study was published in Langmuir.

An aqueous suspension with nanoparticles

"We use a suspension, a liquid, in which the nanoparticles initially float around freely," says Prof. Markus Valtiner from the Institute of Applied Physics at TU Wien. "When this suspension gets into the rock, then the aqueous part evaporates, the nanoparticles form stable bridges between the sand grains and give the rock additional stability."

"The smaller the nanoparticles, the more can they strengthen the cohesion between the sand[stone] grains."

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This method is already used in restoration technology, but until now, it was not known exactly what physical processes take place. When the water evaporates, a very special kind of crystallization occurs: Normally, a crystal is a regular arrangement of individual atoms. However, not only atoms, but also entire nanoparticles can arrange themselves in a regular structure—this is then referred to as a "colloidal crystal."

The silicate nanoparticles come together to form such colloidal crystals when they dry in the rock and thus jointly create new connections between the individual sand grains. This increases the strength of the sandstone.

Measurements at the large-scale research facility DESY and in Vienna

To observe this crystallization process in detail, the TU Wien research team used the DESY synchrotron facility in Hamburg. Extremely strong X-rays can be generated there, which can be used to analyze the crystallization during the drying process.

"This was very important to understand exactly what the strength of the bonds that form depends on," says Joanna Dziadkowiec (University of Oslo and TU Wien), the first author of the publication in which the research results have now been presented. "We used nanoparticles of different sizes and concentrations and studied the crystallization process with X-ray analyses." It was shown that the size of the particles is decisive for optimal increased strength.

To this end, the TU Vienna also measured the adhesive force created by the colloidal crystals. For this purpose, a special interference microscope was used, which is perfectly suited for measuring tiny forces between two surfaces.

Small particles, more force

"We were able to show: The smaller the nanoparticles, the more can they strengthen the cohesion between the sand grains," says Joanna Dziadkowiec. "If you use smaller particles, more binding sites are created in the colloidal crystal between two sand grains, and with the number of particles involved, the force with which they hold the sand grains together thus also increases."

How many particles are present in the emulsion is also important. "Depending on the particle concentration, the crystallization process proceeds slightly differently, and this has an influence on how the colloidal

crystals form in detail," says Markus Valtiner. The new findings will now be used to make restoration work more durable and more targeted.

Phys Org, 11 July 2022

https://phys.org

When you pick your nose, you're jamming germs and contaminants up there too. 3 scientists on how to deal with your boogers

2022-07-13

Whether you're in the trusted company of your spouse, or sneaking a quick one when you think nobody's looking, we all pick our noses. Other primates do it too.

The social stigma around nose picking is widespread. But should we really be doing it – and what should we do with our boogers?

We're scientists who have researched the environmental contaminants – in our homes, our workplaces, our gardens – so we've have some insight on what you're really jamming up there when your finger is slotted satisfyingly into your sniffer.

Get your news from people who know what they're talking about.

Here's what you need to know before you pick and flick.

What is in a booger?

Nose picking is an entirely natural habit — children who have not yet learned social norms realise very early on that the fit between their forefinger and a nostril is pretty good. But there's lot more than just snot up there.

During the ~22,000 breath cycles per day, the booger-forming mucus up there forms a critical biological filter to capture dust and allergens before they penetrate our airways, where they may cause inflammation, asthma, and other long-term pulmonary issues.

Cells in your nasal passage called goblet cells (named after their cup-like appearance) generate mucus to trap viruses, bacteria and dust containing potentially harmful substances like lead, asbestos and pollen.

Nasal mucus and its antibodies and enzymes are the body's front line immune defence system against infections.

Come on, you know you do it.

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The nasal cavity also has its own microbiome. Sometimes these natural populations can be disturbed, leading to various conditions such as rhinitis. But in general, our nose microbes help repel invaders, fighting them on a mucus battlefield.

The dust, microbes and allergens captured in your mucus eventually get ingested as that mucus drips down your throat.

This is typically not an issue, but it can exacerbate environmental exposure to some contaminants.

For instance, lead – a neurotoxin prevalent in house dust and garden soils – enters children's bodies most efficiently through ingestion and digestion.

So, you may worsen particular environmental toxic exposures if you sniff or eat boogers up instead of blowing them out.

What does the science say about the risks of booger-mining?

Golden Staph (Staphylococcus aureus, sometimes shortened to S. aureus) is a germ that can cause a variety of mild to severe infections. Studies show it is often found in the nose (this is called nasal carriage).

One study found:

Nose picking is associated with S. aureus nasal carriage. The role of nose picking in nasal carriage may well be causal in certain cases. Overcoming the habit of nose picking may aid S. aureus decolonization strategies.

Nose picking may also be associated with an increased risk of Golden Staph transmission to wounds, where it poses a more serious risk.

Sometimes, antibiotics do not work on Golden Staph. One paper noted:

growing antibiotic resistance calls for health care providers to assess patients' nose picking habits and educate them on effective ways to prevent finger-to-nose practices.

Nose picking could also be a vehicle for transmission of Streptococcus pneumoniae, a common cause of pneumonia among other infections.

In other words, sticking a digit in your nose is a great way to jam germs further into your body, or spread them around your environment with your snotty finger.

There's also the risk of gouging and abrasions inside the nostrils, which can allow pathogenic bacteria to invade your body. Compulsive nose picking to the point of self-harm is called rhinotillexomania.

Well, I picked. Now what?

Some people eat them (the technical term is mucophagy, meaning "mucus feeding"). Apart from booger eating being disgusting, it means ingesting all those inhaled mucus bound germs, toxic metals and environmental contaminants discussed earlier.

Others wipe them on the nearest item, a little gift to be discovered later by someone else. Gross, and a great way to spread germs.

Some more hygienic people use a tissue for retrieval, and dispose of it in a bin or toilet afterwards.

That's probably among the least worst options, if you really must pick your nose. Just make sure you wash your hands extra carefully after blowing or digging in your nose, given that until mucus has completely dried, infectious viruses can remain on the hands and fingers.

No advice in the world will keep you from digging away

In secret, in the car or on napkins, we all do it. And truth be told, it is so very satisfying.

But let's honour the tireless labour done by our remarkable noses, mucus and sinus cavities – such amazing biological adaptations – and remember they're trying hard to protect you.

Your snoz is working overtime to keep you healthy, so don't make it any harder for it by jamming your grubby fingers up there. Don't be a grub – blow discreetly, dispose of the tissue thoughtfully and wash hands afterwards.

The Conversation, 13 July 2022

https://theconversation.com

Biodiversity: Wild species can help feed the world

2022-07-11

"Transformative changes" are needed to save wild species from extinction and preserve ecosystems that are essential to human life, say the authors of two landmark reports from the the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES).

Biodiversity experts are calling for the preservation of often endangered wild species, which could provide food and income for billions worldwide.

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The reports examine options for using algae, animals, fungi, and land-based and aquatic plants in a sustainable way.

Almost 400 experts and scientists, as well as representatives of indigenous communities, were involved in the reports. In total, they evaluated thousands of scientific sources. The executive summary was released this week.

"Almost half the world's population actually depends to a greater or lesser extent on the use of wild species. And it's much more prevalent than most people think," said John Donaldson, co-chair of IPBES.

The sixth mass extinction

Currently, about a million species worldwide are threatened with extinction as biodiversity and ecosystem health deteriorate at unprecedented rates.

This undermines economic prosperity while harming the health and quality of life of people around the world.

Due to human-caused climate change, the Earth is currently heading for a warming of 2.7 degrees Celsius (4.9 degrees Fahrenheit) by century's end compared to pre-industrial times. This level of warming will increase the risk to endangered species in extinction hotspots tenfold.

The report builds on findings by researchers that a sixth mass extinction is already underway.

It notes that the nurturing of wild species of fish, insects, fungi, algae, wild fruits, forests and birds of any kind is fundamental to building and preserving sustainable ecosystems.

Wild species benefit people

Protecting wild species and their ecosystems will help secure the livelihoods of millions of people, says the report. Sustainable management of wild species would further bolster one of the UN Sustainable Development Goals of fighting poverty and hunger, it adds.

Two-thirds of all food crops, for example, depend largely on wild pollinators. Meanwhile, wild plants, fungi and algae are part of the diet of one-fifth of the global population.

Some 70% of low-income people globally are directly dependent on wild species, with the use of wild tree species forms an important source of income for millions worldwide.

But at the same time, the 2 billion people who need wood for cooking are destroying biodiversity. Most access timber unsustainably, with around 5 million hectares of forest lost annually through deforestation.

Wild species can also produce income, even without harvesting for food or cutting down habitat.

Nature tourism such as scuba diving, bushwalking or wildlife viewing generated $120 billion (€118 billion) in revenue in 2018. National parks and protected areas generated about $600 billion per year in revenue before the pandemic.

Assessing impacts and factoring in environmental costs

Undervaluing nature when making political and economic decisions is fundamentally worsening the global biodiversity crisis, say the authors.

Basing policy decisions on economic considerations overlooks how environmental changes impact people's lives. For example, a focus on short-term gains and measuring growth and progress in terms as gross domestic product fails to account for negative impacts such as overexploitation or social injustice.

Incorporating nature values into policy-making "entails redefining 'development' and 'good quality of life,' and recognizing the multiple ways people relate to each other and to the natural world," said Patricia Balvanera, a co-author of one of the two reports.

From sushi hype to tuna population recovery

Bluefin tuna had been on the verge of extinction since the 1980s due to the rising popularity of sushi, noted Donaldson.

But the shortening of the fishing season, an increase in the minimum size of the fish, new tools to monitor and control fishing activity, and a sharp reduction in fishing capacity — as well as annual quotas — have seen stocks recover.

"Where you get the management done properly," said Donaldson, it not only enhances sustainability, but "allows for the recovery of stocks where they've been overutilized."

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The authors recommend similar levels of innovation in the timber industry, including the establishment of a functioning certification system, an end to illegal logging, strong state regulations, forestry that respects the land rights of Indigenous peoples and nurtures wild species instead of monocultures.

Indigenous communities 'undervalued'

When proposing how ecosystems could be better protected and used, the report highlights the role of Indigenous communities.

Sustainability aspects of Indigenous peoples include crop rotation and resting livestock grazing, and stopping certain species from being harvested or hunted during given seasons, all with the goal of maintaining or even increasing biodiversity.

There tends to be less deforestation in areas where Indigenous communities live, the report noted.

Representatives of Indigenous communities directly contributed to the report, which highlighted their shared culture of not taking more from nature than is needed; of avoiding waste; and of distributing harvests equitably.

This recognition of Indigenous knowledge "is progress," says Viviana Figueroa of the International Indigenous Forum on Biodiversity. "Indigenous people are doing the real work in species conservation without being paid for it," she added.

Yet despite this extensive contribution, many communities continue to face human rights violations, from displacement to violence and illegal extraction on their lands.

"[Governments need to] support us in the conservation and sustainable use of wildlife species," said Figueroa. "We want that this report also supports real action at a local level."

Deutsche Welle, 11 July 2022

https://dw.com

Electric shock to petroleum coke generates sustainable graphene

2022-06-16

Researchers at Texas A&M University and ExxonMobil are developing a method to reprocess petroleum coke—a byproduct of refining crude oil—into a sustainable, high-value alternative. Using a chemical process called electrochemical exfoliation, they have converted petroleum coke into graphene, a nanomaterial with applications in electronics, medicine and energy storage.

This study was published in npj 2D Materials and Applications.

Crude oil is a mixture of many different hydrocarbons, with light portions going to natural gas while the heaviest portions form viscous or even solid materials. One of the many products that comes from refining crude oil is solid petroleum coke.

Although there are many ways to utilize petroleum coke, such as electrodes for steel and aluminum production, this process releases harmful carbon emissions. For this reason, the industry is looking for low-emissions, high-value materials that can be derived from crude oil.

A possible solution is repurposing the carbon-rich petroleum coke to generate graphene, a versatile sheet-like material composed of a single layer of carbon atoms. Conventionally, graphene is exfoliated from graphite. The researchers investigated whether any chemical processes would facilitate graphene production from fossil fuel-derived materials.

"We know that petroleum coke contains graphene-like materials," said Dr. Micah Green, professor in the Artie McFerrin Department of Chemical Engineering at Texas A&M. "Our challenge was to isolate the graphene from the starting material."

To accomplish this task, the researchers turned to electrochemistry. They placed coke into an electrolyte solution with a working electrode and a counter electrode. When they applied voltage to the working electrode, the ionic species or negative ions from the electrolyte migrated in between the graphene sheets in a process called intercalation.

"Think of the coke as a book and the graphene as each individual sheet of paper," said Green. "When the book is laid flat on its spine, the pages fan out and have more gaps between them. The process of electrochemical exfoliation is similar."

"The future of nanomaterial scaleup is directly tied to existing streams in the petrochemical industry."

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When the coke is expanded, the graphene separates. Negative ions are created and move into the spaces between the graphene sheets, completing the coke byproduct and graphene separation.

Many graphene applications require high conductivity, but whether the graphene from petroleum coke could achieve such performance was unknown. The graphene created from the coke had a conductivity of 50 siemens per meter compared to a typical lithium-ion battery, whose electrical conductivity is about 150-160 siemens per meter. With a heat treatment called annealing, the researchers could boost the conductivity even higher, making it comparable to electrodes in lithium-ion batteries.

With these findings, graphene applications that have been in development for years could come to fruition.

"The future of nanomaterial scaleup is directly tied to existing streams in the petrochemical industry, and I anticipate many more cases where petroleum-derived chemicals are converted to high-value carbon materials like graphene," said Green.

Phys Org, 16 June 2022

https://phys.org

NIH: Common chemicals linked to preterm births

2022-07-13

Exposure to a common group of chemicals used in plastics and a broad range of personal care products leads to an uptick in preterm births, according to the National Institutes of Health.

Research released this week and published in the Journal of the American Medical Association links those chemicals, phthalates, to early deliveries, one of the top causes of death and disease in newborns. Based on data from more than 6,000 pregnant women, NIH found that a higher concentration of phthalates in urine samples correlated to a greater likelihood of preterm births.

Kelly Ferguson, an epidemiologist at the NIH's National Institute of Environmental Health Sciences and the senior author on the study, said that the findings offer insight into just how chemical exposure can impact pregnant people, with severe implications.

Research published in the Journal of the American Medical Association links those chemicals, phthalates, to early deliveries, one of the top causes of death and disease in newborns.

"Having a preterm birth can be dangerous for both baby and mom, so it is important to identify risk factors that could prevent it," said Ferguson in a statement.

The study marks the largest to date probing the link between phthalates and preterm births. Those chemicals are common as plasticizers, increasing transparency and flexibility, but they are also used in detergents and solvents, as well as personal care products like shampoos and soaps.

Exposure can come through avenues like eating and drinking foods that have come into contact with phthalates. And the chemicals pose significant health risks — they are linked to endocrine disruption and interference with sexual development.

The NIH findings are based on data from 16 studies and births between 1983 and 2018. Urine from participants yielded phthalate metabolites in more than 96 percent of samples, with 9 percent (or 539 people) resulting in preterm births. Higher concentrations of phthalates, the researchers noted, led to higher odds of births three or more weeks before a person's due date.

They also found that reducing exposure to phthalate metabolite levels by 50 percent could meanwhile prevent preterm births by around 12 percent. The researchers encouraged behaviors that could see reduced exposure to the chemicals, like avoiding food that comes in plastic containers and wrapping, in addition to opting for "phthalate-free" products like cosmetics.

"It is difficult for people to completely eliminate exposure to these chemicals in everyday life, but our results show that even small reductions within a large population could have positive impacts on both mothers and their children," said Barrett Welch, a postdoctoral fellow at NIEHS and an author on the study.

Phthalates are among the more controversial chemicals long singled out by advocacy groups and public health experts, with particular concerns around pregnancy. An earlier study published in 2020 by Harvard University researchers similarly found that phthalate exposure correlated with preterm births (E&E News PM, April 13, 2020).

That study was significantly smaller than the research published in JAMA, which is likely to escalate calls for regulators and legislators to do more to crack down on the chemicals.

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Advocates have repeatedly pushed the government to do more to address the dangers phthalates pose, applying particular pressure to the U.S. Food and Drug Administration, which allows the chemicals to remain in food packaging (Greenwire, Dec. 7, 2021). But FDA has rejected those calls, part of a broader trend from the agency which typically sides with industry over advocates.

E&E News, 13 July 2022

https://eenews.net

The next breakthrough tool in biology? It's maths. Here are some ways mathematical biology is helping change the world

2022-07-11

Biology is rich in patterns. You'll find them everywhere – from the number of petals on a flower (which generally correspond to a number in the Fibonacci sequence), to the number of vertebrae in mammals (giraffes, humans and quokkas all have seven neck vertebrae). Even many viruses follow patterns and have symmetry in their shells.

Mathematics is, at its core, the science of patterns. Patterns can be subtle. So without using maths to formally describe and understand them, we could miss them completely.

For a long time, biological research had largely progressed without the advanced mathematical modelling that has now become core to physics, engineering and climate science. But this is changing.

Mathematical biology is a growing field which promises to revolutionise microbiology, biotechnology, evolutionary biology and health care. With maths, scientific breakthroughs that previously required years of trial-and-error experimentation (and tonnes of waste) can be achieved in a fraction of the time.

Here are some of the latest advances being made in mathematical biology.

Viruses and the natural world

As children, most of us would have played rock, paper, scissors, that game where rock crushes scissors, scissors cut paper and paper covers rock.

Well, the same maths we use to describe rock, paper, scissors can also be used to predict the cycle of dominance between animal species in a region that allows their coexistence. For example, there are three varieties of side-blotched lizards in south-western United States. Each variety has an advantage over one of the others, and a disadvantage to the third.

Maths has also been at the forefront of our fight against COVID-19. If you watch the news you've probably heard of R0, a mathematical concept that indicates if an epidemic will occur. When R0 is greater than 1 the number of infections rises. With R0 less than 1 the epidemic will eventually die out.

This crucial concept in infectious disease epidemiology is a result of the power of maths and statistics to detect patterns in data that are too subtle

Mathematics is, at its core, the science of patterns. Patterns can be subtle. So without using maths to formally describe and understand them, we could miss them completely.

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to notice otherwise. It has been the key to predicting and managing the spread of the COVID-19 virus. What's perhaps less well known is maths is also being used to:

- design viruses to kill cancer cells, such as by making combination therapies to treat ovarian cancer
- design interventions to help eliminate malaria
- identify the cause of antimicrobial resistance
- create clean drinking water for developing nations and arid regions
- unlock the inner workings of living cells.

Whole cell models

We're now at the onset of a new era in biology – one in which we can build mathematical models to comprehensively describe an individual biological cell in order to predict its fate. This is called the "whole cell model". It allows us to compute the life of a cell and is helping us understand how the human body works.

One writer for The New Yorker magazine called the quest to understand the intracellular world the "final frontier". And despite the field still being in its infancy, potential applications are everywhere.

Imagine for a moment if we could build a mathematical replica model of the inner cellular workings of the Methicillin-resistant Staphylococcus aureus (MRSA), a bacterial superbug that doesn't respond to standard antibiotics.

With a whole cell model of MSRA, we could use computer simulations informed by biological experiments to engineer new ways of both preventing and treating MRSA bacterial infections. This would add another layer of defence in our fight against resistant superbugs.

The benefit of whole cell modelling extends to cancer treatment too. For example, cancer immunotherapy relies on using a patient's own immune system to fight the cancer. If we had a complete cell model of immune cells, we could fine-tune specific anti-tumour responses to improve therapies against cancer – and do so without any invasive exploration of the patient.

Clean water

Beyond health care, whole cell models are giving us methods to provide clean water for agriculture and food production. Effective water treatment

produces high-quality water by removing microorganisms, organic matter and micropollutants.

However, buildup of the removed biological matter will cause the filters to become blocked by a layer of biological material, or "biofilm". The biofilm must be removed for the filtration process to work again. In water desalination plants, around one-quarter of the running costs are attributed to the removal of biofilms — it's a big problem.

Whole cell models will allow us to dissect the mechanisms underpinning how biofilms form. We'll then be able to identify suitable targets to inhibit biofilm formation in the first place, or destroy biofilms once they're created, to restore the integrity of the water supply.

This is just one of many examples. Being able to understand, predict and control the behaviour of cells will fast-track discoveries in biotechnology and health care, ensuring a healthier, more secure and prosperous future for everyone.

The Conversation, 11 July 2022

https://theconversation.com

Study argues insects feel pain, raises questions around ethical farming

2022-07-05

A new review article penned by a trio of researchers suggests insects do have the capacity to experience pain. The article summarizes the latest behavioral and molecular science before concluding the potential of pain states in insects could have ethical implications for current farming and research practices.

The new article first clarifies the important distinction between what is called nociception, and the negative subjective experience of pain. Nociception was defined more than a century ago as a way of separating the physiological process of sensing damaging stimuli from the subjective felt experience of pain.

Nociception is often accompanied by feelings of pain in humans and animals. However, in more simple organisms it is difficult to infer whether a simple nociceptive reflex is felt like pain. All insects have been found to display nociceptive responses. If you heat up the floor in an enclosure containing a fruit fly, for example, that fly will quickly move away from the

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hot surface. This is an example of nocifensive behavior, proving insects do respond to damaging stimuli.

But how do we distinguish a simple reflex from a more complex pain experience? Here, the new article refers to a concept called "descending order of nociception".

This concept refers to a kind of higher level of nervous system activity where an organism can adjust its nociceptive processing depending on a given situation. Speaking to Newsweek, lead author on the study Matilda Gibbons said the ability to turn down a nociceptive reflex and alter one's behavior is a useful sign an organism has the ability to subjectively experience pain.

"One hallmark of human pain perception is that it can be modulated by nerve signals from the brain," Gibbons noted. "Soldiers are sometimes oblivious to serious injuries in the battlefield since the body's own opiates suppress the nociceptive signal. You can also consciously 'grit your teeth' and bear the pain, in case such 'heroic' behavior earns you a reward or prestige. We thus asked if the insect brain contains the nerve mechanisms that would make the experience of a pain-like perception plausible, rather than just basic nociception."

After outlining a number of insect behaviors that clearly demonstrate nociceptive dampening processes, the new article presents several pieces of research to explain the molecular mechanisms at work. Unlike mammals, insects do not have any genes that code for opioid receptors. So other neurochemical mechanisms must be at play. A number of neuropeptides are hypothesized as possible nociception modulators in insects. These include drosulfakinin, allatostatin-C, and leucokinin, all molecules found to influence insect behavior.

The review suggests the presence of descending nociception controls in insects makes it plausible to consider they experience some sensation of pain. Certain behaviors known to be mediated by descending nociceptive controls, and used to quantify pain in animals such as mice, are seen in insects. Reduced feeding patterns in mice, for example, are often used as an indicator of pain, and insects have also been seen to display reduced responses to food stimuli following nociceptive experiences.

Ultimately, the review gestures toward a radical revision of how insects are treated in both farming and research contexts. Co-author on the article Sajedeh Sarlak said it is crucial more research is done to understand these

But how do we distinguish a simple reflex from a more complex pain experience? Here, the new article refers to a concept called "descending order of nociception".

nociceptive processes in insects as mass production of these organisms for food is rapidly increasing around the world.

"…the ethical implications have so far not been considered, in part because many decision-makers' view is that there are none to consider for insects," Sarlak noted to Newsweek. "We need to understand: are insects capable of the experiences of pain and suffering, to ensure that the ethical mistakes of conventional battery livestock farming are not repeated."

The new article encapsulates a growing body of research that may cause many governments to reevaluate animal welfare policies. Last year the UK government added a number of invertebrates to its animal welfare protections following an independent review.

The review presented eight criteria by which animal sentience can be established. Here, sentience was defined as the capacity to feel emotions such as distress, and the review ultimately concluded crabs, octopuses, and lobsters should all be considered sentient with the welfare protections that affords.

The new article was published in Proceedings of the Royal Society B.

New Atlas, 5 July 2022

https://newatlas.com

How Are We Possibly Still Disinfecting Things?

2022-07-07

Two weeks into the pandemic, a box of Cheerios sent me into an existential tailspin. I'd just returned from an unnerving trip to a New York City supermarket, where bandanna-masked customers with carts full of toilet paper dodged one another like bandits. As I unpacked my groceries, I was gripped by fear. If I don't Lysol the living daylights out of this cardboard, I wondered, will I die?

I kept up the cleaning for weeks. My garbage bin, like so many in America, turned into a disposable-wipe repository. It took until May 2020 for the CDC to confirm that the coronavirus is rarely transmitted by touching things. My Cheerios boxes became markedly less soggy, but even then, other, more public surfaces—elevator buttons, subway poles, shopping-cart handles—remained in a continuous wash cycle. I knew this because signs everywhere told me they had recently been cleaned.

America can't quit hygiene theater.

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Today, it's well understood that because the coronavirus spreads through the air, good ventilation and air filtration are far more effective at disrupting transmission than wiping down surfaces. Best practices for avoiding infection during a surge include opening a window when gathering indoors, opting for outdoor dining, and masking. In March, the Biden administration made air quality a pillar of its COVID response (finally). Meanwhile, study after study has found that the risk posed by lingering virus on surfaces is low compared with the threat it poses in the air.

Which raises the question: Why in the world is so much cleaning still happening?

Although most people are no longer disinfecting their groceries, signs flaunting cleanliness are still all over the place. Public bathrooms tout regular spray-downs with disinfectant. Elevators advertise self-cleaning buttons. At my local Marshalls, the cashier sanitizes the credit-card reader after every use—even if I use Apple Pay! A recent issue of United Airlines' in-flight magazine was "treated with an antimicrobial process," according to its cover. Signs lining the queue for a Delta flight in June read, cryptically: certified by lysol pro solutions.

It's not just the cleaning, either. Months after mask mandates have lifted and vaccine requirements have eased—meaningful interventions that do protect people—you'll still come across QR-code menus, floor stickers placed six feet apart (has anyone ever used these correctly?), temperature screening, and hand-sanitizing stations. In 2020, The Atlantic's Derek Thompson dubbed such measures "hygiene theater": precautions that are far more performative than useful at stopping the spread of the coronavirus. Somehow, in 2022, the show goes on.

Some places hardly bothered with pandemic protections, theatrical or otherwise, in the first place. Among those that did, some of the pushy signs and other small measures you might still find are likely vestiges of a more cautious time—the flimsy plexiglass shield that no employee has bothered to remove, the long-empty dispenser of hand sanitizer. Perhaps in some cases, like the constant wipe-downs at Marshalls, performative cleanliness has simply become part of the employee script, like asking customers to sign up for a credit card.

But hygiene theater also continues to rear its useless head in much more deliberate ways, lingering in offices, airports, and shops, often proudly touted as a service to patrons. Joseph Allen, an associate professor at the Harvard T. H. Chan School of Public Health, told me that he recently stayed

at a hotel where the remote control was sheathed in a disposable wrapper that said it had been sanitized. Just another day in pandemic-era travel.

One simple explanation for hygiene theater's enduring appeal is that some Americans who remain pandemic-cautious (and the businesses that cater to them) still don't understand that this virus primarily spreads through face-to-face airborne transmission. Though the messaging on this point is now abundantly clear, confusion is understandable. At the beginning of the pandemic, studies did detect potentially infectious remnants of the coronavirus on surfaces in cruise ships and hospitals, and the health messaging at the time reflected those findings. The idea stuck. "I don't blame the public at all," Allen told me. "The science has changed every day for two years."

A related reason might be that some people who do understand how the virus spreads see no harm in erring overwhelmingly on the side of caution. Though it's irrational, they feel more secure knowing—or better yet, seeing—that their surroundings have recently been cleaned or that attempted safety protocols are in place. As customers have come to expect a higher level of visible hygiene, some businesses might feel as though they have no choice but to supply the theatrics. They're left with an inflated standard that they don't dare to burst.

If we're talking about actual safety, it would make more sense to ask both customers and employees to simply wear good masks when infection rates are high. But America has never been especially prudent about effective COVID interventions, and hygiene theater has the perk of shifting the perceived burden of safety onto other people, implying that protection against COVID is a service to be provided rather than a personal act of self-preservation and community good. This seems to add to the pressure on businesses that want to remain pandemic safe, even if they already have good COVID hygiene protocols in place.

At Voance Salon in New York City, standard protocol is for masked and vaccinated staff to sanitize stations and tools between clients, who are required to wear masks when a CDC recommendation or mask mandate is in effect. But the salon also provides additional measures upon request, such as heavy cloth dividers between stations to wall off other guests, Voance's owner, Rasheda Akter, told me. Precautions like these give customers "confidence to get their hair done," she said.

Meanwhile, in Santa Barbara, California, "sanitation captains" roam the dining area of a restaurant called the Lark, cleaning surfaces. The restaurant also employs the R-Zero, an ultraviolet-light-powered

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disinfection system that looks like a human-size lamp on wheels. There is good evidence that UVC light inactivates the coronavirus, but perhaps the device's bigger draw is that it's noticeable. It's "one of the ways we tried to bring comfort and visible safety," Skyler Gamble, the director of people and culture at Acme Hospitality, the restaurant group that owns the Lark, told me. Gamble added that the company's strict hygiene protocols are as much for guests as they are for staff, many of whom are worried about being unable to work. "We're asking our employees what would help them feel safe and comfortable coming to work," he said. "For us, it's for peace of mind."

Peace of mind can go only so far, however. The Lark is fortunate: It operates in perpetually sunny and warm Southern California, where open windows and outdoor seating can significantly bolster the safety of restaurant dining. But in general, with or without sanitation captains, dining indoors is always going to be a higher-risk pandemic activity. The same is true for traveling on cruise ships, where some of the largest early COVID-19 outbreaks occurred, and where hygiene measures—useful and otherwise—are now especially prevalent. Most major cruise lines require the majority of guests to be vaccinated, but masking policies and COVID-19 protocols vary widely. In a number of cases, cruise ships' measures have been insufficient. In May, for example, an outbreak on a fully vaccinated Carnival Cruise forced many passengers into quarantine and prompted a highly publicized CDC investigation.

No wonder so many ships feel the need for hygiene overkill. Variety Cruises, an international line based in Greece, maintains a vaccine requirement and asks employees to wear masks at all times and guests to do the same when indoors. It also screens guests for body temperature and blood oxygen content, disinfects all luggage before boarding, and steam-sterilizes the ship's upholstery, cushions, and curtains daily, according to Constantine Venetopoulos, Variety's PR and communications manager. Research shows that temperature checks are useless for diagnosing COVID, and some people with COVID do not have altered blood oxygen levels. Furthermore, although pulse oximeters may be more helpful than thermometers for detecting illness in the elderly, they have been found to be unreliable when used on Black, Hispanic, and Asian COVID patients.

A related and more nefarious reason hygiene theater persists is that good ventilation and filtration, great measures at cutting back infection, are invisible. For companies aiming to demonstrate their concern about COVID, these practices can have less payoff because they're harder to

flaunt (or at least, they'll seem to have less payoff until the staff has a COVID outbreak and business stalls out). Instead of a wrapped and sanitized remote control in his hotel, Allen told me, "what I would have loved to have seen was a note on my bed that said they've upgraded the filters and increased the ventilation rate. The other stuff is just silly." Maybe so, but plastic-wrapping a remote is a lot easier and cheaper than installing a suite of HEPA filters and convincing people that they're there.

And thus, the theater continues. Jim Dudlicek, the director of communications and external affairs for the National Grocers Association, told me that his organization expects grocery stores' "enhanced sanitation procedures to be permanent, as consumers will continue to look for that assurance when they choose where to shop."

At its best, hygiene theater is benign—albeit time-consuming, wasteful, and expensive. It's never a bad idea to keep places clean or to insist on hand-washing; clean hands and surfaces are a cornerstone of public health. (Hotel-room TV remotes might not give you COVID, but they are pretty gross.) Hygiene theater becomes a serious problem, however, when it falsely reassures people that an environment is safe, giving them permission to relax their expectations and behavior. A hotel that sanitizes its common areas with hospital-grade disinfectant isn't safe if guests are unmasked at the bar during a surge. Neither is a restaurant that uses QR-code menus but doesn't filter its air or open its windows. The real dangers posed by hygiene theater are that it perpetuates unscientific thinking about coronavirus transmission and takes time, attention, energy, and resources away from the measures that are effective against COVID.

While visibility is keeping hygiene theater alive, perhaps it will also be its downfall. Those who understand how ridiculous hygiene theater is may get into the habit of using it as a barometer for outdated standards. There are already signs that more people and businesses are updating their beliefs: Trade associations representing the banking, hospital, restaurant, and airline industries told me that they've shifted their recommendations for members toward improving air quality, signaling a change in consumer expectations. Maybe, eventually, plastic barriers and floor stickers will go the way of disinfected cereal boxes—humorously obsolete trash.

The Atlantic, 7 July 2022

https://theatlantic.com

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Why can't we simply plant more trees to clean carbon dioxide from the air?

2022-07-08

If we're to have any shot at meeting the climate targets set out in the Paris Agreement, scientists estimate that countries would need to remove billions of tons of CO2 from the atmosphere by mid-century. And that's just the start of things. We'd also have to continue removing increasing amounts every year thereafter.

"That's a hell of a lot of carbon to get rid of," says Helgason, head of research & innovation at Carbfix, an Iceland-based company that is capturing CO2, injecting it into the ground, and turning it into stone.

The reason carbon capture and storage companies like Carbfix exist is because trees alone won't solve the world's CO2 challenge. "We didn't get into this climate catastrophe by burning trees," notes Helgason.

Instead, we got into this mess by cheating. "We basically dug into the earth and pulled out hundreds of millions of years' worth of trees, in the form of fossil fuels, and then proceeded to burn them over a span of 100 years," adds Helgason. "There can never be enough trees in the world to rewind the amount of CO2 we've already put into our air—we are way past that point."

Planting trees is easier said than done

Even if trees could solve our CO2 problem, planting them is easier said than done. First, there's the issue of deforestation.

It's estimated that while 15 billion trees are cut down every year, only 5 billion are replanted—resulting in an annual net loss of 10 billion trees.

With this in mind, some researchers suggest it would take the planting of 1 trillion trees, and then waiting for them to become fully grown, to have an effect on climate change. According to some research, 1 trillion fully grown trees would be able to capture, at best, 1,012 billion tons of CO2—about a third of all human CO2 emissions thus far.

Then there's the issue of suitable habitat. According to the EU-funded REFOREST project, one consequence of climate change is an increase in severe droughts, which happens to be a leading cause of forest decline. Thus, the more the temperature increases, the drier the land becomes, eventually reaching a point where it is inhospitable to many tree species.

It's estimated that while 15 billion trees are cut down every year, only 5 billion are replanted—resulting in an annual net loss of 10 billion trees

Climate change also makes trees more susceptible to insect- and disease-caused damage or death—which can impact a forest's ability to sequester carbon. According to a Frontiers in Forest and Global Change study, forests damaged by insects and disease capture 69 % and 28 % less carbon respectively.

Game over?

What all of this says is that while they can play an important role in removing CO2 from the atmosphere, trees alone are not a viable solution. "Natural solutions must work hand-in-hand with technological solutions, like direct air capture and permanent storage," says Helgason.

Yet all this discussion about trees, technology and direct air capture ignores the 36.7 billion metric ton elephant in the room: the annual industrial emissions.

"All this talk is moot if we don't address the emissions coming from industrial facilities and fossil fuel-fired power plants," concludes Helgason. "If we don't stop emissions at the source, we have no chance of meeting our climate targets—and it's simply game over with or without carbon removals."

Phys Org, 8 July 2022

https://phys.org

Sound can blunt pain in an unexpected way

2022-07-07

A fascinating new study has shed light on the phenomenon of using sound for pain relief. Using state-of-the-art brain-imaging techniques an international team of researchers has uncovered the neural mechanism by which sound reduces pain sensitivity, and surprisingly, low volumes were more effective than turning the music up loud.

In 1960 a dentist named Wallace Gardner published an unusual study purporting to use sound for pain relief. He reported conducting more than 200 tooth extraction procedures using sound as the only analgesic agent. His study also cited eight other dentists who successfully used what was then dubbed "audio analgesia."

Since then, the phenomenon has been replicated a number of times by researchers all over the world, but little is known about how the brain could actually be producing these analgesic effects. Yuanyuan Liu, co-

In 1960 a dentist named Wallace Gardner [...] reported conducting more than 200 tooth extraction procedures using sound as the only analgesic agent.

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senior author on the new research, said prior studies have hinted at brain mechanisms that could be at play but this new work homes in on the actual neural circuitry for the first time.

"Human brain imaging studies have implicated certain areas of the brain in music-induced analgesia, but these are only associations," said Liu, from the National Institute of Dental and Craniofacial Research. "In animals, we can more fully explore and manipulate the circuitry to identify the neural substrates involved."

First, the researchers tested the common idea that pleasant classical music could have intrinsic analgesic properties. Mice were played a piece of music called Réjouissance by Johann Sebastian Bach while being injected with a solution in their paws to test pain thresholds.

Across difference experiments the volume of the music was increased in 5-db increments. The first surprise of the study came with the discovery that the only volume effective as an analgesic was the quietest – at 50 db, just 5 db above the ambient volume of the room.

The next test looked at different kinds of sound. So instead of classical music, the same experiments were conducted using white noise and a version of the classical piece pitch-shifted to sound unpleasant. Here the researchers came across the second unexpected finding – all sounds generated analgesic effects in the animals.

The only influential factor was volume. Essentially, any kind of sound worked if it was played at a volume just a whisper louder than the ambient room noise.

"We were really surprised that the intensity of sound, and not the category or perceived pleasantness of sound would matter," Liu added.

Finally, the researchers set out to uncover exactly which neural circuits seemed to be generating these sound-influenced analgesic effects. Using a number of sophisticated techniques to zoom in on active neural pathways, the researchers discovered a direct pathway between the auditory cortex and the thalamus.

Low-intensity sound seemed to blunt neural activity at the thalamus end of this pathway, and subsequent tests suppressing activity in this pathway using methods other than sound led to similar pain-reduction outcomes. Interestingly, this suggests the research has identified a mechanistic pathway by which sound directly reduces pain sensations.

The finding perhaps validates Gardner's study from 60 years ago, which presciently hypothesized music directly blunted the felt experience of pain by potentially disrupting communication between auditory brain systems and the thalamus.

"In thinking toward an explanation, we note that parts of the auditory and pain systems come together in several regions of the reticular formation and lower thalamus," Gardner wrote in 1960. "The interactions between the two systems are largely inhibitory. Both the direct suppressive effect and the effects mediated through relaxation, reduction of anxiety, and diversion of attention, can be explained by assuming that acoustic stimulation decreases the 'gain' of pain relays upon which branches of the auditory system impinge."

In a commentary on the new study, researchers Rohini Kunar and Thomas Kunar indicate the findings somewhat contradict prior hypotheses that argue sound-induced anesthesia in humans maybe solely be due to psychological factors such as being calmed or distracted by music.

"Previous concepts on using music and sounds for pain relief attributed their effects to distraction-associated analgesia and reduction of anxiety," the pair of researchers noted. "Although sound likely contributes to distraction, the study by Zhou et al. reveals that sound-induced analgesia is a specific mechanistic entity in its own right, supported by the observation that suppression of pain outlasted the application of sound by several days."

Nevertheless, Liu is cautious not to discount those other psychological factors. He does point out music is much more complex for humans than rodents, with elements such as nostalgia, memory and pleasant harmony possibly playing relevant roles in any analgesic effect.

"We don't know if human music means anything to rodents, but it has many different meanings to humans – you have a lot of emotional components," Liu said.

Moving forward it will be crucial to first explore whether this neural circuit observed in mice also plays out in humans. And if it is validated then it could open the doors for a whole host of new non-pharmacological methods for pain control.

Speaking to Science, Harvard neurobiologist Clifford Woolf said the findings suggest low-volumes of noise could be useful analgesics instead of the more traditional idea of using calming classical music.

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"Many would have anticipated you need to listen to Mozart to get pain relief," said Clifford. "But maybe all we need to do is give patients a tiny level of buzzing noise."

The new study was published in the journal Science.

New Atlas, 7 July 2022

https://newatlas.com

Newborns develop language skills within hours of birth

2022-07-11

In contrast to the traditional view of newborns, passively lying around and crying, a recent study published in Nature Human Behaviour established that newborns start soaking up and tuning into the specifics of the world around them within hours, including the specific languages that they'll speak.

Babies are known to start learning language by hearing speech even when they're in the womb, but can't hear the detail as it's muffled, as if underwater.

The study, with international contributors including Gary Oppenheim and Guillaume Thierry of Bangor University's School of Human and Behavioral Sciences, worked with newborns, starting within just minutes of their birth using a combination of vowels played forward (that is, naturally) and played backwards (a time-reversed version of the sound).

Using optical imaging, a non-invasive form of neuroimaging, to measure changes in the body, the process involved shining tiny torches (i.e., flashlights) at the babies' scalps. The light shines into the body, and some bounces back and depending on what's going on in the body (e.g., how much oxygenated blood is in an area of the brain), a little more or a little less light will bounce back.

To obtain accurate results, multiple torches were used, with their power and placement precisely controlled, as well as very precise light detectors to measure tiny changes in how much light bounces off.

Recordings of spoken vowels were played and then tested to see whether their brains responded differently when they heard these same vowels being played backward versus forward. In the first test, the babies could not distinguish between forward and backward vowels, as it is a very subtle contrast (even adults fail such discrimination test 70% of the time).

"Our research showed that a very subtle distinction—even for the adult ear—is enough to trigger a significant brain activity surge in the newborn's brain."

After merely five hours of exposure to this contrast, optical imaging showed that the newborns' brains started distinguishing between the two sounds. And after a further two hours, during which the newborns mostly slept, the exposure to the vowel contrast triggered a spurt of connectivity, with neurons talking to each other on a large scale, as if they had been inspired by the language sounds they heard.

Guillaume Thierry, professor of cognitive neuroscience, said, "Our research showed that a very subtle distinction—even for the adult ear—is enough to trigger a significant brain activity surge in the newborn's brain, showing that early experiences have potentially major consequences for cognitive development.

"In other words, we should challenge the myth that babies are mostly unaware of their environment until after a few weeks, simply because they sleep a lot, and pay attention to what babies are exposed to from the moment when they are born."

Gary Oppenheim, lecturer in psychology, added, "When my son was born, I was surprised to see that he was immediately alert, his eyes wide open and looking around to soak in information about his strange new environment (even though a newborn's vision is known to be quite poor). The work that a newborn's ears and auditory system are doing isn't as obvious to the naked eye, but this spectacular result shows we have remarkable sensitivity to language information from the very moment we are born and we immediately set to work developing and refining it in response to our experiences in the world, even when we appear to be just sleeping."

Medical Xpress, 11 July 2022

https://medicalxpress.com

DNA typewriter encodes full sentences into living cells

2022-07-11

Forget invisible ink – in the future spies could be sending secret messages encoded directly into the DNA of living cells. Researchers at the Howard Hughes Medical Institute (HHMI) have demonstrated a "DNA Typewriter" by encoding full sentences into DNA, which may eventually function as a cellular "black box."

As impressive as our own digital information storage systems are, they pale in comparison to nature's. DNA is an incredibly dense medium, with a singe gram able to store up to 215 million GB of data – and possibly more,

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with some tweaking. Unfortunately, writing to and reading from DNA remains a fiddly process.

So the HHMI team developed a new system to record information to DNA easily and sequentially. The DNA Typewriter, as they call it, inserts short segments of DNA into a blank "DNA tape," one after another from left to right. The team created as many as 4,096 specific symbols that can be inserted, and demonstrated that the DNA Typewriter can lay them out in order to form full sentences that can be read back later.

In their first tests, the researchers spelled out "What hath God wrought?" This Bible verse may sound a bit dramatic, but the phrase was chosen because it was the first sentence transmitted via telegraph using Morse code. The second phrase – "Mr. Watson, come here!" – was similarly historic, as the first line ever spoken over a telephone line. The third and final test sentence was "Bound forever, DNA," a line from a song by Korean pop group BTS.

But the DNA Typewriter isn't just for writing quotes into cells. The team says it could eventually be used to track the activity and history of cells, allowing scientists to unravel their development or responses to disease or drugs like a plane's black box. In experiments, the researchers tracked how one cell divided into 1.2 million over the course of 25 days, analyzing their barcodes to reconstruct their family tree.

The research was published in the journal Nature.

New Atlas, 11 July 2022

https://newatlas.com

Dark Matter May Not Exist: These Physicists Favor of a New Theory of Gravity

2022-07-10

Using Newton's laws of physics, we can model the motions of planets in the Solar System quite accurately. However, in the early 1970s, scientists discovered that this didn't work for disc galaxies – stars at their outer edges, far from the gravitational force of all the matter at their center – were moving much faster than predicted by Newton's theory.

As a result, physicists proposed that an invisible substance called "dark matter" was providing extra gravitational pull, causing the stars to speed up – a theory that's become widely accepted. However, in a recent review my colleagues and I suggest that observations across a vast range of

DNA is an incredibly dense medium, with a single gram able to store up to 215 million GB of data. Unfortunately, writing to and reading from DNA remains a fiddly process.

Dark matter was proposed to explain why stars at a galaxy's far edge were able to move much faster than predicted with Newton. An alternative theory of gravity might be a better explanation.

scales are much better explained in an alternative theory of gravity called Milgromian dynamics or Mond – requiring no invisible matter. It was first proposed by Israeli physicist Mordehai Milgrom in 1982.

Mond's primary postulate is that when gravity becomes very weak, as it does near the edge of galaxies, it starts behaving differently from Newtonian physics. In this way, it is possible to explain why stars, planets, and gas in the outskirts of over 150 galaxies rotate faster than expected based on just their visible mass. However, Mond doesn't merely explain such rotation curves, in many cases, it predicts them.

Philosophers of science have argued that this power of prediction makes Mond superior to the standard cosmological model, which proposes there is more dark matter in the universe than visible matter. This is because, according to this model, galaxies have a highly uncertain amount of dark matter that depends on details of how the galaxy formed – which we don't always know. This makes it impossible to predict how quickly galaxies should rotate. But such predictions are routinely made with Mond, and so far these have been confirmed.

Imagine that we know the distribution of visible mass in a galaxy but do not yet know its rotation speed. In the standard cosmological model, it would only be possible to say with some confidence that the rotation speed will come out between 100km/s and 300km/s on the outskirts. Mond makes a more definite prediction that the rotation speed must be in the range 180-190km/s.

If observations later reveal a rotation speed of 188km/s, then this is consistent with both theories – but clearly, Mond is preferred. This is a modern version of Occam's razor – that the simplest solution is preferable to more complex ones, in this case that we should explain observations with as few "free parameters" as possible. Free parameters are constants – certain numbers that we must plug into equations to make them work. But they are not given by the theory itself – there's no reason they should have any particular value – so we have to measure them observationally. An example is the gravitation constant, G, in Newton's gravity theory or the amount of dark matter in galaxies within the standard cosmological model.

We introduced a concept known as "theoretical flexibility" to capture the underlying idea of Occam's razor that a theory with more free parameters is consistent with a wider range of data – making it more complex. In our review, we used this concept when testing the standard cosmological

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model and Mond against various astronomical observations, such as the rotation of galaxies and the motions within galaxy clusters.

Each time, we gave a theoretical flexibility score between –2 and +2. A score of –2 indicates that a model makes a clear, precise prediction without peeking at the data. Conversely, +2 implies "anything goes" – theorists would have been able to fit almost any plausible observational result (because there are so many free parameters). We also rated how well each model matches the observations, with +2 indicating excellent agreement and –2 reserved for observations that clearly show the theory is wrong. We then subtract the theoretical flexibility score from that for the agreement with observations, since matching the data well is good – but being able to fit anything is bad.

A good theory would make clear predictions that are later confirmed, ideally getting a combined score of +4 in many different tests (+2 -(-2) = +4). A bad theory would get a score between 0 and -4 (-2 -(+2)= -4). Precise predictions would fail in this case – these are unlikely to work with the wrong physics.

We found an average score for the standard cosmological model of –0.25 across 32 tests, while Mond achieved an average of +1.69 across 29 tests. The scores for each theory in many different tests are shown in figures 1 and 2 below for the standard cosmological model and Mond, respectively.

It is immediately apparent that no major problems were identified for Mond, which at least plausibly agrees with all the data (notice that the bottom two rows denoting falsifications are blank in figure 2).

The problems with dark matter

One of the most striking failures of the standard cosmological model relates to "galaxy bars" – rod-shaped bright regions made of stars – that spiral galaxies often have in their central regions (see lead image). The bars rotate over time. If galaxies were embedded in massive halos of dark matter, their bars would slow down. However, most, if not all, observed galaxy bars are fast. This falsifies the standard cosmological model with very high confidence.

Another problem is that the original models that suggested galaxies have dark matter halos made a big mistake – they assumed that the dark matter particles provided gravity to the matter around it, but were not affected by the gravitational pull of the normal matter. This simplified the calculations, but it doesn't reflect reality. When this was taken into account

in subsequent simulations it was clear that dark matter halos around galaxies do not reliably explain their properties.

There are many other failures of the standard cosmological model that we investigated in our review, with Mond often able to naturally explain the observations. The reason the standard cosmological model is nevertheless so popular could be down to computational mistakes or limited knowledge about its failures, some of which were discovered quite recently. It could also be due to people's reluctance to tweak a gravity theory that has been so successful in many other areas of physics.

The huge lead of Mond over the standard cosmological model in our study led us to conclude that Mond is strongly favored by the available observations. While we do not claim that Mond is perfect, we still think it gets the big picture correct – galaxies really do lack dark matter.

Sci Tech Daily, 10 July 2022

https://scietechdaily.com

"Aspirin" for plants could help crops survive climate change

2022-07-12

Much like we take aspirin to alleviate a splitting headache, plants also have their own form of medicine that helps in times of stress. Known as salicylic acid, this organic compound is naturally produced when plants encounter things like drought and heat, and a new study demonstrates how this process might be leveraged to protect crops in the face of rising global temperatures.

Salicylic acid occurs naturally in plants and is actually a precursor to aspirin, but has been used for the purposes of pain relief long before the synthetic drug landed on pharmacy shelves. Ancient Egyptians would strip the leaves and bark from willow trees to ease their aching joints, and the Greek physician Hippocrates also noted the compound's ability to relieve fevers and pain.

The authors of this new study sought to better understand the way salicylic acid is produced, and the conditions that cause plants to do so. This led them to chemicals called reactive oxygen species (ROS), which all living organisms produce in response to environmental stress. An example is human skin, which produces high levels of ROS in response to harsh

Salicylic acid occurs naturally in plants and is actually a precursor to aspirin, but has been used for the purposes of pain relief long before the synthetic drug landed on pharmacy shelves.

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sunlight that results in freckles and sunburn. But at lower, safer levels, ROS do play an important role.

"At non-lethal levels, ROS are like an emergency call to action, enabling the production of protective hormones such as salicylic acid," explains study author Jin-Zheng Wang, from the University of California, Riverside. "ROS are a double-edged sword."

Through experiments on a model plant called Arabidopsis, the scientists found that heat, relentless sunshine and drought conditions caused the plant cells to produce an alarm molecule called MEcPP. As this molecule builds up, it triggers the production of salicylic acid, which goes on to play an important role in protecting chloroplasts, the organelles where photosynthesis takes place.

"It's like plants use a painkiller for aches and pains, just like we do," said study author Wilhelmina van de Ven.

The hope is that this knowledge around how salicylic acid forms can be applied to help plants survive climate change. This could make for more durable crops that can withstand higher temperatures, but the benefits may extend to many other aspects of the environment.

"Because salicylic acid helps plants withstand stresses becoming more prevalent with climate change, being able to increase plants' ability to produce it represents a step forward in challenging the impacts of climate change on everyday life," said Katayoon Dehesh, senior paper author. "Those impacts go beyond our food. Plants clean our air by sequestering carbon dioxide, offer us shade, and provide habitat for numerous animals. The benefits of boosting their survival are exponential."

The research was published in the journal Science Advances.

New Atlas, 12 July 2022

https://newatlas.com

Doctors advocate for treating obesity as an environmental problem

2022-07-14

When Dr. Rob Sargis sees a patient struggling with obesity, his recommendations go beyond diet and exercise. He may advise them to stop heating things in plastics, or to avoid congested roads during rush hour.

Obesogens are a subset of endocrine-disrupting chemicals — man-made compounds that alter hormone activity.

Sargis, a practicing doctor and professor of medicine at the University of Illinois, is one of a number of doctors incorporating the science of obesogens — endocrine-disrupting chemicals that spur obesity — into their clinical practice.

Obesogens are a subset of endocrine-disrupting chemicals — man-made compounds that alter hormone activity. They are generally defined as any chemical that can cause the human body to produce more fat than it normally would, and can include substances we usually think of as fattening, like sugars or artificial sweeteners.

However, obesogens are not only found in food, rather entering the body through other consumer products, like makeup, shampoos, soaps, plastics, and food packaging. People are exposed through contact with the chemicals and through ingestion of contaminated foods. The chemicals are also shed from such products and can accumulate in household dust, which people breathe in. PFAS, or per- and polyfluoroalkyl substances (toxic chemicals used in many consumer and industrial products) are another example of obesogens, as is bisphenol- A (BPA).

By disrupting hormone activity, these chemicals can spur obesity in a number of ways. They can alter metabolism, cause the body to produce new fat cells, alter eating behavior, and even change the way food is digested.

To Sargis, incorporating an understanding of obesogens into clinical practice is part of the goal of medicine as a whole: to build a healthier society. Obesogenic chemicals have other harmful health impacts too — for example, PFAS and BPA are also linked to certain cancers and reproductive problems. Reducing obesogen exposure is beneficial across the health spectrum.

"What we've seen in medicine over the last few years is this shift from individual factors, like genetics, lifestyle and diet, to an embracing of the social determinants of health, including things like food, environment, exercise and education," Sargis told EHN.

However, Sargis and other doctors interested in using the obesogen framework face barriers, such as difficulties gathering data on obesogens, a bias toward focusing on diet and exercise, and inadequate medical school training in environmental exposures.

In addition, a lack of regulation of obesogens makes it hard to reduce the exposures — even for patients who are aware of the risks. "The challenge

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is that there are systemic forces that you have to fight, and a lot of that's policy, and a lot of that policy is embedded in politics," Sargis said.

Lack of data

A major obstacle to incorporating an understanding of obesogens into clinical practice is that doctors are sometimes not convinced by the data available. While plenty of data exists to show a correlation between obesogen exposure and obesity, there is less data that shows that if a person reduces their obesogen exposure, they can lose more weight.

Gathering that data is difficult, but possible, said Sargis. However, the ubiquity of obesogens in everyday products, as well as the lack of transparency from companies about the chemicals in their products, makes designing such a study difficult. The sheer number of chemicals that would need to be tested — there are more than 9,000 types of PFAS, for example — also adds to the challenge.

Jerry Heindel, a biochemist and founder and director of HEEDS*, a coalition of researchers advocating for better regulation of chemicals, told EHN that doctors and patients could benefit from an accessible and cheap way to measure exposure to obesogens. That way, patients could hypothetically see if their exposure levels drop over time as they worked to eliminate obesogens from their daily life. For now, he said, patients would need to pay for the tests themselves, but he hopes insurances would cover the tests in the future.

Jenna Hua, a doctor-turned-CEO of medical testing company Million Marker, thinks her company's product could play a role. Million Marker offers at-home test kits that measure the levels of 13 common endocrine-disruptors, some of which also act as obesogens, in a person's urine. The tests are able to detect BPA, two BPA alternatives, five types of phthalates, four types of parabens, and oxybenzone. It's "quite empowering," Hua told EHN, when someone using the tests can see their exposure levels drop as they swap out products they're using that include obesogens.

The type of testing that Million Marker offers would be another tool in managing weight loss. "It would not be possible to tease out what part of weight gain is due to obesogens," Heindel said. "The doctor would have to explain to the patient all the possibilities and how to address each of them to reduce their weight."

As more patients recognize that obesogen exposure is a threat to their health, Hua said, the public may be more inclined to pressure

governments to regulate endocrine-disrupting chemicals. Most obesogens are not currently regulated in the U.S., for example, the Food and Drug Administration does not restrict the use of BPA in food packaging, and there are no federal standards limiting PFAS discharges in drinking water.

Bias toward individual factors

One of the reasons that obesogens have been overlooked, Sargis said, is that treatment of obesity is biased toward individual factors like diet and exercise. "There's an inherent bias that this is somehow a personal failing," he said.

That kind of thinking, he said, might be rooted in conventional beauty standards and the idea that obesity is an aesthetic problem more than a health problem. Research has shown that in the U.S., obese individuals are often highly stigmatized and labeled as lazy, unmotivated, and lacking in self discipline. Medical students themselves can perpetuate these stigmas — one study of third-year medical students at Wake Forest University found that more than one-third of the future doctors associated obesity with negative attributes, with the majority of students, 72%, reporting that they preferred "thin" people to "fat" people.

Enhancing education, growing awareness

There is still a huge gap in medical school training when it comes to obesogens, Sargis said. The sheer volume of knowledge medical students are required to learn leaves little room for discussions about environmental exposures. The end result is that doctors often leave environmental exposures out of their practice — for example, a 2015 study of maternal and child physicians found that environmental health assessments were "infrequently" part of routine counseling of patients.

Dr. Jamaji Nwanaji-Enwerem, a 2021 graduate of Harvard Medical School and current resident at the Emory University School of Medicine, said he got very little training in environmental exposures in medical school. "Medical students across the nation are not being extensively exposed or trained formally on the effects of the environment on a patient's health," he said. Rather, Nwanaji-Enwerem, who is also an assistant professor of environmental health at Emory, gained his expertise in learned about environmental exposures through classes outside of the medical school and through his own practice.

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One patient suffering from hypertension and respiratory problems inspired Nwanaji-Enwerem to write a paper about the importance of considering environmental risks. In the paper, Nwanaji-Enwerem writes that other doctors should ask their patients about the chemicals they come into contact with at work, and whether they wear proper personal protective equipment to protect them from chemical exposures.

To supplement medical school training about obesogens, Heindel said, professional societies, like the Endocrine Society, Obesity Society and Pediatric Society, could be a good starting point to help young doctors learn about obesogens. For example, East Carolina University professor and pediatrician David Collier first learned about environmental exposures at a conference for academic practicing pediatricians. According to Collier, there need to be "many touch points" where researchers and doctors can have such conversations.

Additionally, Sargis said, doctors get very little time with patients. It's difficult to squeeze in a conversation about the risks obesogens pose during a 20-minute consultation. To help, he said he'd like to see more educational materials available to patients after their visit, such as short videos explaining obesogen exposure.

Part of the solution, too, could be getting doctors to care more about the environmental health of the neighborhoods where their patients live, Sargis said. While doctors might not want to engage in political discussions, they might play a key role in decreasing the chemical exposure of their patients. Getting doctors involved in discussions about housing, city planning, building codes, policing, water use, and environmental policy could make a difference for the health of people living in those communities, he said.

"When you have physicians that aren't willing to step out of the clinic and into these discussions, it becomes difficult," he said. "We really need physicians, scientists, and health policy experts at the table."

Environmental Health News, 14 July 2022

https://www.ehn.org

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Assessing the protection gap for mobile and persistent chemicals during advanced water treatment - A study in a drinking water production and wastewater treatment plant

Shape dependence of the release rate of chemicals from plastic microparticles

To be or not to be degraded: in defense of persistence assessment of chemicals

ENVIRONMENTAL RESEARCH

Forecasting of non-accidental, cardiovascular, and respiratory mortality with environmental exposures adopting machine learning approaches

Development of an environmental hazard-based rating assessment for defence-related chemical compounds in ecological soil systems

PHARMACEUTICAL/TOXICOLOGY

Long-term personal PM 2.5 exposure and lung function alternation: A longitudinal study in Wuhan urban adults

The causal and independent effect of ozone exposure during pregnancy on the risk of preterm birth: Evidence from northern China

Titanium dioxide and carbon black nanoparticles disrupt neuronal homeostasis via excessive activation of cellular prion protein signaling

OCCUPATIONAL

A review of omics-based PFAS exposure studies reveals common biochemical response pathways

Identification of occupations susceptible to high exposure and risk associated with multiple toxicants in an observational study: National Health and Nutrition Examination Survey 1999-2014