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CONTACT US

subscribers@chemwatch.
net
tel +61 3 9572 4700
fax +61 3 9572 4777

1227 Glen Huntly Rd
Glen Huntly
Victoria 3163 Australia

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ASIA PACIFIC

New country of origin labelling requirements in New Zealand

2022-03-25

New requirements for labelling the country of origin of certain foods were recently introduced in New Zealand.

Businesses must now disclose the origin of certain fresh and thawed food including cured pork products, minimally processed meat and single-ingredient fruit, vegetable, fish and seafood products. These requirements do not apply to food that is intended for immediate consumption (for example, at restaurants) or food sold for fundraising.

From May 2023, the new requirements will also apply to frozen foods within the above mentioned categories. For more information about the new requirements, visit the Ministry of Business, Innovation & Employment website and the New Zealand Commerce Commission website.

[Read More](#)

Food Standards Australia New Zealand, 25-03-22

<https://mailchi.mp/c74fbb88fc8f/food-standard-news-1300241?e=%5bUNIQID%5d>

China Issues 14th Five-Year Plan (2021-2025) for Safe Production of Hazardous Chemicals

2022-03-24

On March 21, 2022, the Chinese Ministry of Emergency Management (MEM) issued the 14th Five-Year Plan (2021-2025) for Safe Production of Hazardous Chemicals (hereinafter referred to as the Plan), with the focus on accurately controlling the safety risks of hazardous chemicals in eight key industries, including chemical industry, pharmaceutical industry, oil and gas industry, firework industry, etc.

[Read More](#)

Chemlinked, 24-03-22

<https://chemical.chemlinked.com/news/chemical-news/china-issues-14th-five-year-plan-2021-2025-for-safe-production-of-hazardous-chemicals>

China is making efforts to enhance the work on the safe production of hazardous chemicals

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Country of origin labelling evaluation report released in Australia

2022-03-25

On 25 February, the Department of Industry, Science, Energy and Resources released an evaluation report on country of origin labelling for food in Australia. This report follows a review of country of origin labelling requirements which were introduced in 2018.

The evaluation considered whether the reforms improved consumer access to information about the origin of food and clarified the origin claims businesses can make about their products, without imposing excessive costs on those businesses. The evaluation:

- found that the country of origin labelling reforms were well implemented, effective and met objectives, and
- recommended against making major changes to the requirements at this time.

To read the recommendations and key findings in more detail, check out the full report here.

[Read More](#)

Food Standards Australia New Zealand, 25-03-22

<https://mailchi.mp/c74fbb88fc8f/food-standard-news-1300241?e=%5bUNIQID%5d>

AMERICA

The Next Wave of PFAS Regulation

2022-03-15

Last fall, we wrote about the EPA's strategic roadmap regarding its goals for investigating, regulating, and remediating Per- and Polyfluoroalkyl Substances (PFAS).

Our post on the EPA's strategic roadmap can be found here.

On November 18, 2021, the bipartisan Keep Food Containers Safe from PFAS Act was introduced, adding to the growing number of proposed federal PFAS regulations.

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The proposed legislation would amend the Federal Food, Drug, and Cosmetic Act to prohibit food packaging containing "intentionally added" PFAS beginning as soon as January 1, 2024. The Act does not define "intentionally added," but, since it was introduced, two states where similar laws are proposed have defined "intentionally added," providing clarity on what the phrase covers.

New York defines "intentionally added" as "a chemical in a product that serves an intended function in the product component." However, Minnesota defines the phrase as "PFAS deliberately added during the manufacture of a product where the continued presence of PFAS is desired in the final package or packaging component to perform a specific function." It is not clear whether the Act will include similar definitions.

Since the Act was introduced in the House, it has been referred to the House Committee on Energy and Commerce to be studied. If the Committee releases the Act, it will be voted on by the House and then the Senate.

[Read More](#)

The National Law Review, 15-03-22

<https://www.natlawreview.com/article/next-wave-pfas-regulation>

Calif. takes first moves to limit 'Erin Brockovich' chemical

2022-03-23

California has emerged as the first state to advance limits on hexavalent chromium in drinking water, a contaminant linked to cancer first made famous by Erin Brockovich's advocacy efforts.

The California Water Resources Control Board's Drinking Water Program on Monday unveiled a proposal to set a "maximum contaminant level" (MCL) of 10 parts per billion, or ppb, in water.

The board is also proposing to set the "detection limit," which would trigger reporting, at 0.05 ppb, according to the document. In addition, the board laid out a schedule for utilities across the state to comply — according to staggered deadlines based on their size — within four years.

The contaminant, also called chromium-6, was featured in the 2000 blockbuster movie "Erin Brockovich," in which actress Julia Roberts plays Brockovich, an activist and legal clerk, as she fights companies accused of

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polluting California waterways. Public health advocates have repeatedly warned that chromium-6, a widely used industrial solvent in the 1950s and '60s, is among the most common drinking water pollutants in the country (E&E News, May 2, 2012).

According to the California water board, hexavalent chromium has been detected in numerous drinking water sources across California, but past attempts to set regulatory limits at the currently proposed levels were thwarted by court decisions.

In 2011, California's Office of Environmental Health Hazard Assessment established a hexavalent chromium "public health goal" of 0.02 ppb based on cancer risk. In 2014, the California Department of Public Health used that goal to establish an MCL of 10 ppb for hexavalent chromium.

But three years later in 2017, the Superior Court of California, Sacramento County, invalidated that regulation and directed the state water board to withdraw the regulation and establish a new MCL.

Five years after the court ordered the agency to rework its rule, California is once again moving forward.

[Read More](#)

EE News, 23-02-22

<https://www.eenews.net/articles/calif-takes-first-moves-to-limit-erin-brockovich-chemical/>

PFAS In Consumer Goods The Target In Washington

2022-03-15

On March 10, 2022, a bill was sent to the Governor of Washington's desk that significantly accelerates the state's initiative to develop regulations for various consumer goods that contain PFAS. With increasing attention being given to PFAS in consumer goods in the media, scientific community, and in state legislatures, Washington's bill takes direct aim at a variety of specific products. It is critical for companies anywhere in the manufacturing or supply chain for consumer goods to immediately assess the impact of the proposed PFAS legislation on corporate practices, and make decisions regarding continued use of PFAS in products, as opposed to substituting for other substances. At the same time, companies impacted by the PFAS legislation must be aware that the bill poses risks to the companies involvement in PFAS litigation in both the short and long term.

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[Read More](#)

The National Law Review, 15-03-22

<https://www.natlawreview.com/article/pfas-consumer-goods-target-washington>

Mexico updates textiles labelling Standard

2022-03-16

On January 14th, 2022, the new NOM-004-SE-2021, Commercial information – Labelling of textile products, clothing, their accessories and household linens was published in the Mexico Official Gazette of the Federation (DOF). Businesses will have one year to comply with the new textile standard, which will come into effect on January 15th, 2023, at which point the current NOM-004-SCFI-2006 will be replaced.

[Read More](#)

Eurofins, 16-03-22

<https://www.eurofins.com/consumer-product-testing/media-centre/news/regulatory-updates-03-2022/>

EUROPE

17th meeting of the POPs review committee

2022-03-16

At the end of January 2022, the 17th meeting of the persistent organic pollutants POPs review committee took place. Methoxychlor was recommended to be listed in Annex A to the Stockholm Convention for 2023.

The Committee also considered the risk profiles of the following substances, which will now be moved to the risk management evaluation:

UV-328 (UV-stabiliser and plastic additive)

Dechlorane Plus (flame retardant)

Three new proposals meet the screening criteria for POPs and will move forward to the risk profile stage for more assessment:

- chlorpyrifos, submitted by the European Union;

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- chlorinated paraffins with carbon chain lengths C14-17 and $\geq 45\%$ chlorine by weight (MCCP), submitted by the UK; and
- long-chain perfluorocarboxylic acids (LC-PFCA), their salts and related compounds, submitted by Canada.

[Read More](#)

Eurofins, 16-03-22

<https://www.eurofins.com/consumer-product-testing/media-centre/news/chemicals-monthly-bulletin-march-2022/#A4>

EC Requests SCCS for a Scientific Opinion on “Hydroxyapatite (Nano)”

2022-03-22

On March 17, 2022, the European Commission (EC) requested that the Scientific Committee on Consumer Safety (SCCS) prepare a scientific opinion on “hydroxyapatite (nano).” As reported in our April 13, 2021, blog item, SCCS issued a final opinion in 2021 stating that having considered the data provided, and other relevant information available in scientific literature, it “cannot conclude on the safety of the hydroxyapatite composed of rod-shaped nanoparticles for use in oral-care cosmetic products at the maximum concentrations and specifications given in this Opinion.” This is because the available data and information are not sufficient to exclude concerns over the genotoxic potential of hydroxyapatite (nano). According to the EC, in February 2022, industry submitted additional information to support the safety of hydroxyapatite (nano) in oral products, specifically addressing its potential genotoxicity. The EC asks whether SCCS considers hydroxyapatite (nano) safe when used in oral cosmetic products according to the maximum concentrations and specifications as reported in the submission, taking into account reasonably foreseeable exposure conditions. The EC also asks if SCCS has any further scientific concerns with regard to the use of hydroxyapatite (nano) in oral cosmetic products. The deadline for the scientific opinion is six months.

[Read More](#)

Nano and Other Emerging Chemical Technologies Blog, 23-03-22

<https://nanotech.lawbc.com/2022/03/ec-requests-sccs-for-a-scientific-opinion-on-hydroxyapatite-nano/>

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Proposal to amend Annexes IV and V of POP Regulation

2022-03-16

On 17th January 2021, the European Commission published the following proposal:

Proposal for a Regulation of the European Parliament and of the Council amending Annexes IV and V to Regulation (EU) 2019/1021 of the European Parliament and of the Council on persistent organic pollutants

This Proposal amends the annexes IV and V that deal with waste in the Regulation (EU) 2019/1021 (the POPs Regulation). These annexes set limits for persistent organic pollutants in waste and determine how waste that contains POP substances should be managed in the EU.

[Read More](#)

Eurofins, 16-03-22

<https://www.eurofins.com/consumer-product-testing/media-centre/news/chemicals-monthly-bulletin-march-2022/#A4>

Toxic chemicals present in UK drinking water

2022-03-22

The UK’s safe level for tap water for PFAS chemicals is too high, claimed a recent report by the BBC. The BBC took 45 tap water samples and had them analysed in a laboratory. The analysis found that almost half of the samples contained PFAS chemicals and 10 percent of the samples had readings that exceeded 10 nanograms per litre.

None exceeded the UK level of 100ng/l though – a limit that compared to European protection standards is remarkably high and perhaps challenges the myths of better UK chemical regulations post Brexit. Half of all the UK samples exceeded the European Food Standards Agency limit of 2.2ng/l.

Guidelines from the UK Drinking Water Inspectorate state drinking water must contain PFAS chemicals at no more than 100 nanograms per litre (ng/l). Though they are considering revising this down to 70ng/l.

To emphasise this vital point, the European standard for this health concern is 2.2ng/l. The UK standard is 100ng/l.

Chemicals in our water supply

The BBC study follows on the recent evidence of high levels of PFAS chemicals found in Cambridgeshire water supply in February this year.

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Over 1,000 people were not informed that they had been exposed to levels of PFOS that were four times the regulatory limit, or 400ng/l. When set against the European limit of 2.2ng/l, this Cambridge reading is remarkable.

To add to the residents' anger at this lack of information, it was then revealed that Cambridge City Council had known about this supply of excessive PFOS pollution almost a week before the customers had. Cambridge Water is adamant that the polluted water did not reach customers' taps, though an investigation is ongoing.

What about here in Yorkshire? Like most water companies, Yorkshire Water provides customers with an opportunity to check what is in their water supply. But what is remarkably conspicuous by its absence, is the lack of reference to PFAS chemicals. Yorkshire Water refer to the Water Supply (Water Quality) Regulations 2016, which do not specify PFAS at all. As there is no regulatory requirement to test for PFAS chemicals, the water company relies on the Environment Agency to do this for them.

[Read More](#)

Yorkshire Bylines, 22-03-22

<https://yorkshirebylines.co.uk/news/health/toxic-chemicals-in-uk-tap-water/>

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REACH Update

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Highlights from March RAC and SEAC meetings

2022-03-22

The Committee for Risk Assessment (RAC) adopted its opinion supporting Norway's proposal to restrict Dechlorane Plus. The Committee for Socio-Economic Analysis (SEAC) also supports a restriction in its draft opinion, which is open for consultation until 16 May 2022. The proposal aims to address risks for human health and the environment from emissions of the substance.

Helsinki, 22 March 2022 – RAC concluded that there is an EU-wide risk for people and the environment from the use of Dechlorane Plus, which is a very persistent and very bioaccumulative substance. It is mainly used as a flame retardant, for example, in adhesives and sealants in cars, aeroplanes and electronic equipment. RAC considers that the proposed restriction would be effective in reducing emissions of Dechlorane Plus and the related risks.

SEAC considers that a restriction is, in general, an appropriate Union-wide measure to address the identified risks from Dechlorane Plus and any of the restriction options presented by Norway could be proportionate in terms of their benefits and costs to society. SEAC, however, noted that there are clear differences between the different restriction options in terms of their marginal cost-effectiveness.

A 60-day consultation of SEAC's draft opinion started on 17 March 2022. The combined opinion of both committees is expected to be ready by summer.

The committees also adopted an opinion on a review report on the industrial use of 1,2-dichloroethane as a solvent in chemical synthesis. Furthermore, RAC adopted two opinions on occupational exposure limits (OELs) for 1,4-dioxane and isoprene, and 10 opinions on harmonised classification and labelling. Among the harmonised classification and labelling opinions are those for sulfur and multi-walled carbon nanotubes.

[Read More](#)

ECHA, 22-03-22

<https://echa.europa.eu/pt/-/highlights-from-march-rac-and-seac-meetings>

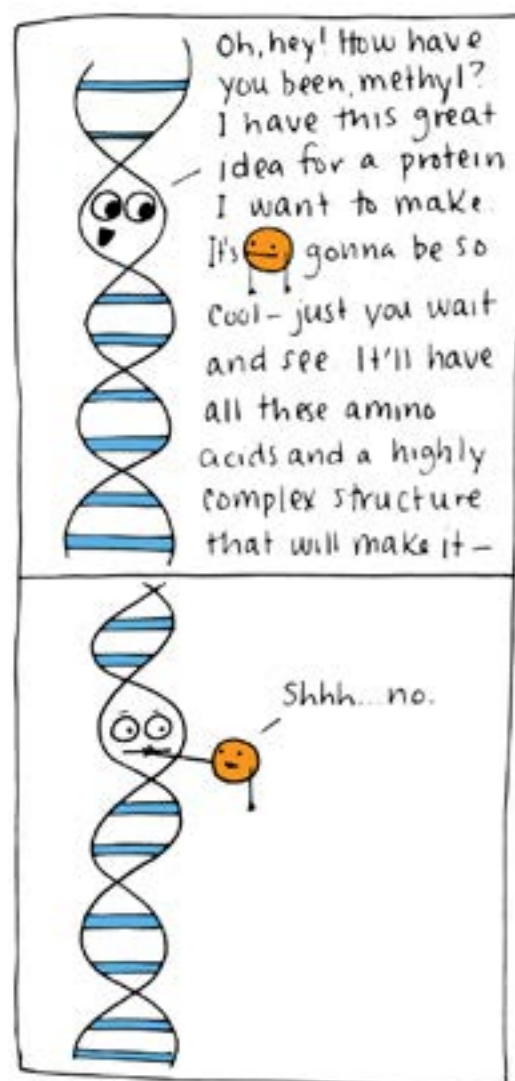
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Janet's Corner

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Gene Silencing

2022-04-01



Another gene silenced.
-Beatrice the Biologist

<http://www.beatricebiologist.com/2016/06/gene-silencing/>

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Hazard Alert

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Carbon Disulfide

2022-04-01

Carbon disulfide is a colourless volatile liquid with the formula CS_2 . The compound is used frequently as a building block in organic chemistry as well as an industrial and chemical non-polar solvent. [1] Pure carbon disulfide is a colourless liquid with a pleasant odour that is like the smell of chloroform. The impure carbon disulfide is contaminated with foul-smelling impurities, such as carbonyl sulfide. Carbon disulfide evaporates at room temperature, and the vapour is more than twice as heavy as air. It easily explodes in air and also catches fire very easily. In nature, small amounts of carbon disulfide are found in gases released to the earth's surface as, for example, in volcanic eruptions or over marshes. Commercial carbon disulfide is made by combining carbon and sulphur at very high temperatures. [2]

USES [3]

Carbon disulfide's most important industrial use has been in the manufacture of regenerated cellulose rayon (by the viscose process) and cellophane. Another principal industrial use for carbon disulfide has been as a feedstock for carbon tetrachloride production. It has also been used to protect fresh fruit from insects and fungus during shipping, in adhesives for food packaging, and in the solvent extraction of growth inhibitors. Carbon disulfide has also been highly suitable for other industrial applications including the vulcanisation and manufacture of rubber and rubber accessories; the production of resins, xanthates, thiocyanates, plywood adhesives, and flotation agents; solvent and spinning-solution applications, primarily in the manufacture of rayon and polymerisation inhibition of vinyl chloride; conversion and processing of hydrocarbons; petroleum-well cleaning; brightening of precious metals in electroplating; rust removal from metals; and removal and recovery of metals and other elements from waste water and other media. In agriculture, carbon disulfide has been widely used as a fumigant to control insects in stored grain, and to remove botfly larva infestations from the stomachs of horses and ectoparasites from swine. Use of carbon disulfide as a grain fumigant in the USA was voluntarily cancelled after 1985.

Carbon disulfide is a colourless volatile liquid with the formula CS_2 .

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SOURCES & ROUTES OF EXPOSURE

Sources of Exposure [3,4]

The main route of exposure to this compound is in the workplace. Workers in plants that use carbon disulfide in their manufacturing processes have a high degree of exposure potential. Releases of carbon disulfide from industrial processes are almost exclusively to the air; individuals in proximity to these sites may be exposed. Exposure may result from breathing air, drinking water, or eating foods that contain it. People may also be exposed through skin contact with soil, water, or other substances that contain carbon disulfide. Furthermore, low amounts of carbon disulfide may be emitted naturally from volcanoes and marshes.

Routes of Exposure [3]

Probable routes of human exposure to carbon disulfide are inhalation, ingestion, and skin contact.

HEALTH EFFECTS [4]

Acute Effects

Acute inhalation exposure of humans caused changes in breathing and some chest pains during an accidental release of carbon disulfide. Nausea, vomiting, dizziness, fatigue, headache, mood changes, lethargy, blurred vision, delirium, and convulsions have also been reported in humans acutely exposed by inhalation. Brain chemistry changes and sensory and motor nerve conduction alterations were observed in rats acutely exposed to carbon disulfide by inhalation. Tests involving acute exposure of rats, mice, and rabbits have shown carbon disulfide to have low acute toxicity from inhalation and moderate acute toxicity by ingestion.

Chronic Effects

Neurotoxic effects have been observed in chronic human and animal inhalation studies. Behavioural and neurophysiological changes, reduced nerve conduction velocity, peripheral neuropathy, and polyneuropathy have been observed in chronically exposed workers. An increased incidence of coronary heart disease has been observed in an epidemiological study of workers who chronically inhaled carbon disulfide in the workplace. Concomitant exposure to other chemicals and a failure to control for other coronary heart disease risk factors have been noted with this study. An increased incidence of angina has been reported in another occupational study. Muscle pain, headaches, and general fatigue

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have been reported by workers chronically exposed to carbon disulfide in the air. Ocular effects have been observed in chronically exposed workers. Workers who handled fibres made from a polymer solution in carbon disulfide developed blisters and eczematous lesions on their hands. Chronic inhalation exposure has been observed to affect the CNS, blood, liver, and kidneys in animals. The Reference Concentration (RfC) for carbon disulfide is 0.7 milligrams per cubic metre (mg/m³) based on neurological effects in humans. The Reference Dose (RfD) for carbon disulfide is 0.1 milligrams per kilogram body weight per day (mg/kg/d) based on foetal toxicity/malformations in rabbits.

Reproductive/Developmental Effects

Reproductive effects, such as decreased sperm count and decreased libido in men and menstrual disturbances in women, have been reported from occupational settings involving inhalation exposure to carbon disulfide. Developmental effects, including skeletal and visceral malformations, embryotoxicity, and functional and behavioural disturbances, have been observed in several animal studies across a wide exposure range. Pharmacokinetic studies indicate that carbon disulfide and its metabolites cross the placenta and localise in the target organs of the foetus (brain, blood, liver, and eyes).

Cancer Risk

In a study of workers exposed by inhalation to carbon disulfide and other solvents, an increased incidence of lymphatic leukaemia was reported. However, there were many confounding factors in this study, making it difficult to interpret the results. EPA has not classified carbon disulfide for human carcinogenicity.

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. Cover the irritated skin with

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- 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 Data

Carbon disulfide is flammable in presence of open flames and sparks, of oxidising materials. Liquid carbon disulfide is flammable, soluble or dispersed in water. Dry chemical powder should be used for small fires and alcohol foam, water spray or fog should be used on large fires.

Exposure Controls & Personal Protection

Engineering Controls

Exhaust ventilation or other engineering controls should be used 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 is recommended when handling carbon disulfide:

- 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;

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- Full suit;
- Vapour respirator;
- Boots;
- Gloves
- 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 [2,3,6]

Exposure Limits

United States

- The Occupational Safety and Health Administration (OSHA) permissible exposure limits (PELs) for carbon disulfide are 20 ppm as an 8-hour time-weighted average (TWA) concentration, 30 ppm as an acceptable peak concentration for 30-minutes, and 100 ppm as a maximum peak [29 CFR 1910.1000, Table Z-2].
- The National Institute for Occupational Safety and Health (NIOSH) has established a recommended exposure limits (RELs) for carbon disulfide of 1 ppm (3 milligrams per cubic metre (mg/m³) as a TWA for up to an hour workday and a 40-hour workweek, and a 10 ppm (30 mg/m³) short-term exposure limit. NIOSH also assigns a "Skin" notation, which indicates that the cutaneous route of exposure, including mucous membranes and eyes, contributes to overall exposure [NIOSH 1992].
- The American Conference of Governmental Industrial Hygienists (ACGIH) has assigned carbon disulfide a threshold limit value (TLV) of 10 ppm mg/m³ as a TWA for a normal 8-hour workday and a 40-hour workweek. The ACGIH also assigns a "Skin" notation to carbon disulfide [ACGIH 1994, p. 15].
- The EPA requires that spills or accidental releases into the environment of 100 pounds or more of carbon disulfide be reported to the EPA.

Australia

Worksafe Australia:

- Maximum time weighted average TWA: 10 ppm 31 mg/m³
- Harmful: concentration cut-off level: 0.20 % weight/weight
- Toxic: concentration cut-off level: 1 % weight/weight

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- Irritant: concentration cut-off level: 20 % weight/weight

REFERENCES

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5. <https://www.sciencelab.com/msds.php?msdsId=9927125>
6. <http://www.osha.gov/SLTC/healthguidelines/carbondisulfide/recognition.html>

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Gossip

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Scientists discover protein that reverses muscle aging

2022-03-18

A University at Buffalo-led research team has shown that a protein named for the mythical land of youth in Irish folklore is effective at reversing aging in skeletal muscle cells.

Published in *Science Advances*, the study centers on the protein NANOG, which is derived from Tír na nÓg, a place in Irish lore renowned for everlasting youth, beauty and health.

In a series of experiments, researchers overexpressed NANOG in myoblasts, which are the embryonic precursors to muscle tissue. The myoblasts were senescent, meaning they were no longer able to divide and grow.

The overexpression ameliorated some of the primary characteristics associated with age-related deterioration of cells, including autophagy, energy homeostasis, genomic stability, nuclear integrity and mitochondrial function.

Most notably, NANOG increased the number of muscle stem cells in the muscle of prematurely aging mice. This demonstrated the feasibility of reversing cellular aging in the body without the need to reprogram cells to an embryonic pluripotent state, a process that's often used in stem cell therapy but runs the risk of tumorigenesis.

"Our work focuses on understanding the mechanisms of NANOG's actions in hopes of discovering druggable targets in signaling or metabolic networks that mimic the anti-aging effects of NANOG.

Ultimately, the work could help lead to new treatments or therapies that help reverse cellular senescence, and aid the many people suffering from age-related disorders," says the study's corresponding author Stelios T. Andreadis, PhD, SUNY Distinguished Professor in the Department of Chemical and Biological Engineering at the UB School of Engineering and Applied Sciences.

The Brighter Side of News, 18 March 2022

<https://thebrighterside.news>

The research could help lead to treatments for atherosclerosis, osteoporosis and other age-related disorders

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Gossip

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Researchers discover new form of ice

2022-03-18

UNLV researchers have discovered a new form of ice, redefining the properties of water at high pressures.

Solid water, or ice, is like many other materials in that it can form different solid materials based on variable temperature and pressure conditions, like carbon forming diamond or graphite. However, water is exceptional in this aspect as there are at least 20 solid forms of ice known to us.

A team of scientists working in UNLV's Nevada Extreme Conditions Lab pioneered a new method for measuring the properties of water under high pressure. The water sample was first squeezed between the tips of two opposite-facing diamonds—freezing into several jumbled ice crystals. The ice was then subjected to a laser-heating technique that temporarily melted it before it quickly re-formed into a powder-like collection of tiny crystals.

By incrementally raising the pressure, and periodically blasting it with the laser beam, the team observed the water ice make the transition from a known cubic phase, Ice-VII, to the newly discovered intermediate, and tetragonal, phase, Ice-VIII, before settling into another known phase, Ice-X.

Zach Grande, a UNLV Ph.D. student, led the work which also demonstrated that the transition to Ice-X, when water stiffens aggressively, occurs at much lower pressures than previously thought.

While it's unlikely we'll find this new phase of ice anywhere on the surface of Earth, it is likely a common ingredient within the mantle of Earth as well as in large moons and water-rich planets outside of our solar system.

The team's findings were reported in the March 17 issue of the journal *Physical Review B*.

The research team had been working to understand the behavior of high-pressure water that may be present in the interior of distant planets.

To do so, Grande and UNLV physicist Ashkan Salamat placed a sample of water between the tips of two round-cut diamonds known as diamond anvil cells, a standard feature in the field of high pressure physics. Applying a little bit of force to the diamonds enabled the researchers to recreate pressures as high as those found at the center of the Earth.

Solid water, or ice, is like many other materials in that it can form different solid materials based on variable temperature and pressure conditions, like carbon forming diamond or graphite.

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By squeezing the water sample between these diamonds, scientists drove the oxygen and hydrogen atoms into a variety of different arrangements, including the newly discovered arrangement, Ice-VIII.

Not only did the first-of-its-kind laser-heating technique allow scientists to observe a new phase of water ice, but the team also found that the transition to Ice-X occurred at pressures nearly three times lower than previously thought—at 300,000 atmospheres instead of 1 million. This transition has been a highly debated topic in the community for several decades.

"Zach's work has demonstrated that this transformation to an ionic state occurs at much, much lower pressures than ever thought before," Salamat said. "It's the missing piece, and the most precise measurements ever on water at these conditions."

The work also recalibrates our understanding of the composition of exoplanets, Salamat added. Researchers hypothesize that the Ice-VIII phase of ice could exist in abundance in the crust and upper mantle of expected water-rich planets outside of our solar system, meaning they could have conditions habitable for life.

"Pressure driven symmetry transitions in dense H₂O ice," was published March 17 in the journal *Physical Review B*.

Phys Org, 18 March 2022

<https://phys.org>

Simple electrical circuit learns on its own—with no help from a computer

2022-03-18

A simple electrical circuit has learned to recognize flowers based on their petal size. That may seem trivial compared with artificial intelligence (AI) systems that recognize faces in a crowd, transcribe spoken words into text, and perform other astounding feats. However, the tiny circuit outshines conventional machine learning systems in one key way: It teaches itself without any help from a computer—akin to a living brain. The result demonstrates one way to avoid the massive amount of computation typically required to tune an AI system, an issue that could become more of a roadblock as such programs grow increasingly complex.

"It's a proof of principle," says Samuel Dillavou, a physicist at the University of Pennsylvania who presented the work here this week at the annual

System sidesteps computing bottleneck in tuning artificial intelligence algorithms

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March meeting of the American Physical Society. “We are learning something about learning.”

Currently, the standard tool for machine learning is the artificial neural network. Such networks typically only exist in a computer’s memory—although some researchers have found ways to embody them in everyday objects. A neural network consists of points or nodes, each of which can take a value ranging from 0 to 1, connected by lines or edges. Each edge is weighted depending on how correlated or anticorrelated the two nodes are.

The nodes are arranged in layers, with the first layer taking the inputs and the last layer producing the outputs. For example, the first layer might take as inputs the color of the pixels in black and white photos. The output layer might consist of a single node that yields a 0 if the picture is of a cat and a 1 if it is of a dog.

To teach the system, developers typically expose it to a set of training pictures and adjust the weights of the edges to get the right output. It’s a daunting optimization problem that grows dramatically more complex with the size of the network, and it requires substantial computer processing distinct from the neural network itself. Making matters more difficult, all of the edges across the entire network must be tuned simultaneously rather than one after another. To get around this problem, physicists have been looking for physical systems that can efficiently tune themselves without the external computation.

Now, Dillavou and colleagues have developed a system that can do just that. They assembled a small network by randomly wiring together 16 common electrical components called adjustable resistors, like so many pipe cleaners. Each resistor serves as an edge in the network, and the nodes are the junctions where the resistors’ leads meet. To use the network, the researchers set voltages for certain input nodes, and read out the voltages of output nodes. By adjusting the resistors, the automated network learned to produce the desired outputs for a given set of inputs.

To train the system with a minimal amount of computing and memory, the researchers actually built two identical networks on top of each other. In the “clamped” network, they fed in the input voltages and fixed the output voltage to the value they wanted. In the “free” network, they fixed just the input voltage and then let all the other voltages float to whatever value they would, which generally gave the wrong voltage at the output.

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The system then adjusted resistances in the two networks according to a simple rule that depended on whether the voltage difference across a resistor in the clamped network was bigger or smaller than the voltage difference across the corresponding resistor in the free network. After several iterations, those adjustments brought all voltages at all the nodes in the two networks into agreement and trained both networks to give the right output for a given input.

Crucially, that tuning requires very little computation. The system only needs to compare the voltage drop across corresponding resistors in the clamped and free networks, using a relatively simple electrical widget called a comparator, Dillavou says.

The network was tuned to perform a variety of simple AI tasks, Dillavou reported at the meeting. For example, it could distinguish with greater than 95% accuracy between three species of iris depending on four physical measurements of a flower: the lengths and widths of its petals and sepals—the leaves just below the blossom. That’s a canonical AI test that uses a standard set of 150 images, 30 of which were used to train the network, Dillavou says.

It seems unlikely that the resistor network will ever replace standard neural networks, however. For one thing, its response to different inputs likely has to vary more dramatically if the resistor network is to match an artificial neural network’s ability to make fine distinctions, Dillavou says.

But Jason Rocks, a physicist at Boston University, says it’s not out of the question that the idea might have some technological utility. “If it’s made out of electrical components then you should be able to scale it down to a microchip,” he says. “I think that’s where they’re going with this.”

Science, 18 March 2022

<https://science.org>

New experiment could confirm the fifth state of matter in the universe

2022-03-21

An experiment that could confirm the fifth state of matter in the universe—and change physics as we know it—has been published in a new paper from the University of Portsmouth.

Physicist Dr. Melvin Vopson has already published research suggesting that information has mass and that all elementary particles, the

“It doesn’t contradict quantum mechanics, electrodynamics, thermodynamics or classical mechanics. All it does is complement physics with something new and incredibly exciting.”

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smallest known building blocks of the universe, store information about themselves, similar to the way humans have DNA.

Now, he has designed an experiment—which if proved correct—means he will have discovered that information is the fifth form of matter, alongside solid, liquid, gas and plasma.

Dr. Vopson said: “This would be a eureka moment because it would change physics as we know it and expand our understanding of the universe. But it wouldn’t conflict with any of the existing laws of physics.

“It doesn’t contradict quantum mechanics, electrodynamics, thermodynamics or classical mechanics. All it does is complement physics with something new and incredibly exciting.”

Dr. Vopson’s previous research suggests that information is the fundamental building block of the universe and has physical mass.

He even claims that information could be the elusive dark matter that makes up almost a third of the universe.

He said: “If we assume that information is physical and has mass, and that elementary particles have a DNA of information about themselves, how can we prove it? My latest paper is about putting these theories to the test so they can be taken seriously by the scientific community.”

Dr. Vopson’s experiment proposes how to detect and measure the information in an elementary particle by using particle-antiparticle collision.

He said: “The information in an electron is 22 million times smaller than the mass of it, but we can measure the information content by erasing it.

“We know that when you collide a particle of matter with a particle of antimatter, they annihilate each other. And the information from the particle has to go somewhere when it’s annihilated.”

The annihilation process converts all the remaining mass of the particles into energy, typically gamma photons. Any particles containing information are converted into low-energy infrared photons.

In the study Dr. Vopson predicts the exact energy of the infrared photons resulting from erasing the information.

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Dr. Vopson believes his work could demonstrate that information is a key component of everything in the universe and a new field of physics research could emerge.

Phys Org, 21 March 2022

<https://phys.org>

Scientists discover a new kind of cell death linked to copper

2022-03-18

Copper is an essential element of life from bacteria and fungi to plants and animals. In humans, it binds to enzymes to help blood clot, hormones mature, and cells process energy. But too much copper kills cells—and now scientists have figured out how.

Researchers at the Broad Institute of MIT and Harvard have uncovered a new form of cell death that is induced by copper. Led by research scientist Peter Tsvetkov and institute director Todd Golub, the team found that copper binds to specialized proteins, causing them to form harmful clumps, and also interferes with the function of other essential proteins. Cells go into a state of toxic stress and ultimately die.

By shedding light on key components of this process, the research also identified which cells are particularly vulnerable to copper-induced death. The findings could help researchers better understand diseases in which copper is dysregulated, and could even inform the development of new cancer treatments. The research is published in *Science*.

“Copper is a double-edged sword: too little and cells can’t survive. But too much, and cells die. It’s been a mystery how excess copper is harmful, but we’ve finally figured it out,” said Golub, who is also a member of the faculty of the Dana-Farber Cancer Institute and Harvard Medical School.

Copper carriers

Tsvetkov and Golub’s quest to understand copper-based toxicity began in 2019 when they stumbled upon two small molecules that shuttle copper across cell membranes. They found that the copper carriers killed specific drug-resistant cancer cells. One of the molecules, elesclomol, had even reached clinical trials as a potential cancer drug, but it failed to show efficacy in patients, as it was not known at the time how this molecule works. However, the researchers knew from their experiments that the copper-bound molecules kill cells—and that this kind of cell death is

“Copper is a double-edged sword: too little and cells can’t survive. But too much, and cells die. It’s been a mystery how excess copper is harmful, but we’ve finally figured it out[.]”

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different from other known forms of cell death pathways. Tsvetkov wanted to dig deeper and learn exactly how copper kills cancer cells.

“Once I started going down that rabbit hole, it very quickly became a very basic cell biology question,” he said.

The researchers began systematically testing the hypothesis that the toxicity of the copper carriers stems from copper itself. They showed that many different copper-binding molecules, or ionophores, induced cell death in a similar way, and that this process completely depended on copper availability. Moreover, the researchers found that this form of cell death, which they call cuproptosis, is distinct from other well studied forms. When the researchers blocked known pathways of cell death such as apoptosis and ferroptosis, the cells treated with copper ionophores still died.

Next, the team homed in on how these copper carriers kill cells. They found that cells that relied on mitochondria to produce energy were nearly 1,000 times more sensitive to copper ionophores than cells that use glucose processing. Using multiple CRISPR knockout screens, the team identified key genes that facilitate copper-induced death.

These genes include FDX1, which encodes a protein targeted by elesclomol, as well as six genes involved in protein lipoylation—a chemical modification of a small number of proteins in the mitochondria that is essential for mitochondrial metabolism. The researchers found that copper delivered to the mitochondria by the ionophores binds directly to these lipoylated proteins, forcing them to form long chains and clumps that lead to cell death. They also discovered that copper interferes with iron-sulfur clusters, which are part of several key metabolic enzymes. This downregulated the enzymes, pushing cells into a toxic state of stress that ultimately killed them.

Hidden signs

Part of this new cell death mechanism is known to occur in bacteria and yeast, so the scientists suggest that their study could shed light on a variety of biological processes, including those in microorganisms that produce copper ionophores with antimicrobial properties, and in people with genetic disorders involving copper dysregulation, such as Wilson’s disease.

Though one of the copper ionophores, elesclomol, failed its clinical trial as a cancer therapeutic, later analysis revealed that the molecule had helped

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patients whose tumors rely on mitochondria for energy production. Now that the team has found markers of copper-induced cell death, they suggest that elesclomol could potentially be used to treat a range of cancers that are particularly vulnerable to the process, such as those expressing FDX1.

Tsvetkov is excited by the breadth of these clues and is eager to learn about new organisms or diseases where copper-induced cell death might play a role. He hopes their findings will inspire new research trajectories in cell biology, cancer, and antibiotics.

“We’ve revealed a new mechanism and found some elements we think are essential for this process, but it opens up so many other important questions that I hope will be explored,” he said. “There’s a lot to do.”

Phys Org, 18 March 2022

<https://phys.org>

Chemical recycling: ‘Green’ plastics solution makes more pollution

2022-03-22

A host of cutting-edge plastics processing technologies, known collectively as ‘chemical recycling,’ are releasing large quantities of toxic and hazardous substances into the environment. But the majority — while making fuel and chemicals — are producing no recycled plastic, according to a recent report by the Natural Resources Defense Council (NRDC).

With over 240 million metric tons of new plastics generated every year, a growing global mountain of plastic waste now threatens to destabilize Earth’s operating system, potentially closing the habitable window of climate and biogeochemical conditions that human civilizations have relied upon for survival over the past 12,000 years.

The United States is one of the world’s top plastic producers, but less than 9% of what it makes is currently recycled, mostly through the established process of mechanical sorting and shredding. Plastic industry representatives claim that so-called cutting edge ‘chemical recycling’ or ‘advanced recycling’ technologies, which use heat or solvents to convert waste plastic into fuels or chemical feedstocks, are the best recycling solution. But environmental groups, including NRDC, have raised concerns over the greenhouse gas emissions and toxic pollution generated by these processes.

With over 240 million metric tons of new plastics generated every year, a growing global mountain of plastic waste now threatens to destabilize Earth’s operating system.

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Chemical recycling creating pollution?

The NRDC investigation collated publicly available data in the summer of 2021 from U.S. Environmental Protection Agency (EPA) databases and state environmental permits for chemical recycling facilities across the United States. They identified eight sites that were either already operating or expected to become operational in the near future.

EPA records revealed that several of these recycling facilities were disposing of large amounts of hazardous waste, containing chemicals such as benzene — a known carcinogen — as well as lead, cadmium and chromium. State-level environmental permits for six facilities allow for the release of hazardous air pollutants, including chemicals that can cause cancer or birth defects.

“The facilities were releasing or permitted to release a variety of hazardous air pollutants,” said NRDC Senior Scientist and report author Veena Singla. “That’s certainly of concern for the communities in direct proximity.” Those communities, the report found, were disproportionately low-income neighborhoods and communities of color. About 380,000 people live within 3 miles of the eight facilities and may be impacted by their toxic emissions.

Judith Enck, president of Beyond Plastics, a not-for-profit project based at Bennington College in Vermont, and a former EPA regional administrator, described NRDC’s investigation as “invaluable,” adding that, “every elected official who’s thinking about supporting [chemical recycling] facilities should read the report first.”

However, Plastics Industry Association Vice President of Government Affairs Matt Seaholm, accused the NRDC report of utilizing “cherry-picked examples, incomplete data, and unsubstantiated claims.” He said that “Attacks on advanced recycling technologies tend to follow the same pattern: ignoring the advancements and investments from many different companies, making unrealistic calls to end plastics production, and ignoring industry positions on waste-to-fuel recovery. NRDC’s report is no different.”

Singla invited the industry to provide substantiation for Seaholm’s claims: “If they are aware of additional data on more facilities, or for these facilities, we’d be very happy to look and do an updated analysis.” She noted that the investigation included all publicly accessible data available at the time of analysis.

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The American Chemical Council and the World Plastics Council did not respond to Mongabay’s request for comment.

Plastic-to-fuel conversion: Greenwashing incineration?

Chemical recycling is being marketed as an alternative to mechanical recycling that can meet the growing demand for recycled plastic and reduce the volume of waste being incinerated or ending up in landfills. However, chemical plastic-to-plastic recycling projects have been besieged by problems as they attempt to scale-up from promising laboratory studies into commercially viable enterprises, and five out of eight facilities identified in the NRDC report were instead converting waste plastics into combustible fuel.

“Producing fuel from plastic is not a circular process,” said NRDC’s Singla. Based on the data their investigation obtained, “this is not a solution for a circular, non-toxic materials cycle for plastic.”

Technologies such as pyrolysis and gasification degrade plastics in high-temperature chambers, often in low-oxygen conditions, to produce a liquid or gas that can be further processed into fuel or chemicals. Although the industry claims these processes can be used to generate new plastic, the NRDC report found no evidence that this is happening in practice. And since the low-grade fuels and chemical waste produced are ultimately burned, critics argue these techniques are simply multi-step incineration processes, generating greenhouse gas emissions and hazardous waste without alleviating consumer demand for virgin plastics.

Despite these concerns, pressure is mounting on politicians and policymakers to classify chemical recycling — including plastic-to-fuel processes — as a manufacturing technology and not solid-waste incineration. Sixteen U.S. states have already passed recycling legislation that redefines chemical recycling facilities as manufacturers, exempting them from stricter reporting requirements imposed on solid waste recyclers, and similar bills have been advanced in other states including New York.

“That’s really concerning,” commented Singla. “There’s already a lack of transparency and reclassifying [of chemical recycling facilities] would narrow that further,” she said.

The EPA is currently evaluating how to regulate pyrolysis and gasification technologies under the Clean Air Act, with industry lobbyists fiercely

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campaigning to prevent these high-temperature degradation techniques from being classed as incineration.

Could chemical recycling hurt global efforts to curb plastic pollution?

Chemical recycling is coming under the global spotlight just as the world comes together to acknowledge and address the plastic crisis. In early March, 175 countries agreed on a UN framework to fight global plastic pollution from cradle-to-grave, reigniting optimism among campaigners. However, environmentalists warn that flexibility in the framework over how individual nations meet recycling targets could leave the door open for exploitation by industry lobbyists seeking policy incentives and regulatory exemptions for plastic-to-fuel techniques.

Some experts say that chemical recycling, and particularly technologies that generate combustible fuel rather than new plastics, are not the plastic-waste solutions the world is so desperately seeking. "I was really disappointed with what we found [in our report], because the plastic waste crisis is so visible and so imminent and I wanted there to be some additional solutions. Unfortunately this isn't it," Singla concluded.

Chemical recycling is "a public relations attempt used by the petrochemical industry to try to hold back actual solutions to the growing plastic pollution problem," said Enck. She encouraged state lawmakers in the U.S. to introduce legislation prohibiting chemical recycling facilities, extending producer responsibility to discourage unnecessary plastic packaging, and incentivizing plastic bottle return programs.

Mongabay, 22 March 2022

<https://news.mongabay.com>

Scientists say they can read nearly the whole genome of an IVF-created embryo

2022-03-21

A California company says it can decipher almost all the DNA code of a days-old embryo created through in vitro fertilization (IVF)—a challenging feat because of the tiny volume of genetic material available for analysis. The advance depends on fully sequencing both parents' DNA and "reconstructing" an embryo's genome with the help of those data. And the company suggests it could make it possible to forecast risk for common diseases that develop decades down the line. Currently, such genetic risk prediction is being tested in adults, and sometimes offered clinically. The

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idea of applying it to IVF embryos has generated intense scientific and ethical controversy. But that hasn't stopped the technology from galloping ahead.

Heart conditions, autoimmune diseases, cancer, and many other adult ailments have complex and often mysterious origins, fueled by a mix of genetic and environmental influences. Hundreds of variations in the human genome can collectively raise or lower risk of a particular disease, sometimes by a lot. Predicting a person's chance of a specific illness by blending this genetic variability into what's called a "polygenic risk score" remains under study in adults, in part because our understanding of how gene variants come together to drive or protect against disease remains a work in progress. In embryos it's even harder to prove a risk score's accuracy, researchers say. "Ultimately, how are we going to validate this in embryos?" says Norbert Gleicher, an infertility specialist at the Center for Human Reproduction in New York City who was not involved in the research. "We'll have to wait for 40 or 50 years" to find out whether a person develops the diseases they were screened for as an embryo.

With current technologies, it's very difficult to accurately sequence a whole genome from just a few cells, though some have tried with different methods. The new work on polygenic risk scores for IVF embryos is "exploratory research," says Premal Shah, CEO of MyOme, the company reporting the results. Today in *Nature Medicine*, the MyOme team, led by company co-founders and scientists Matthew Rabinowitz and Akash Kumar, along with colleagues elsewhere, describe creating such scores by first sequencing the genomes of 10 pairs of parents who had already undergone IVF and had babies. The researchers then used data collected during the IVF process: The couples' embryos, 110 in all, had undergone limited genetic testing at that time, a sort of spot sequencing of cells, called microarray measurements. Such analysis can test for an abnormal number of chromosomes, certain genetic diseases, and rearrangements of large chunks of DNA, and it has become an increasingly common part of IVF treatment in the United States. By combining these patchy embryo data with the more complete parental genome sequences, and applying statistical and population genomics techniques, the researchers could account for the gene shuffling that occurs during reproduction and calculate which chromosomes each parent had passed down to each embryo. In this way, they could predict much of that embryo's DNA.

The researchers had a handy way to see whether their reconstruction was accurate: Check the couples' babies. They collected cheek swab samples from the babies and sequenced their full genome, just as they'd done

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with the parents. They then compared that “true sequence” with the reconstructed genome for the embryo from which the child originated. The comparison revealed, essentially, a match: For a 3-day-old embryo, at least 96% of the reconstructed genome aligned with the inherited gene variants in the corresponding baby; for a 5-day-old embryo, it was at least 98%. (Because much of the human genome is the same across all people, the researchers focused on the DNA variability that made the parents, and their babies, unique.)

“What they presented is a nice method to sequence the genomes of all embryos,” says Shai Carmi, a statistical geneticist at the Hebrew University of Jerusalem. Such an accomplishment “is not trivial.” Kumar hopes being able to reconstruct most of an embryo’s genome will provide information well beyond what’s now available to people undergoing IVF, to determine an offspring’s chances of staying healthy. “It’s not enough to focus on the single gene anymore,” he says.

Once they had reconstructed embryo genomes in hand, the researchers turned to published data from large genomic studies of adults with or without common chronic diseases and the polygenic risk score models that were derived from that information. Then, MyOme applied those models to the embryos, crunching polygenic risk scores for 12 diseases, including breast cancer, coronary artery disease, and type 2 diabetes. The team also experimented with combining the reconstructed embryo sequence of single genes, such as BRCA1 and BRCA2, that are known to dramatically raise risk of certain diseases, with an embryo’s polygenic risk scores for that condition—in this case, breast cancer.

“We’re talking about providing information on risks that people care about—heart disease, cancer, autoimmune disease,” says Kumar, who is also a pediatric medical geneticist. He still sees patients and sometimes encounters frustration from parents wanting to avoid conferring a high risk of ailments that run in their families to their offspring. At the same time, Kumar stresses, “This is a new technology. It’s going to have controversies and challenges.”

In fact, many researchers say it’s premature to use polygenic risk scores to select which embryos are transferred. Such risk scores are “primarily still a research tool, even in adults,” says Barbara Koenig, a medical anthropologist who works on bioethics at the University of California, San Francisco. She’s involved in a large study called Women Informed to Screen Depending On Measures of risk that offers some women polygenic risk scores for breast cancer along with screening recommendations. “The

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scores are constantly being refined, every week they change,” Koenig says. “It’s like a constantly moving target.”

Kumar and his co-authors acknowledge the scores’ limitations, including that they are based on DNA from populations of overwhelmingly European ancestry and may be less accurate in other groups. Because of that, the MyOme team did not create disease risk assessments for embryos whose genome reflected at least 20% Asian or African ancestry. Even the DNA array technologies used to reconstruct the embryonic genomes have a European bias, says Genevieve Wojcik, a genetic epidemiologist at Johns Hopkins University, and may be less reliable for those with non-European ancestry. “You have a tool that cannot be used for a large proportion of the population,” she says. Kumar says the company is working to make the technology more broadly applicable.

There are other concerns, too. Although Carmi says the accuracy of polygenic risk scores in adults has improved, it’s unknown whether scores based on adult DNA and health data translate to embryos, in part because the environment can play a major role in shaping outcomes. “It’s difficult to say whether this will be meaningful,” Carmi says. He and his colleagues have seen this limitation up close: They’ve used computer modeling to assess whether height and IQ can be boosted by selecting embryos using polygenic risk scores for either trait, and found that generally, it doesn’t work. “We’re still missing a lot” when it comes to understanding genetics, even for highly heritable traits such as height, he says. In another computer modeling paper, however, Carmi found certain disease polygenic risk scores in embryos may prove useful. That’s because unlike height, which runs across a spectrum, heart attacks, say, either happen or they don’t. And pulling down genetic risk somewhat by implanting a different embryo, he says, may be enough to avoid that outcome.

But like a painting with only one corner visible, much of the human genome remains shrouded, including how genes interact with each other and the multiple effects one gene may have. Gleicher worries about the unintended consequences of applying polygenic risk scores to embryos. “You can achieve omission of one disease but at the same time, by doing that, induce another disease.” For example, modeling suggests selecting an embryo with a high polygenic risk score for educational attainment could also increase its risk for bipolar disorder. In December 2021, the European Society of Human Genetics urged against using polygenic risk scores for embryo selection—a position firmly endorsed by Gleicher, who calls such practice “unethical.”

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Still, some companies and fertility clinics already claim they can help parents select embryos for IQ and risk of various diseases. MyOme, meanwhile, is applying the methods from this latest study to another that's ongoing, working with IVF clinics and couples who want to learn polygenic risk scores for their frozen embryos. Couples may opt to decide which embryos to implant based on that information. "When you have a lot of information presented in this context, is it going to provide empowerment, or is it just going to confuse the parents?" Kumar asks. That's one question he hopes this ongoing study can answer.

Kumar says he's well aware of the criticisms, including that polygenic risk scores may not even be accurate for embryos. "That point is heard," Kumar says. "Our focus is doing this research because we see promise."

Science, 21 March 2022

<https://science.org>

Revealed: the dangerous chemicals in your food wrappers

2022-03-24

Independent testing of more than 100 packaging products from US restaurant and grocery chains identified PFAS chemicals in many of the wrappers, a Consumer Reports investigation has found.

The potentially dangerous "forever chemicals" were found in food packaging including paper bags for french fries, wrappers for hamburgers, molded fiber salad bowls and single-use paper plates.

They were found in the packaging from every retailer CR looked at, including fast-food chains – such as Burger King and McDonald's – and places that promote healthier fare, such as Cava and Trader Joe's.

CR tested multiple samples of 118 food packaging products and found evidence of PFAS in more than half of those tested, while almost a third had levels beyond a threshold supported by CR experts and others.

In recent decades, PFAS exposure has been linked to a growing list of health problems, including immune system suppression, lower birth weight and increased risk for some cancers.

PFAS can be found not only in nonstick pans and waterproof gear but also in the grease-resistant packaging that holds food from takeout chains and supermarkets. A seemingly virtuous alternative to plastic, packaging made

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with PFAS often resembles paper or cardboard but salad dressing and fry oil do not leak through.

"We know that these substances migrate into food you eat," said Justin Boucher, an environmental engineer at the Food Packaging Forum, a non-profit research organization based in Switzerland. "It's clear, direct exposure."

That's especially likely when food is fatty, salty or acidic, according to a 2021 review in the journal *Foods*. Some research even suggests that PFAS levels are higher in people who regularly eat out.

Another concern: when packaging is tossed into the trash it can end up in landfills, and PFAS can contaminate water and soil, or it is incinerated, and PFAS can spread through the air.

Health and environmental advocates have been pushing for PFAS use to be restricted, especially in items such as food packaging. In response, some fast-food and fast-casual restaurants, as well as several grocery stores, say that they have taken steps to limit PFAS in their food packaging or that they plan to phase it out.

In CR's tests the chemicals were also found in packaging from places that claimed to be moving away from PFAS, though those levels were often lower than at other retailers. "We know from our testing that it is feasible for retailers to use packaging with very low PFAS levels," said Brian Ronholm, director of food policy at CR. "So the good news is there are steps that companies can take now to reduce their use of these dangerous chemicals."

Searching for PFAS

The first known PFAS in the US was accidentally discovered in 1938 by a 27-year-old chemist named Roy Plunkett and in the decades since it and related chemicals have been added to a wide variety of products to make them resistant to heat, water, oil and corrosion.

Today, these practically unbreakable compounds, created when the elements carbon and fluorine are fused, can be found in the air and the water, as well as in our bodies, our food, and our homes.

Identifying the exact type of PFAS in a product is complex: there are more than 9,000 known PFAS, yet common testing methods can identify only a couple dozen.

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So CR tested products for their total organic fluorine content, which is considered the simplest way to assess a material's total PFAS content. That's because all PFAS contain organic fluorine, and there are few other sources of the compound, says Graham Peaslee, PhD, a professor of physics, chemistry and biochemistry at the University of Notre Dame in Indiana, who has studied PFAS in food packaging.

Another complication: PFAS is used so widely – found in ink on food containers, recycled paper, machines that make packaging and more – that it often shows up in products unintentionally.

Scientists and regulators are still debating what level of organic fluorine indicates intentional use. California has banned intentionally added PFAS; starting in January 2023, paper food packaging must have less than 100 parts per million organic fluorine. Denmark has settled on 20ppm as that threshold, a limit supported by CR's experts as well.

"If they can get to 100ppm, they should be able to get to 20ppm," Peaslee says. "Lower is always the ultimate goal."

CR tested multiple samples of 118 products and calculated average organic fluorine levels for each. Overall, CR detected that element in more than half the food packaging tested. Almost a third – 37 products – had organic fluorine levels above 20ppm, and 22 were above 100ppm.

Among the 24 retailers CR looked at, nearly half had at least one product above that level, and most had one or more above 20ppm. But almost all also had products below that amount. For example, while the two products with the highest average levels came from Nathan's, the chain also had four products below 20ppm. Nathan's told CR that it was redoing its packaging and had eliminated the high-level items, as did Chick-fil-A, which had the item with the next highest level in CR's tests.

The results of the tests are not representative of all the packaging from a retailer, and packaging may have changed since CR conducted them.

Putting PFAS claims to the test

CR looked at retailers that claimed to be phasing out PFAS, including Cava, Chipotle, Panera Bread, Sweetgreen, and Whole Foods Market.

All 13 of the products the companies said had reduced PFAS still had some detectable organic fluorine, and seven were above 20ppm. They ranged from a Whole Foods soup container with 21ppm organic fluorine – the

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only Whole Foods item to exceed the 20ppm limit – to a paper bag for pita chips from Cava with 260ppm.

In response to questions from CR, companies stressed that with PFAS so common in the environment, it's almost impossible to eliminate them entirely. Sweetgreen, for example, said, "We may have trace amounts of fluorine in our bowls. Unfortunately, PFAS are a widespread problem and are present in everyday life from tap water to air to soil." Whole Foods said the company "does not make PFAS-free claims but has strived to prevent intentionally added PFAS in packaging." Panera and Chipotle also said their goal was to avoid packaging with intentionally added PFAS.

Cava said that supply chain problems had slowed its "transition to eliminating added PFAS." The company said that it hoped to complete that process by the end of 2022 and that it had updated its public statements to reflect the new timeline.

Michael Hansen, senior scientist at CR, acknowledges that trace amounts of PFAS in food packaging may be inevitable. And that's why he says that "no company should tell consumers that their products are 100% free of PFAS." But he also says CR's tests show that getting to very low levels is possible and should be a goal for every company.

Protecting the next generation

Brian Ronholm, director of food policy at CR, and others say the federal government should regulate PFAS as a group. "Trying to ban individual PFAS is an impossible game of whack-a-mole," he says. "As soon as one is addressed, industry comes up with another."

The Environmental Protection Agency now has guidance levels on just two PFAS – PFOS and PFOA – and just in drinking water. And even those are too high, says Philippe Grandjean, a professor of Environmental Medicine at the University of Southern Denmark and an expert on PFAS health risks.

In addition, research from the EPA and elsewhere confirms that many newer PFAS chemicals, like their older cousins, will probably remain in the environment almost indefinitely and will pose health risks, especially to infants.

"The next generation is being exposed to these toxic compounds at the most vulnerable time period in their development," Grandjean says.

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Says Ronholm: "It's long past time we got PFAS out of products, our water, and our food."

The Guardian, 24 March 2022

<https://theguardian.com>

Road traffic in European cities exposes 60 million people to noise levels harmful to health

2022-03-24

A study by the Barcelona Institute for Global Health (ISGlobal), a centre supported by the "la Caixa" Foundation, assessed the levels of noise generated by road traffic and examined its impact on health in 749 European cities. The findings, published in *Environment International*, show that nearly 60 million adults are subjected to unhealthy levels of vehicle-generated noise. Compliance with the World Health Organisation (WHO) noise-level guidelines could prevent 3,600 deaths annually from ischaemic heart disease alone.

Road traffic is the main source of environmental noise. Previous research has linked environmental noise to a range of adverse health effects: sleep disturbance, annoyance, cardiovascular and metabolic disease, adverse birth outcomes, cognitive impairment, poor mental health and well-being, and premature mortality. Long-term exposure to road traffic noise can cause a sustained stress reaction, which results in the release of stress hormones and increases in heart rate, blood pressure and vasoconstriction, eventually leading to chronic diseases such as cardiovascular disease, depression and anxiety disorders.

For this study, data on European cities were retrieved from the Urban Audit 2018 dataset. Road traffic noise exposure was estimated using noise maps produced by countries and cities under the current European legislative framework (Environmental Noise Directive) or available from local sources (e.g. city governments and research institutions). For cases in which city-level data were not available, country-specific predictive models were developed and applied to estimate exposure to road traffic noise. Data on different causes of mortality for the year 2015 were retrieved from the Eurostat database.

The results showed that more than 48% of the 123 million adults (aged 20 years or older) included in the study were exposed to noise levels exceeding the WHO-recommended threshold. Specifically, the WHO recommendation states that the average noise level recorded over a 24-

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hour period should not exceed 53 decibels (53 dB Lden). The percentage of the population exposed to higher-than-recommended noise levels in Europe's capital cities ranges from 29.8% in Berlin to 86.5% in Vienna, including 43.8% in Madrid and 60.5% in Rome.

Preventable Deaths and Annoyance

Building on previous research that established associations between noise and mortality caused by ischaemic heart disease, the researchers estimated that compliance with WHO guidelines would prevent more than 3,600 deaths each year from ischaemic heart disease alone.

The study also found that more than 11 million adults were highly annoyed by road traffic noise. Annoyance was defined as the repeated disturbance of everyday activities, such as communicating, reading, working and sleeping. In this sense, annoyance goes beyond mere inconvenience, as it can increase stress and eventually give rise to various health problems.

"Our results provide, for the first time, a comprehensive picture of European cities and a clearer understanding of why transport-generated noise is the second major environmental cause of adverse health outcomes in western Europe, after airborne particulate matter," explained ISGlobal researcher Sasha Khomenko, lead author of the study. "Even so, we are convinced that the true health impact of traffic noise is much greater, as the lack of city-level data limits the health effects we can assess, thus leading to an underestimation of the impact. Moreover, the available data have only allowed us to analyse the population exposed to more than 55 dB Lden, whereas the WHO-recommended threshold is 53 dB Lden, and we suspect that adverse effects could occur even with exposure to lower noise levels."

The team encountered methodological difficulties due to the heterogeneity and quality of the available data. The quality of each noise map was assessed, with most maps falling into the low or moderate quality categories; less than 17% of the maps were considered to be of good quality.

"The European directive on environmental noise made strategic noise mapping mandatory, but it did not set out a specific methodology or guidelines, so the results have been mixed," commented Mark Nieuwenhuijsen, head of the Air Pollution and Urban Environment programme at ISGlobal and senior author of the study. "The EU member states have had a common methodology since January 2019, so we can

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expect to see much more comprehensive and accurate health impact assessments of traffic noise in the coming years.”

Consult Data for All 749 Cities

This study forms part of the European Urban Burden of Disease Project, which so far has produced rankings of mortality associated with air pollution and green space, respectively, in European cities. However, due to differences in methodologies and sources of traffic noise data, the results obtained for the various cities analysed are not considered to be comparable. As a result, a road-noise ranking was not produced, although all data have been posted on the project website, where values for all 749 cities can be consulted.

Science Daily, 24 March 2022

<https://sciencedaily.com>

Next-generation telescopes could search for intelligent civilizations directly

2022-03-24

We're still in the early days of searching for life elsewhere. The Perseverance rover is on its way to a paleo-delta on Mars to look for fossilized signs of ancient bacterial life. SETI's been watching the sky with radio dishes, listening for signals from distant worlds. Our telescopes are beginning to scan the atmospheres of distant exoplanets for biosignatures.

Soon, we'll take another step forward in the search when new, powerful telescopes begin to search not just for life but for other civilizations.

The search for biosignatures is gaining momentum. If we can find atmospheric indications of life at another planet or moon—things like methane and nitrous oxide and a host of other chemical compounds—then we can wonder if living things produced them. But the search for technosignatures raises the level of the game. Only a technological civilization can produce technosignatures.

Technosignatures are simply the effects of technology on an environment. Light from massive cities, particular atmospheric chemicals, and even satellites orbiting a planet are all technosignatures. The granddaddy of all technosignatures is probably the Dyson sphere. A Dyson sphere is a hypothetical megastructure surrounding a star and capturing its solar energy output. The idea is that as a civilization grows, its energy

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requirements will balloon, and the only way to gather the energy the civilization requires is to surround its star with an energy-gathering sphere.

In 2021, the National Academies of Sciences released their Decadal Survey on Astronomy and Astrophysics 2020, called Astro2020. They release one every 10 years, and each survey outlines the critical challenges in astrophysics and astronomy for the next decade. Astro2020 contains several recommendations that can advance the search for technosignatures. A NASA working group has released a white paper digging into the technosignature part of Astro2020.

The paper is titled “Opportunities for Technosignature Science in the Astro2020 Report.” It comes from Nexus for Exoplanet System Science (NExSS). NExSS is a multidisciplinary group that includes Earth scientists, planetary scientists, heliophysicists, and astrophysicists. They bring a collaborative and synthesized approach to the search for biosignatures and technosignatures.

“Technosignatures refer to any observable manifestations of extraterrestrial technology, and the search for technosignatures is part of the continuum of the astrobiological search for biosignatures,” the paper says. “The search for technosignatures is directly relevant to the ‘World and Suns in Context’ theme and ‘Pathways to Habitable Worlds’ program in the Astro2020 report.”

The white paper aims to “... demonstrate the relevance of technosignature science to a wide range of missions...” The NExSS group is urging the larger science community to include the search for technosignatures in the design and implementation of projects like LUVOIR, ELTs, infrared and X-ray observatories, and other similar facilities.

LUVOIR (Large Ultraviolet Optical Infrared Surveyor) is a NASA telescope concept in two proposed sizes. LUVOIR-A is a 15-meter mirror design, and LUVOIR-B is an eight-meter design. Thanks to its multi-wavelength capabilities, it's a powerful and versatile design with many applications. It would be situated at L2 but would be serviceable like the Hubble was.

ASTRO2020 focuses on the biosignature aspect of LUVOIR in the search for habitable planets, but it mentions technosignatures a couple of times. The authors of this new white paper point out that LUVOIR would be an effective tool in the search for technosignatures. “Industrial pollution represents a class of atmospheric constituents on Earth that could conceivably be technosignatures if observed in the spectra of an exoplanet,” they write. “One example is nitrogen dioxide (NO₂), which

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has large sources on Earth from combustion that are greater than non-anthropogenic sources.”

NO₂ makes a good case study in detection scenarios. Elevated NO₂ levels in a planet’s atmosphere can indicate industrial activity. But there are natural sources, too, and any detection would have to be studied carefully in case of false positives. This is the same problem biosignature detections face: They need to be unambiguous. But whether a signal is a false positive or not, it first has to be detected.

The white paper authors believe LUVVOIR can detect NO₂, and to strengthen their case, they cite previous studies showing that LUVVOIR could successfully detect NO₂ in the atmospheres of exoplanets. “A study by Kopparapu et al. (2021) showed that the absorption features of NO₂ ... could be detectable with the Large Ultraviolet Optical Infrared Surveyor. Kopparapu et al. (2021) found that a 15 m LUVVOIR-like telescope could detect Earth-like levels of NO₂ for a planet around a sun-like star at 10 PC (~33 light-years) with ~400 hours of observation.”

The white paper also addresses how LUVVOIR could detect more purposeful technosignatures like laser signals and optical beacons. “Optical beacons could provide a cost-effective means of directed communication between exoplanetary systems, which could be encoded and transmitted through rapid nanosecond pulses,” the paper states. LUVVOIR could help with these, too, by placing “... constraints on the prevalence of optical beacons and other pulsed laser signals.”

The authors couple the detection of optical beacons with the detection and characterization of habitable rocky planets and say that LUVVOIR is a powerful tool for these detections. “Space missions such as the IR/O/UV telescope could provide detectability constraints on the prevalence of optical beacons in exoplanetary systems,” they write. “... relatively low-powered optical beacons could be detectable with the IR/O/UV telescope for most or all targets where the characterization of rocky planets within the HZ is also possible.”

Extremely Large Telescopes (ELTs) can also play a role in the search for technosignatures. An ELT is a telescope with a primary mirror larger than about eight meters. Eight meters is a design limitation because telescope mirrors larger than that are heavy and deform themselves. ELTs get around that physical limitation with segmented mirrors. The European Extremely Large Telescope (E-ELT) is the most well-known example of an ELT and should see first light in 2027, but the white paper explicitly mentions two other ELTs.

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One is the Giant Magellan Telescope (GMT), and the other is the Thirty Meter Telescope (TMT.) Together, the ELTs seeing first light through the next decade will be powerful engines for advancing scientific objectives. The white paper expands on ELTs’ role in the hunt for technosignatures.

“The GMT and TMT are ongoing projects that have been developing for many years,” the paper says. “These ground-based facilities could be capable of characterizing the atmospheres of terrestrial planets discovered by missions like TESS and CHEOPS at optical and near-infrared wavelengths.”

Red dwarfs are the most prevalent type of star, but their light is dimmer, which makes them more challenging targets. The GMT and the TMT should be able to study the atmospheres of exoplanets around red dwarfs. “Possible spectral technosignatures such as atmospheric pollution and optical beacons ... could likewise be constrained with observations of exoplanetary systems by ELTs.”

The white paper also talks about far-Infrared (FIR) probes. There are gaps in our observing capabilities, and FIR probes are one of those gaps. They have to be space-based facilities to be effective, and they could play a crucial role in the search for technosignatures. “... the aforementioned wavelength range is exciting for the so-called artifact SETI, of which the best-known example is Dyson spheres, the energy-harvesting megastructures conceived by Olaf Stapledon and formalized by their eponym Freeman Dyson.”

In 1960 Dyson published his paper “Search for Artificial Stellar Sources of Infra-Red Radiation.” As the title makes clear, IR radiation is key to detecting this type of megastructure. A Dyson sphere would harvest an enormous amount of energy, an almost inconceivable amount, and the process would undoubtedly produce some waste heat. An FIR probe may not detect the waste heat because of the wavelengths involved, but it could rule out other FIR sources and streamline the search. “However, a Dyson sphere would typically not have much far-infrared emission, unlike dust. Thus, far IR capabilities offer a way to significantly reduce the problem of confounders such as protoplanetary disks.”

Infrared probes can also detect specific chemicals in exoplanet atmospheres that are strong indications of industrial activity. Chlorofluorocarbons are one class of chemicals. “... none of the abiotic or biological (but non-technological) pathways operating today can give rise to chlorofluorocarbons (CFCs),” the white paper states. The authors say that IR spectroscopy could detect CFCs, which can persist in an atmosphere for

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tens of thousands of years. The James Webb Space Telescope can detect CFCs in some cases, but it has a lot of other jobs.

Deeper into the white paper, things get a little murky. X-ray probes could detect technosignatures, but the authors say the topic warrants further investigation. They say X-rays are "... not a promising 'messenger' for artificial signals from ETIs since the latter are conventionally associated with radio (and optical) wavelengths." But X-rays are still intriguing because of the novel ways an advanced civilization could use them to create signals.

"If a km-sized rock were to be hurled onto the surface of a neutron star, it may result in an intense X-ray pulse of ~1029 W that might be detectable throughout the Milky Way." That might sound far-fetched, but who knows? They also say that an advanced civilization could use their technology to modulate existing X-ray sources like X-ray binaries to send signals.

The white paper also covers radio astronomy, the cosmic microwave background, and pulsar timing. According to the authors, each of these can be part of our search for technosignatures.

This white paper is a scientific plea. The ASTRO2020 report relegates the search for technosignatures to the report's appendices, and the white paper authors hope to raise its prominence.

"Technosignature observations can often be conducted commensally with other observations, and many technosignature searches can be conducted without changing the recommended mission architecture," the authors write in the white paper's conclusion.

They point out that including the search for technosignatures wouldn't incur any additional expense and that the possibility of finding technosignatures is too important to ignore.

"This white paper recommends that all of the missions and facilities discussed above should consider including the search for technosignatures as part of the explicitly stated science case."

Phys Org, 24 March 2022

<https://phys.org>

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It may not be cute, but here's why the humble yabby deserves your love

2022-03-18

For children growing up in rural areas, going "yabbing" in farm dams is a rite of passage. The common yabby (*Cherax destructor*) is the most widely distributed Australian crayfish, inhabiting rivers and wetlands across southeast Australia.

And although the humble yabby is not as cute and cuddly as some better-known Australian icons, from an ecosystem perspective, we argue they may be more important.

Yabbies are a staple food for platypus, many waterbird species, and fish such as Murray cod and golden perch. And yabbies' diet is largely made up of algae, detritus (dead organic material) and small animals. This means they link energy from the very bottom of the food chain to apex predators at the top.

And yet, little is known how their diets influence their growth and alter their quality as a food source. Our recent research starts to fill this critical gap.

We found yabbies in wetlands are better food source for fish than those in rivers, because wetland yabbies eat more foods rich in high-quality fatty acids. While more research is needed, these results show how higher quality yabby diets can increase the total biomass of predators, such as Murray cod, that riverine ecosystems can support.

Untangling the food web

Food webs describe what eats what within ecological communities and provide a useful way to illustrate how energy moves through the environment.

But it's more complex than big fish eats little fish. Within food webs, organisms can be lumped into two groups:

1. autotrophs: organisms that obtain energy from the sun via photosynthesis, such as plants
2. heterotrophs: organisms that obtain energy by eating other organisms, such as bacteria, fungi, and animals.

Algae fall in to the first group, providing a high-quality energy pathway in food webs because they can synthesise so-called "long-chain polyunsaturated fatty acids": omega 3 and omega 6.

Yabbies are a staple food for platypus, many waterbird species, and fish such as Murray cod and golden perch.

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If you grew up in the 1980s you're probably familiar with the term "polyunsaturated fatty acids" from its association with margarine (though few probably understood its relevance back then). Today, we more often hear the term around seafood.

We're encouraged to eat oily fish because of the omega 3 and omega 6 they provide, which the body needs for brain function and cell growth. We source these fatty acids from fish thanks to algae, which underpins many aquatic food webs. Fatty acids are essential for the growth of all animals, including yabbies.

The other primary energy source in freshwater comes from detritus – organic debris and decomposing material. In wetlands and rivers, detritus accumulates from falling leaves and branches along banks, which can be washed into rivers during high flows.

But while detritus is often abundant, it's considered poorer quality because it's difficult to digest and has low concentrations of some important fatty acids. And in food webs, poor quality food provides less bounce for the ounce, so to speak.

The yabby is an omnivore - algae, detritus and other animals are its food, but we know little about how these different energy sources affect yabby growth and survival – or how it might affect animals that rely on yabbies for food.

You are what you eat

Our research investigated how different quality fatty acid diets affected yabby growth, and how this might influence other animals up the food chain.

We found yabbies fed poor quality diets in the laboratory, made up of only dead plant matter, barely grew at all. These yabbies also represented a poor-quality food resource for predators.

In contrast, yabbies fed mixed diets rich in high quality polyunsaturated fatty acids grew the most – more than doubling in mass over a 70-day trial. They also retained higher concentrations of these fatty acids in their body tissue, making them a good food resource for other animals.

Yabbies are tough. They're well adapted to Australia's extremes, capable of surviving dry conditions by lying dormant in burrows dug in dried waterways. During wetter periods, they can travel long distances in search of a new home – usually wetlands or rivers.

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So how might their environment affect their diet? We found wild yabbies that live in wetland habitats ate foods with higher concentrations of these fatty acids compared to yabbies that live in rivers.

And as with our laboratory fed yabbies, wild wetland yabbies eating high quality foods also represented a better food option for fish than riverine yabbies. This is likely due to wetlands containing a higher proportion of diatoms (single-celled algae) and green algae, which both synthesise long-chain polyunsaturated fatty acids.

What does this mean for freshwater ecosystems?

Australia's floodplain rivers are dynamic. Wet periods with high flows connect rivers to wetlands that lie on the floodplain. In dry periods with low flows, this connection is interrupted, leaving wetlands on floodplains isolated, sometimes even drying out completely.

Connectivity between rivers and their floodplain is important for many reasons. It provides habitat and breeding opportunities for birds and fish, revitalises plants, and an exchange of nutrients.

Water in the Murray-Darling Basin is shared between irrigators, municipal water supply and the environment, and is largely regulated with infrastructure such as dams and weirs.

Our research is an example of the many benefits that come with ensuring we have adequate water for the environment. Our work shows that an important aspect of connection is to allow riverine predators access to high quality food resources – yabbies – in floodplain wetlands.

If yabbies are thriving and passing essential fatty acids up the food chain, populations of popular recreational fish, such as Murray cod and golden perch, will benefit accordingly.

It's critical we improve our understanding of these complex relationships. This includes recognising other drivers of riverine population success such as competition, habitat, life history traits and spawning cues, to ensure Australia's riverine animals can thrive.

The Conversation, 18 March 2022

<https://theconversation.com>

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Could I have had COVID and not realised it?

2022-03-21

It seems not a day goes by without learning someone in our inner circle of family, friends and colleagues has COVID. When we ask how unwell our acquaintance is, the responses vary from “they’re really crook” to “you wouldn’t even know they had it”.

This is in line with studies that report moderate to severe illness in a minority of people (usually older with other risk factors) and that up to one in three positive people exhibit no symptoms.

Given the ubiquitous presence of this highly infectious coronavirus in our community and the high rate of asymptomatic illness, those who have not been diagnosed with COVID might wonder, “how would I know if I had been infected?” And, “does it matter if I have?”.

How COVID is diagnosed

Most people know they’ve had COVID because they had a fever or upper respiratory tract symptoms and/or were exposed to an infected person AND had a swab test (PCR or rapid antigen) that detected the COVID virus (SARS-CoV-2) in the upper airway.

At the beginning of 2022, many people with consistent symptoms or high-risk exposures were not able to access PCRs or RATs to confirm their diagnosis, but instead presumed themselves positive and quarantined.

It is possible to diagnose past infection in those who never tested positive. A blood test can look for SARS-CoV-2 antibodies (also known as immunoglobulins). When we are infected with SARS-CoV-2, our immune system launches a precision counter strike by producing antibodies against viral targets, specifically the Spike (S) and Nucleocapsid (N) proteins. COVID vaccination induces a similar immune response against the S protein only. The S antibody “neutralises” the invader by preventing the virus from attaching to human cells.

These antibodies can be detected within one to three weeks after infection and persist for at least six months – potentially much longer. A blood test that shows antibodies to S and N proteins indicates someone has been previously infected. Detection of antibodies to the S protein only indicates vaccination (but not infection).

The problem with antibody tests

At the beginning of 2022, many people with consistent symptoms or high-risk exposures were not able to access PCRs or RATs to confirm their diagnosis, but instead presumed themselves positive and quarantined.

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Before you rush off to get a COVID antibody test, there are a few notes of caution. There is still much to learn about the characteristics of the immune response to COVID infection. Not everyone mounts a detectable antibody response following infection and levels can decline to undetectable levels after several months in some people.

Because there are other circulating seasonal coronaviruses (such as those that cause the common cold), tests may also pick up antibodies to non-SARS-CoV-2 strains, leading to “false positive” results.

Commercial and public hospital pathology labs can perform SARS-CoV-2 antibody testing, but the interpretation of results should be undertaken carefully.

So, antibody testing should really only be done when there’s a good reason to: say, when confirming past infection or effectiveness of vaccination is important for the current care of an individual. Diagnosing a post-infectious complication or eligibility for a specific treatment, for example. It could also be useful for contact tracing or for assessing the background population rate of infection.

Antibody testing a population

“Seroprevalence studies” test for the presence of SARS-CoV-2 antibodies in repositories of stored blood that are representative of the general population, such as from a blood bank. This data helps to understand the true extent of COVID infection and vaccination status in the community (and informs our assessment of population susceptibility to future infection and reinfection). It’s more useful than daily reported case numbers, which are skewed towards symptomatic individuals and those with access to swab testing.

New research from the World Health Organization, which is yet to be reviewed by other scientists, reported the results of a meta-analysis of over 800 seroprevalence studies performed around the world since 2020. They estimated that by July 2021, 45.2% of the global population had SARS-CoV-2 antibodies due to past infection or vaccination, eight times the estimate (5.5%) from a year earlier.

There are plans to conduct fresh seroprevalence studies in Australia in the coming year, which will update local data and help us understand to what extent the Omicron wave has washed through the population.

Does it matter if I have had COVID and didn’t know?

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For most people, knowing your COVID infection status is unlikely to be more than a topic of dinnertime conversation.

While some studies have pointed to a less robust and durable antibody response following mild or asymptomatic infection compared with severe illness, it is not known how this influences protection from reinfection. Certainly, the knowledge we have antibodies from past infection should not deter us from being fully up-to-date with COVID vaccination, which remains the best protection against severe illness.

There are reports of people with mild or asymptomatic COVID infection developing long COVID – persistent or relapsing symptoms that last several months after initial infection. Symptoms can include shortness of breath, physical and mental fatigue, exercise intolerance, headaches, and muscle and joint pain.

However, the likelihood of developing this condition appears higher in those who suffer a heavier initial bout of COVID illness. This might be linked with higher viral load at that time.

Bottom line

As we enter the third year of the COVID pandemic and given that up to one in three infections may be asymptomatic, it is likely many of us have been infected without knowing it.

If you are experiencing lingering fatigue, brain fog or other symptoms that could be long COVID, you should talk to your GP. Otherwise, knowing our COVID infection status is unlikely to be of much practical benefit. Antibody testing should be reserved for specific medical or public health indications.

Being up-to-date with COVID vaccination is still our best defence against severe illness moving forward.

The Conversation, 21 March 2022

<https://theconversation.com>

Waste coffee grounds could someday help detect brain waves

2022-03-20

There's nothing like a steaming cup of joe to give your morning a quick boost. Now, there's yet another reason to love the beverage. Today, researchers report the first application of used coffee grounds as

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environmentally friendly electrode coatings for sensitive neurochemistry measurements. The material could eventually help scientists get a better handle on brain activity and detect minute levels of neurotransmitters.

The researchers will present their results at the spring meeting of the American Chemical Society (ACS).

Spent coffee grounds have previously been used to make porous carbon supercapacitors for energy storage. But now, new research led by principal investigator Ashley Ross, Ph.D., has taken recycled coffee waste in another, more biological direction. She and her team have demonstrated that electrodes coated with carbon from this waste can detect trace levels of biomolecules in vitro. According to Ross, this is the first example of residual coffee grounds being repurposed for biosensing applications.

"I saw papers about using spent grounds to produce porous carbon for energy storage, and I thought maybe we could use this conductive material in our neurochemistry detection work," says Ross. "And I also thought this would be a good excuse to buy lots of coffee for the lab!" Ross, who is at the University of Cincinnati, and several members of her team are self-professed coffee lovers.

The traditional microelectrodes that neuroscientists use are commonly made from carbon fiber—fine, solid carbon strands bundled together. Making them is typically an arduous and expensive process, involving multiple steps and harsh chemicals. Eventually, Ross wants to fabricate entire electrodes with carbon from coffee grounds because this type of approach would be inexpensive and environmentally friendly. As a first step toward realizing that goal, the researchers adapted the material from the grounds as a coating for conventional electrodes.

Kamya Lapsley, who was a summer student in Ross's lab and who is currently an undergraduate student at Kent State University, took this initial challenge on. She and other members of the lab dried used coffee grounds and heated them in a tube furnace at about 1,300 F. Next, they added the material to a potassium hydroxide solution to activate the carbon and open up holes in the structure. Then, the researchers heated the mixture again under nitrogen gas to remove any undesired byproducts. What was left was an inky slurry full of flecks of porous carbon. As a final step, the researchers diluted the sludge with water, into which they dipped the carbon fiber electrodes to coat them with a layer of porous carbon nearly a hundred times thinner than the diameter of a human hair.

Spent coffee grounds have previously been used to make porous carbon supercapacitors for energy storage.

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The researchers compared the performance of coated and uncoated electrodes for sensing small quantities of dopamine, a neurotransmitter, with fast-scan cyclic voltammetry. With this technique, they applied a rapidly varying voltage to the electrode to alternately oxidize and reduce dopamine. The technique is fast enough to detect subsecond neurotransmitter release, as would happen in the brain. The researchers found that electrodes coated with porous carbon reached oxidative current levels over three times higher than bare carbon fibers in the presence of dopamine, indicating that the coated electrode offered a more sensitive surface for dopamine detection. Not only does the porous structure allow more dopamine molecules to participate in the reaction because of the coating's large surface area, it also momentarily traps dopamine molecules in the crevices of the electrode, says Ross. These properties increase the sensitivity and allow the researchers to carry out faster measurements. The group is now exploring how these porous coatings impact the temporal resolution of the technique.

Next, the team will make carbon fiber electrodes from scratch with porous carbon from waste coffee grounds, which would give the electrodes uniform porosity not just on the surface, but also through and through. Ross predicts that this will boost their neurochemical detection abilities because an even larger total surface area of the electrode will be exposed to adsorb the dopamine molecules. At the same time, Ross plans to put the current coffee-coated electrodes to the test in the brains of live rats.

In the meantime, there will be no lack of starting materials to carry out the next stages of the project, for the entire lab seems to love their brew. "The grad students provided quite a bit of coffee grounds—more than we will ever need," says Ross. "My entire lab really loved this project."

Phys Org, 20 March 2022

<https://phys.org>

Vitamin B3, niacinamide and reducing skin cancer risk: what does the research say?

2022-03-21

If you've had a skin cancer check lately, you might have been told to consider adding a daily vitamin B3 pill to your skin safety regime (hopefully, you already use sunscreen, wear sun-smart clothes and avoid sun exposure in the middle of the day).

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So, what is this vitamin and why is it sometimes recommended as a way to reduce skin cancer risk?

Australia is the skin cancer capital of the world, where two-thirds of people can expect to develop some form of skin cancer by retirement age. It is the most common type of cancer and also exerts the costliest burden on the health-care system. Anything that can help minimise the burden of skin cancer is worth considering.

Supplementing your diet with vitamin B3 may benefit the skin

The key chemical you need to know about is called nicotinamide (also known as niacinamide).

Nicotinamide or niacinamide is a variant of vitamin B3. It's found in dietary sources such as meat, fish, nuts, grains and mushrooms. It is the precursor of nicotinamide adenine dinucleotide (NAD+), essential for many physiological reactions that help cells obtain energy.

If you don't get enough vitamin B3, you can get the disease pellagra. Pellagra affects organs with high cellular energy requirements such as the brain, skin and gut, manifesting with what medical professionals sometimes call the "4 Ds" – dermatitis, diarrhoea, dementia and death.

Recently, emerging evidence suggests supplementing your diet with vitamin B3 may have a range of benefits, particularly for the skin.

Nicotinamide has been shown to replenish cellular energy, enhance DNA repair, act as an anti-inflammatory and modulate some of the local immunosuppression caused by ultraviolet radiation.

Much of the work in this field has been led by Professor Diona Damian, Head of Dermatology at Royal Prince Alfred Hospital, Sydney. Building on from her pioneering laboratory work in the field, she went on to lead the landmark ONTRAC trial published in the New England Journal of Medicine in 2015.

In this phase 3, double-blind, randomised controlled study, 386 patients at high risk of skin cancer took either nicotinamide 500mg twice daily or a placebo for 12 months. The results were striking: the rate of new non-melanoma skin cancer was 23% lower in the nicotinamide group than in the placebo group.

Similar improvements have been observed in a small study of renal transplant patients – a group well known to be at increased risk of developing skin cancer.

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Nicotinamide is also becoming increasingly employed in cosmetics and skincare products. Several small clinical studies have demonstrated niacinamide may help improve wrinkles, excess pigmentation, redness, sallowness and elasticity of the skin.

Aged skin has less nicotinamide adenine dinucleotide in it. The theory is supplementing with nicotinamide may help replenish these levels, which then helps repair cellular dysfunction.

Taking niacinamide supplements

Nicotinamide is a well-tolerated supplement. It is easily available from most pharmacies or supermarkets, costing less than 10c per capsule.

You should be aware different formulations of vitamin B3 exist over the counter, such as niacin (which can cause profound flushing upon consumption). It is better to seek out the niacinamide formulation.

The optimum long-term niacinamide dose is not known, but given the ONTRAC study used a regime of 500mg twice daily, this is generally what is recommended.

Its role in children is less clear. It appears to be safe, but the therapeutic benefit offered by niacinamide in paediatric patients is yet to be determined.

Based on the scientific literature to date, it is reasonable to recommend niacinamide for people at high risk of skin cancer.

It is, however, is only one of the pillars of sun safety. Using sunscreen and sun-smart clothing, avoiding sun exposure during the middle of the day and being aware of new or changing spots on the skin all remain crucial.

The Conversation, 21 March 2022

<https://theconversation.com>

As creator of 'CRISPR babies' nears release from prison, where does embryo editing stand?

2022-03-21

Biophysicist He Jiankui, having served a 3-year sentence for creating the world's first genetically engineered babies, may be released from a Chinese prison this week, Science has learned. He's largely secret use of the genome editor CRISPR to alter the DNA of human embryos and implant them into two women led to three births, sparking ethical outrage

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and fears for the babies' health (about which little is known). It did not, however, bring an end to basic research on human embryo editing.

The response to He's November 2018 announcement was "severe and vibrant," says Fyodor Urnov, who studies CRISPR-based genome editing at the University of California, Berkeley. For now, Urnov sees no circumstance that would justify efforts to genetically modify babies. But he strongly supports using CRISPR to fix disease-causing mutations after birth, without causing heritable changes to a human genome, and regrets that "we have poured a jar of tar on gene editing." And Urnov and others believe that, used responsibly and safely, embryo editing could eventually prove a powerful tool against disease in rare circumstances. In laboratory studies, they continue to explore possible avenues—and the many hurdles.

The work has proceeded with little notice. "The pandemic has pushed this topic out of people's primary attention," says Alta Charo, an emeritus bioethicist and lawyer at the University of Wisconsin, Madison, who notes that oversight measures intended to stop rogue experiments like He's have stalled, including a proposed global registry of preclinical heritable genome-editing research.

This type of registry might have noted a study reported last week in which a research team working with surplus human embryos from in vitro fertilization (IVF) clinics showed how CRISPR could rid a newly fertilized egg of an extra copy of a chromosome—a problem that can lead to Down syndrome and other medical conditions. Other groups are exploring how to introduce heritable genetic changes via human sperm or eggs. There are "quite a lot of people pushing boundaries" in that regard, says Robin Lovell-Badge, a developmental geneticist at the Francis Crick Institute—although few if any think the work is ready for the clinic. "We're still waiting for some better tools," says developmental biologist Shoukhrat Mitalipov of Oregon Health & Science University.

The original concerns about designer babies centered on CRISPR's sloppiness. The DNA-cutting enzyme that is one of its two components occasionally slices unintended spots, and even if the cut is on target, the cell's gene repair equipment may scramble adjacent DNA by inserting or deleting bases, potentially creating new harm. Indeed, a study of CRISPR-altered human embryos found 16% had these "unintended editing outcomes" at the targeted DNA, a group led by Kathy Niakan of the Crick reported last year in the Proceedings of the National Academy of Sciences.

When He Jiankui exits prison he'll find scientific and ethical concerns still challenge his controversial vision of genetically engineering babies

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Genetic screening of edited IVF embryos might not catch these errors. Although CRISPR is introduced right after fertilization, at the single-cell stage, its action is not necessarily immediate. "The edit may occur at the two-cell or four-cell stage, so not all the cells are identical," Lovell-Badge says—a phenomenon called mosaicism. Both incorrectly altered and unaltered cells can easily go undetected because an embryo is screened by taking a sample of its cells at the 5-day stage, when it contains about 100 cells. "If you have any mosaicism, then you don't know what you've got in the rest of the embryo," Lovell-Badge says.

Stem cell researcher Dietrich Egli at Columbia University hopes to find a way to start and stop CRISPR at the embryo's single-cell stage, preventing mosaicism. In the meantime, his group has found a specific kind of CRISPR edit for an embryo that vastly reduces the risk of unintended DNA changes.

One of the most common abnormalities found when IVF clinics screen embryos, especially those made with eggs of older people, is the presence of either one or three copies of certain chromosomes rather than the normal two. In a preprint posted on bioRxiv on 10 March, Egli's group demonstrated a strategy for trisomy, an errant third chromosome. The scientists showed they could target an extra paternal or maternal chromosome copy with a CRISPR cut at or near its centromere, the DNA-protein structure that holds the different arms of a chromosome together. The extra chromosome then falls apart during cell division. Unintended on- or off-target edits theoretically wouldn't matter because CRISPR would, in effect, destroy the entire DNA sequence.

Mosaicism might still be a problem if CRISPR does not correct the trisomy in all of the cells in an early embryo, but Egli notes that when such embryos have a mix of cells with normal and abnormal chromosomes, a natural "rescue mechanism" usually seems to eliminate the abnormal cells. "There are still multiple obstacles," he stresses. "We could have given this a different title, 'Correction of Trisomy 16 in Human Embryo,' and we might have created more buzz and news articles, but we didn't think it was appropriate because it conveys that you're going to do this clinically tomorrow, which is absolutely not the case."

Researchers studying CRISPR in human embryos face obstacles beyond the science. In the United States, Congress forbids government funding of research with human embryos, forcing Egli, Mitalipov, and others to rely on foundations, academic institutions, or companies. Legislation also

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prevents the U.S. Food and Drug Administration from even evaluating therapies that edit human embryos.

Editing the DNA of egg or sperm precursor cells may avoid some of these hurdles. It also gets around what Kyle Orwig, a reproductive biologist at the University of Pittsburgh, calls "a numbers problem." Even under the best circumstances, IVF clinics could only create, edit, and test a small number of embryos for a given couple, giving them few chances to get it right.

Editing the cells that give rise to sperm could improve the odds. Researchers have already removed these spermatogonial stem cells from mice and grown millions in culture. This allows for a rigorous quality control of CRISPR edits: Scientists can screen for the stem cells that have the correct edit, with no unintended DNA changes, and clone them en masse, again checking for errors. Then, they can transplant those cells into the testes where they should produce mature sperm, Orwig says. Indeed, rodents with edited sperm stem cells have been used to create offspring with a desired DNA edit.

Turning that basic research into a way to help potential parents won't be easy. "The barrier is that we don't yet know how to maintain human spermatogonial stem cells in culture," Orwig says. His team is exploring a different route to creating edited sperm stem cells: "reprogramming" adult human cells into a stem cell state and trying to coax them partly down the pathway that creates sperm. Other groups are hoping that reprogrammed adult cells could one day produce human eggs, which could then be altered in large numbers.

Discouragingly, in mice, spermatogonial stem cells only survive when placed into newborn animals, which isn't a realistic option for humans. As a first step to exploring whether the scheme could work in people, Orwig's team is now recruiting men who became infertile because of cancer treatment and had testicular tissue or cells frozen before chemotherapy or radiation. The team plans to isolate spermatogonial stem cells from the thawed tissue and then inject them, unedited, into the owner's testis to see whether that produces viable sperm.

The 3 years since He went to prison have seen glimmers of progress in heritable human genome editing, but many scientists say the increased awareness of CRISPR's shortcomings has underscored the recklessness of transplanting edited embryos with the technology available today. An exception is Russian geneticist Denis Rebrikov, one of the few scientists after the He scandal to openly advocate implanting edited embryos

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into people. "We've done a lot of validation experiments, and now we're confident that we can move on to real clinical use," Rebrikov says.

Lovell-Badge speaks for most researchers when he says such confidence is unwarranted. Stick to lab work on embryo editing for now, he advises. "People should do as much preclinical research as they can, and let's find out whether it's feasible."

Science, 21 March 2022

<https://science.org>

What's the best way to parallel park your car? Engineers have the answer

2022-03-24

You're driving slowly along a street, looking for a place to park. You come across a long stretch of parallel parking. But to your frustration, the spaces left by other people's parking efforts are not quite long enough for you to fit. The search continues.

Drawn from our own frustrating experiences with parking, we decided to answer the question once and for all - what's the best way to parallel park your car? Our research has found a simple answer.

You should always park at one end of a parking space, leaving as big a space as possible at the other end. It doesn't matter which end – just remember to leave yourself room to get out. While this might sound obvious, a quick look at the street outside your home will show many drivers think parking in the middle of the space is best – or just don't give it much thought at all.

Optimising how we park our cars in cities matters, because free parking spaces are, by their nature, a limited resource. We've taken to our cars with a vengeance as the world slowly reemerges from lockdowns. Mobility data shows our cities are coming back to life, with our travel behaviours changing in turn.

Even though many of us are still working from home, those of us commuting are reluctant to return to public transport. You'll have already noticed the result based on traffic. The number of cars on the roads of Australian cities has already met or gone past pre-COVID numbers, and so too the parking demand.

How can we all park better?

Even though many of us are still working from home, those of us commuting are reluctant to return to public transport.

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Everyone is familiar with marked spaces, where painted lines show you where to park. These help manage our frustrations with unreliable parking, but they are bad for density because every space needs to be able to accommodate a large car.

In our research, we focused on unmarked parallel parking, such as that found on most residential streets. That's because here we can control exactly where we position our cars.

We tested four strategies drivers can follow in these types of parks:

3. always park as far back as possible
4. park at either end of the space
5. park in the middle of the space
6. randomly park anywhere in the available space.

We simulated what would happen in the common situation where demand exceeds supply, in which there is always a car waiting to park, with a driver who is prepared to wait until someone else leaves.

The worst strategy for maximising car parks? Parking in the middle of the space. You might find this useful if, say, you wanted to discourage people from parking directly outside your house. Parking in the middle of the available space makes it harder to cram more cars in.

We found parking randomly in a space can produce slightly better outcomes. Many drivers use this strategy subconsciously.

But overall, the best strategy for fitting as many cars into scarce street parking is to park at either end of the space. It doesn't matter which end you park at, and it doesn't even matter if you choose the same end as your neighbours. Under this scenario, we could fit the most cars onto any street.

We also analysed what happens when there's only a small distance between driveways or intersections. If you live in a street with shorter kerbs, parking at either end of the spot becomes even more beneficial.

How significant is this technique? In many residential areas, you can almost double the number of cars able to fit on the road by parking at the front or back of the available spaces.

Issues with parking

Parking is a scarce resource that we need to manage carefully to encourage other modes of transport, such as public and active transport. Storing cars on valuable land is also a poor use of real estate.

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If autonomous cars arrive, we might see a future in which cars drive themselves off to remote car parks and free up all of the highly accessible land currently used for street parking.

If we wanted to reduce the demand for parking, we would have to encourage more people to return to public transport through measures such as lowering fares, or increasing the cost of parking or fuel. We could also build extra car parks next to train stations or bus bays.

But given these measures are unlikely to happen in the near future, we need to make the most of the parking we have.

Until then, the management of on-street parking will remain a vexed issue, particularly in our most congested cities. In Sydney, for instance, local residents and commuters vie with visitors for the right to park in a given street.

As the amount of on-street parking is more or less fixed, we should make the most of the space we've got. Next time you come across an unmarked parallel park, try parking at the front or back of the space.

The Conversation, 24 March 2022

<https://theconversation.com>

Do octopuses, squid and crabs have emotions?

2022-03-24

Octopuses can solve complex puzzles and show a preference for different individuals, but whether they, and other animals and invertebrates, have emotions is being hotly debated and could shake up humans' moral decision-making, says a York University expert in animal minds.

Most countries don't recognize invertebrates, such as octopuses, crabs, lobsters and crayfish, as sentient beings that can feel pain, but the United Kingdom is considering amendments to its animal welfare legislation that would recognize this.

"A London School of Economics (LSE) report commissioned by the U.K. government found there is strong enough evidence to conclude that decapod crustaceans and cephalopod molluscs are sentient," says York University Professor and philosopher Kristin Andrews, the York Research Chair in Animal Minds, who is working with the LSE team.

Andrews co-wrote an article published today in the journal Science, "The question of animal emotions," with Professor Frans de Waal, director of the

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Living Links Center at Emory University, which discusses the ethical and policy issues around animals being considered sentient.

Andrews points out it has long been thought in Western culture that other animals don't feel pain or have emotions. "It's been a real struggle even to get fish and mammals recognized under welfare law as sentient. So, it's pretty cutting-edge what seems to be happening in the U.K. with invertebrates."

Pre-verbal human babies were considered not to feel pain up until at least the 1980s. It is still thought by many that animals, including invertebrates, don't feel pain and only have unconscious reactions to negative stimuli. However, research on mammals, fish, octopuses, and to a lesser extent crabs, has shown they avoid pain and dangerous locations, and there are signs of empathy in some animals, such as cows -- they become distressed when they see their calf is in pain.

Recognizing the sentience of invertebrates opens a moral and ethical dilemma. Humans can say what they feel, but animals don't have the same tools for describing their emotions. "However, the research so far strongly suggests their existence," says Andrews, is working on a research project called Animals and Moral Practice.

"When we're going about our normal lives, we try not to do harm to other beings. So, it's really about retraining the way we see the world. How exactly to treat other animals remains an open research question," says Andrews. "We don't have sufficient science right now to know exactly what the proper treatment of certain species should be. To determine that, we need greater co-operation between scientists and ethicists."

There may be a point when humans can no longer assume that crayfish, shrimp, and other invertebrates don't feel pain and other emotions.

"If they can no longer be considered immune to felt pain, invertebrate experiences will need to become part of our species' moral landscape," she says. "But pain is just one morally relevant emotion. Invertebrates such as octopuses may experience other emotions such as curiosity in exploration, affection for individuals, or excitement in anticipation of a future reward."

It may be time to look at our world differently.

Science Daily, 24 March 2022

<https://sciencedaily.com>

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An algorithm makes it possible to identify people by their heartbeat

2022-03-24

A study carried out by the Universidad Carlos III de Madrid (UC3M), together with the Shahid Rajaei Teacher Training University of Iran, concludes that the heartbeat can be used as a biometric tool to identify people.

Biometrics is the science that explores the identification of humans and animals through biological measures or physical characteristics, for example, fingerprints or the iris of the eye. In this regard, biometric-based tools are increasingly used in fields such as security, to supplement or replace password systems; and in the field of civil administration, in the registration and provision of identity documents.

This research proposes an innovative technique for identifying people, based on the exclusive characteristics of their heartbeat. To do this, electrocardiograms (ECG) are used and five musical qualities are analyzed: dynamics, rhythm, timbre, pitch and tonality—commonly used to characterize audio files—applying them to the sound of heartbeats. Thus, a combination of parameters is obtained from these five qualities, which is unique for each person and has an accuracy rate of 96.6%.

“Biometric identification based on cardiac recording has been studied for years, proving to be effective. The main novelty of our work is that we look at the ECG recording, which is a temporary signal, as if it were a sound wave. From there, we analyze this sound wave using the qualities that are commonly used to characterize music,” explains Carmen Cámara, a researcher from UC3M’s Computer Science Department.

The main advantage of this technique is the universality of its identification, since, to this day, certain people still cannot be recognized by certain types of biometrics—in cases of injury, amputation or disabling physical characteristics—but the heartbeat is a bio-signal which is present in all human beings, without exception. Another advantage is its low cost and non-invasive operation: “Nowadays, there are already smart bracelets and watches that perform ECG recordings, so it would be sufficient to install an application on them which uses our identification algorithm,” says researcher Pedro Peris-López, also from UC3M’s Computer Science Department.

This technique is currently under development. Although the future of cardiac identification is promising, researchers say that they must

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“continue this line of research, before considering commercialization.” One of the critical aspects of this study is analyzing the behavior of the system according to the different activities that the person carries out, such as walking, running, resting, doing physical exercise or being in a stressful situation. Furthermore, factors such as the use of pacemakers or the effects of an arrhythmia must be taken into account.

Age is also a factor to consider: “Due to our aging, the signal changes slightly over time. This means that our system must be updated approximately every five years,” the researchers say.

Tech Xplore, 24 March 2022

<https://techxplore.com>

Can insects get fat?

2022-03-25

Insects don’t have time to laze about—that’s probably why we say someone is “as busy as a bee.” But would an overfed and underactive bug find itself putting on weight like we do? We put this question to insect expert Erlend Sild.

The short answer is a hypothetical yes, explains Sild, CEO and founder of BugBox Ltd in Estonia. “They are very much what they eat, and so it depends really on the food they are given.”

Sild notes that different species of insects can have very different levels of body fat. Around 75% of insects go through a larval stage, where the body of the insect can become almost 50% fat. “This serves an important function,” he says. “Insects are fat at a time when they are undergoing an extreme transformation (from larva to pupa to adult), which is an extremely high energy consuming process. The fat is very necessary.”

Sild’s chief interest in insects, however, is their protein content. Demand for protein alternatives is growing, as a rising global population strains existing food supply chains, and surging demand for meat and dairy drives overconsumption and increased pressure on land, water and energy resources.

Sild’s company BugBox has developed an automated mass-rearing system for edible insects, with the aim of making insect protein farming an economically viable proposition. The system is controlled by software, with no human input required during the process.

Around 75% of insects go through a larval stage, where the body of the insect can become almost 50% fat.

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“Our farming technology is developed for Orthoptera, the order of insects that includes crickets, grasshoppers and locusts,” explains Sild. “The most popular species, house crickets, are the most efficient species for human consumption from the perspective of protein.”

These crickets typically have around 10% to 12% body fat, on par with a lean human athlete. And it needn't go to waste. To turn ground-up grasshoppers into protein powder, their protein content must first be separated from the fat. And as it turns out, this fat could be quite valuable.

“We've made studies from our own lab in Uganda about how to manipulate the diet of local grasshoppers,” says Sild. “We found that different feed can affect fatty acid levels, and produce quantities of omega-3 and omega-6. Once fat is separated, you are left with a nice green oil, with no additives and no smell. So there is potential here to develop a nutritional ingredient.”

So insects have the potential to be fattened up, and this fat could be useful for humans. Does this mean we might also find overweight insects in nature? Sild shakes his head. Insects don't overeat for the sake of it, he says: “Fat is always a resource for them.”

PhysOrg, 25 March 2022

<https://phys.org>

Scientists figure out how vampire bats got a taste for blood

2022-03-25

Scientists have figured out why vampire bats are the only mammals that can survive on a diet of just blood.

They compared the genome of common vampire bats to 26 other bat species and identified 13 genes that are missing or no longer work in vampire bats. Over the years, those gene tweaks helped them adapt to a blood diet rich in iron and protein but with minimal fats or carbohydrates, the researchers reported Friday in the journal *Science Advances*.

The bats live in South and Central America and are basically “living Draculas,” said co-author Michael Hiller of Germany's Max Planck Institute. About 3 inches (8 centimeters) long with a wingspan of 7 inches (18 centimeters), the bats bite and then lap up blood from livestock or other animals at night.

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Most mammals couldn't survive on a low-calorie liquid diet of blood. Only three vampire species of the 1,400 kinds of bats can do that—the others eat mostly insects, fruit, nectar, pollen or meat, such as small frogs and fish.

“Blood is a terrible food source,” said Hannah Kim Frank, a bat researcher at Tulane University, who was not involved in the study. “It's totally bizarre and amazing that vampire bats can survive on blood—they are really weird, even among bats.”

Some other creatures also have a taste for blood, including mosquitoes, bedbugs, leeches and fleas.

The latest work expands upon research by another team that pinpointed three of the 13 gene losses.

“The new paper shows how different vampire bats are from even other closely related bats, which eat nectar and fruit,” said Kate Langwig, a bat researcher at Virginia Tech, who had no role in the study.

With such a low-calorie diet, vampire bats can't go long without a meal. In a pinch, well-fed ones will regurgitate their food to share with a starving neighbor. They seem to keep track of who has helped them in the past, said Hiller, noting that vampire bats have complex social relationships.

“It's not a kin thing,” said Tulane's Frank. “They just notice and remember: You're a good sharer, I will reward you.”

PhysOrg, 25 March 2022

<https://phys.org>

“Blood is a terrible food source,” said Hannah Kim Frank, a bat researcher at Tulane University.

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