CHEMWATCH

Bulletin Board

Contents

OCT. 28, 2022

(click on page numbers for links)

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Contents

OCT. 28, 2022

CHEMWATCH
Bulletin Board

Contents

OCT. 28, 2022

ASIA PACIFIC

Public consultations

2022-10-21

FSANZ invites written submissions on the assessment of glucoamylase from a genetically modified strain of Aspergillus niger containing the glucoamylase gene from Penicillium oxalicum, as a processing aid in baking processes, brewing processes and starch processing. Submissions close 6pm (Canberra time) 28 September 2022.

For more information and to have your say, see our website.

Read More

FSANZ, 21.10.22

https://mailchi.mp/01b62a40a1d1/food-standard-news-1300460?e=%5bUNIQID

Procymidone final regulatory decision

2022-10-11

The Australian Pesticides and Veterinary Medicines Authority (APVMA) has published the final regulatory decision (FRD) for the reconsideration of procymidone, a fungicide used for the control of fungal diseases in various broadacre and horticultural crops, and ornamental plants.

The FRD for procymidone has:

1. retained procymidone as a safe and effective fungicide for use by Australian broadacre, horticulture and ornamental plant industries
2. affirmed the active constituent approval
3. varied and affirmed the product registrations and label approvals with:

- the deletion of instructions for use on faba beans and navy beans due to insufficient data to quantify the potential residues in treated crops and the potential risk to trade
- restriction of uses on potatoes, limiting the use to 4 applications per crop and increasing the harvest withholding period from 9 days to 21 days to align with the supporting data held by the APVMA
- the removal of state-based restrictions on use
- additional spray-drift restraints to protect the safety of people, animals and the environment

CHEMWATCH
Bulletin Board
Regulatory Update
OCT. 28, 2022

- other minor label updates to make the instructions contemporary.

The APVMA has determined, under section 81(3) of the Agvet Code, that products bearing the previously approved labels may be supplied for 2 years from the date of the decision. After the 2-year phase-out period ends products must be supplied with a new approved label.

Read More

APVMA, 11.10.22

https://apvma.gov.au/node/105761

Taiwan to Allow Online Application for TCSI Inclusion

2022-09-23

Taiwan's new chemical registration system has been implemented since the end of 2014. There is increased demand from the industry for listing qualified new chemical substances in Taiwan's existing chemical substance inventory (TCSI). As planned, a new function will be incorporated into the Chemical Substances Register 2.0 to enable online application for TCSI inclusion from October 3, 2022.

The TCSI inclusion procedures apply to:

- new chemical substances that finished standard registration with hazard and exposure assessment report submitted
- new polymers of low concern registration (PLCs) that finished small quantity registration

At present, an email or a formal letter specifying the registration details (registration date, registration type, registration No., etc.) and the reason for the inclusion of qualified new chemical substances into TCSI should be delivered to the authority. The authority will verify the case and reply with the official decision on whether to add the substance into TCSI.

The online application will streamline the inclusion procedures. It may take 14 working days for the authority to review the applications.

For a new chemical substance listed in the TCSI, a capital letter "E" will be added to its original registration number (e.g., EPNA0AXXXXXX58 –EPNA 0AXXXXXX58E). There is no need to apply for phase 1 existing chemical registration.

Read More

Chemlinked, 23-09-22

https://chemical.chemlinked.com/news/chemical-news/taiwan-to-allow-online-application-for-tcsi-inclusion

New applications and proposals

2022-10-21

Application A1257– Stingless Bee Honey

This application is seeking a definition, compositional requirements and a prescribed name for honey produced by stingless bees native to Australia.

Application A1227– Arabinofuranosidase enzyme from GM Trichoderma reesei

To permit a new source microorganism, being a genetically modified Trichoderma reesei, for the already permitted enzyme arabinofuranosidase.

Application A1228 – Xylanase enzyme from GM Trichoderma reesei

To permit a new source microorganism, being a genetically modified Trichoderma reesei, for the already permitted enzyme, xylanase.

Application A1229 – Carboxypeptidase from GM Aspergillus oryzae as a processing aid (enzyme)

To permit the use of carboxypeptidase, sourced from GM Aspergillus oryzae, as a processing aid in the manufacture and/or processing of proteins, yeast and flavourings; the manufacture of bakery products; and brewing.

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FSANZ, 21.10.22

https://mailchi.mp/01b62a40a1d1/food-standard-news-1300460?e=%5bUNIQID

CHEMWATCH
Bulletin Board
Regulatory Update
OCT. 28, 2022

New form for reporting suspected non-compliance

2022-10-19

The Australian Pesticides and Veterinary Medicines Authority (APVMA) has launched a new form (link is external) for stakeholders to submit reports of suspected non-compliance and Information Reports.

The form will facilitate access to timely and accurate information to help identify and deter instances of non-compliance, to protect Australia's trade and the health and safety of people, animals and the environment.

All information is useful to the APVMA, and we encourage stakeholders to report relevant information to us via the new form.

More information about reporting non-compliance is available on our website, including alternative methods to report information to the APVMA.

Read More

APVMA, 19.10.22

https://apvma.gov.au/node/106096

AMERICA

Toxic Pollutants a Growing Concern for Pregnant Mothers and Babies

2022-10-06

Deborah Bell-Holt lives near a decades-old drilling site in South L.A., where oil sucked to the surface comes laced with dangerous pollutants like benzene, formaldehyde, methane and toluene. What comes up must go somewhere, and Bell-Holt is sick at the prospect of how much toxic pollution ends up inside the bodies of her family and friends.

"There are moments where I'm so furious," says Bell-Holt, 69, who has fostered six children. All of them, like her, suffer chronic asthma, a problem linked to the proximity of oil drilling. Some children have terrible skin problems. Her husband has been battling leukemia for several years. As if that wasn't enough, Bell-Holt now worries about a new generation. "My oldest child is 26, and she has a child that's 3 years old, and they're both asthmatic, and they both live here."

Pregnant mothers living close to oil drilling sites, for example, are at greater risk of giving birth to an underweight baby, a leading cause of infant mortality. More than 2.1 million Californians live within 2,500 feet of an operational oil well.

Bell-Holt said her granddaughter's asthma has worsened. "She'll tell you, 'My chest hurts. I can't breathe.' And my daughter takes her immediately off to the children's hospital. And then she'll get a breathing treatment, antibiotics and steroids. But the steroids are not good for her to have. She's a baby — what does she need to be on steroids for to breathe?"

A growing body of research links prolonged exposure to dangerous pollutants and toxic chemicals in the air, drinking water and neighborhood environment, as well as everyday cleaning and beauty products, to serious health problems for mothers, young infants and babies in the womb.

Black and Latino communities appear particularly vulnerable. In L.A. County, these communities are found disproportionately in heavily polluted neighborhoods, and they suffer disproportionately higher rates of maternal and infant death.

All sorts of social determinants — such as poverty, quality of housing, access to good health care and obesity rates — can play a role in infant and maternal health outcomes. But experts have determined that institutionalized discrimination is the overarching cause for the high death rate among Black mothers and their infants. Over time, the stress this causes has a corrosive "weathering" effect on the body, predisposing Black women to chronic conditions like hypertension and gestational diabetes that put them at higher risk during pregnancy.

Read More

Capital & Main, 06-10-22

https://capitalandmain.com/toxic-pollutants-a-growing-concern-for-pregnant-mothers-and-babies-2

Bipartisan Senate Bill Would Improve Coordination Between Federal And Local Governments To Protect Communities From PFAS

2022-10-21

On September 13, 2022, Senator Gary Peters (D-MI), Chair of the Homeland Security and Governmental Affairs Committee, introduced

CHEMWATCH
Bulletin Board
Regulatory Update
OCT. 28, 2022

bipartisan legislation to improve coordination between federal and local governments to protect Michiganders from exposure to per- and polyfluoroalkyl substances (PFAS). According to Peters's September 13, 2022, press release, the PFAS Intergovernmental Coordination Act (S. 4829) would create a working group within the Office of Management and Budget (OMB) to improve intergovernmental coordination to address PFAS contamination. The working group would include representatives from federal agencies; state, local, and Tribal governments; and academic research institutions. It would meet quarterly for two years and would be tasked with providing a report to the Senate Homeland Security and Governmental Affairs Committee and the House Committee on Oversight and Reform that outlines their recommendations and methodologies to improve responses to current PFAS contamination efforts and mitigate future contamination efforts.

Read More

JDSupra, 21-10-22

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

Senate Bill Would Prohibit EPA Monitoring Of Livestock Emissions

2022-10-21

On September 14, 2022, Senators John Thune (R-SD), a member of the Senate Committee on Agriculture, Nutrition, and Forestry, and Joni Ernst (R-IA), a member of the Senate Committee on Agriculture, Nutrition, and Forestry and Senate Committee on Environment and Public Works, introduced a bill (S. 4850) that would prohibit EPA from monitoring methane emissions from livestock. Thune's September 14, 2022, press release states that the bill would amend the CAA to prohibit EPA from issuing permits for any carbon dioxide, nitrogen oxide, water vapor, or methane emissions resulting from biological processes associated with livestock production.

Read More

JDSupra, 21-10-22

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

Senate Ratifies Kigali Amendment To Reduce HFCs

2022-10-21

On September 21, 2022, the Senate voted 69 to 27 to ratify the Kigali Amendment to the Montreal Protocol. The Kigali Amendment is an international agreement to reduce gradually the consumption and production of HFCs, GHGs commonly used in refrigeration and air conditioning. It is a legally binding agreement that has been ratified or accepted by 138 countries, now including the United States. The phase-out of HFCs is expected to avoid a half a degree Celsius of global warming between now and 2100.

Read More

JDSupra, 21-10-22

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

EUROPE

Rainwater, breastmilk and blood contaminated by forever chemicals - is it time for an EU ban?

2022-10-20

PFAS or 'forever chemicals' have been discovered globally in rainwater, breast milk, wild animals and countless rivers and water sources.

Concerns around this widespread and dangerous pollution are growing. Chemicals in this extremely persistent group of around 12,000 different substances don't break down naturally and some forms of PFAS can take over 1,000 years to degrade.

Last week a group of around 45 NGOs published a manifesto calling for EU member states and the Commission to completely ban all of these forever chemicals.

"There is clear and unequivocal evidence that demonstrates global contamination of the environment, wildlife and human populations by PFAS," wrote organisations including Client Earth and Greenpeace. They added that these are the most persistent human-made chemicals known to date.

CHEMWATCH
Bulletin Board
Regulatory Update
OCT. 28, 2022

"There are 1,000s of different PFAS. However, it is of great concern that only a handful are currently controlled by regulations at the global level even though many safer alternatives are readily available."

They are asking for PFAS to be banned in consumer products by 2025 and for a complete ban by 2030.

So just how widespread is the forever chemical problem in Europe? Here are just a few examples of PFAS pollution.

Read More

Euronews.green, 20.10.22

https://www.euronews.com/green/2022/10/20/rainwater-breastmilk-and-blood-contaminated-by-forever-chemicals-is-it-time-for-an-eu-ban

Commission acts to better protect people from asbestos and ensure an asbestos-free future

2022-09-28

Asbestos is a highly dangerous, cancer-causing substance that is still present in many of our buildings and is responsible for many avoidable deaths in the EU. Today, the Commission presents a comprehensive approach to better protect people and the environment from asbestos and ensure an asbestos-free future.

The package includes:

- A Communication on working towards an asbestos-free future, tackling asbestos in a comprehensive way, from improving diagnoses and treatment of diseases caused by asbestos, to identification and safe removal and waste treatment of asbestos; and
- A proposal to amend the Asbestos at Work Directive to improve workers' protection by significantly lowering the occupational exposure limit to asbestos.

Although all forms of asbestos are banned in the EU since 2005, asbestos remains present in older buildings. It poses a health threat, particularly when materials containing asbestos are disturbed and fibres are released and inhaled, for instance during renovations.

As much as 78% of occupational cancers recognised in the Member States are related to asbestos. When inhaled, airborne asbestos fibres can lead, for example, to mesothelioma and lung cancer, with an average lag of 30 years between exposure and the first signs of disease.

Read More

European Commission, 28.09.22

https://ec.europa.eu/commission/presscorner/detail/en/ip_22_5679

ZWE explains how FCM safety is fundamental to sustainability

2022-10-17

Civil society organization Zero Waste Europe (ZWE) published a report in October 2022 outlining how the safety of chemicals in food contact materials (FCMs) is an essential component of achieving true sustainability. It introduces the increasing demand from consumers and regulatory bodies to achieve a circular economy for packaging, the latest scientific evidence for the presence of hazardous chemicals is various packaging types, and the challenges currently posed by a lack of regulatory guidance and transparency for chemicals along the packaging supply chain.

The report offers businesses guidance on first steps that can be taken to better address hazardous chemicals including a set of recommended peer-reviewed literature resources as well as complimentary databases. Short sections are also dedicated to offering an overview of popular topics including microplastics, bio-based and biodegradable materials, and recycling. Current and upcoming policy initiatives are also addressed, including a summary of regulatory changes expected in the coming years.

Overall, the report emphasizes that "in order for food packaging to be truly sustainable, it needs to be safe for both human and environmental health." Readers are encouraged to implement reuse systems, which have been scientifically shown to significantly reduce overall impacts compared to single-use packaging. Tools such as the Understanding Packaging (UP) Scorecard are recommended to support decision-makers in developing and justifying new proposals (FPF reported).

Read More

Food Packaging Forum, 17.10.22

https://www.foodpackagingforum.org/news/zwe-explains-how-fcm-safety-is-fundamental-to-sustainability

CHEMWATCH
Bulletin Board
Regulatory Update
OCT. 28, 2022

INTERNATIONAL

JBCE Proposes Harmonization of the Classification of MWCNTs

2022-10-13

According to a September 29, 2022, press release, the Japan Business Council in Europe (JBCE) has proposed a harmonization of the classification of multi-walled carbon nanotubes (MWCNT) "based on the latest knowledge on the effects of carbon nanotubes (CNTs) in organisms." JBCE notes that this classification is consistent with the classification of the International Agency for Research on Cancer (IARC). JBCE states that "the morphologies, physicochemical properties, and effects on the human organism depend on the different methods for carbon nanotube production" and that "from a chemical management perspective, different types of CNTs should be evaluated depending on their characteristics instead of simply grouping them all together under the category 'CNTs.'" JBCE proposes that:

- MWCNTs similar to MWCNT-7 should be classified as suspected human carcinogens (Carc. 2) in the Globally Harmonized System of Classification and Labeling of Chemicals (GHS) classification. According to JBCE, "[t]herefore, straight CNTs, that are neither particularly long nor particularly short, should be considered possibly carcinogenic, as they might have asbestos-like effects in humans even though this has not been scientifically proven yet"; and
- MWCNTs other than MWCNT-7 should be classified as non-carcinogenic in the GHS classification.

Read More

Nano and Other Emerging Chemical Technologies Blog,13.10.22

https://nanotech.lawbc.com/2022/10/jbce-proposes-harmonization-of-the-classification-of-mwcnts/

Beyond BPA – Many bisphenols migrate from food packaging

2022-10-19

In an article published on September 9, 2022, in the journal Environmental Science and Pollution, Nan Zhao and co-authors from Zhejiang University of Technology, Hangzhou, China, analyzed white foam take—out containers made of polystyrene (PS) for the presence of 20 different

bisphenols and estimated exposure for the general population. They acquired 152 new containers, mainly used for fast food packaging, from restaurants located in 21 Chinese and three Canadian cities as well as in Krakow, Poland between 2018 and 2019. Zhao and colleagues performed migration experiments with food simulants (tap water, 10% and 50% ethanol, corn oil) and food (rice) by heating the samples to 100 °C and keeping them for 30 min at room temperature. They also extracted the chemicals from the containers using methanol as a solvent. Using ultra-performance liquid chromatography (UPLC) coupled with mass spectrometry, allowed the scientists to determine the quantity of the 20 target bisphenols.

Zhao et al. detected 11 bisphenols in the 126 samples collected in China, five in the 18 samples collected in Canada, and four in the six samples from Krakow. Overall of the 11 detected bisphenols, bisphenol A (BPA; CAS 80-05-7) was found most frequently, followed by bisphenol S (BPS; CAS 80-09-1) and bisphenol AF (BPAF; CAS 1478-61-1). The concentrations varied between countries; PS containers from China had the highest mean concentrations for BPA and BPS with 2694 and 5525 ng/g, respectively while the corresponding levels in Canadian samples were 81 and 45 ng/g, and in Polish samples 95 and 16 ng/g.

Read More

Food Packaging Forum, 19.10.22

https://www.foodpackagingforum.org/news/beyond-bpa-many-bisphenols-migrate-from-food-packaging

Volumes of chemicals subject to authorisation drop by 45 % in a decade

2022-10-22

Our new report takes a deeper look at the substances of very high concern (SVHCs) for which companies applied for authorisation during 2010-2021.

Our analysis estimates that in 2021 the combined volume of these substances placed on the EU market is 45 % less than it was in 2010. For example, the production and import of five phthalates (BBP, DBP, DIBP, DEHP and diisopentyl phthalates) and trichloroethylene are estimated to have decreased by more than 90 % in roughly a decade.

These findings support earlier conclusions made in the 2021 report: REACH authorisation cuts SVHC uses.

Read More

ECHA, 22.10.22

https://echa.europa.eu/documents/10162/2082415/change_of_tonnage_of_axiv_substances_2010_21_en.pdf/fe2ac921-8d75-34f8-d3ea-53fff665ea69

Only representatives must declare their non-EU manufacturers

2022-10-22

Only representatives must identify the non-EU manufacturers they represent and provide their contact information by 14 October 2022. If you need to reorganise your REACH-IT accounts, our new manual can help you.

Helsinki, 25 April 2022 - If you are an only representative of a non-EU manufacturer you will be asked to identify the non-EU manufacturer you represent, including their contact information in REACH-IT, from 26 April. You must have a separate REACH-IT account for each non-EU manufacturer you represent and have the necessary registrations for each of them.

The contact information you will need to provide includes their:

- name, address, telephone number and email address;
- contact person;
- location of any production or formulation sites;
- company website; and

- national company identification numbers.

You may need to reorganise your REACH-IT accounts to ensure that there are separate accounts for each non-EU manufacturer you represent. Similarly, if you are an only representative but also a manufacturer/importer under REACH, you will need separate REACH-IT accounts for the only representative and for the manufacturer/importer roles.

If you need to rearrange your REACH-IT accounts due to these new requirements, the fee for transferring registrations in REACH-IT accounts can be waived until 14 October 2022.

Read our manual 'Only representatives: How to ensure that your account represents only one non-EU manufacturer' to find out how to reorganise your REACH-IT accounts and get the registration transfer fee waived.

Read More

ECHA, 22.10.22

https://echa.europa.eu/pt/-/only-representatives-must-declare-their-non-eu-manufacturers

CHEMWATCH
Bulletin Board

Janet's Corner

OCT. 28, 2022

Microplastics

2022-10-28

ifunny.co/picture/mads-horwath-wow-the-microplastics

Lead

2022-10-28

Lead is a chemical element in the carbon group with symbol Pb and atomic number 82. Lead is a soft and malleable metal, which is regarded as a heavy metal. Metallic lead has a bluish-white colour after being freshly cut, but it soon tarnishes to a dull greyish colour when exposed to air. Lead has a shiny chrome-silver lustre when it is melted into a liquid. [1] Lead is found in the earth's crust. However, it is rarely found naturally as a metal. It is usually found combined with two or more other elements to form lead compounds. Metallic lead is resistant to corrosion (i.e., not easily attacked by air or water). When exposed to air or water, thin films of lead compounds are formed that protect the metal from further attack. Lead is easily moulded and shaped. Lead can be combined with other metals to form alloys. [2]

USES [2]

Lead and lead alloys are commonly found in pipes, storage batteries, weights, shot and ammunition, cable covers, and sheets used to shield us from radiation. The largest use for lead is in storage batteries in cars and other vehicles. Lead compounds are used as a pigment in paints, dyes, and ceramic glazes and in caulk. The amount of lead used in these products has been reduced in recent years to minimise lead's harmful effect on people and animals. Tetraethyl lead and tetramethyl lead were once used in the United States as gasoline additives to increase octane rating. However, their use was phased out in the United States in the 1980s, and lead was banned for use in gasoline for motor vehicles beginning January 1, 1996. Tetraethyl lead may still be used in gasoline for off-road vehicles and airplanes. It is also still used in a number of developing countries. Lead used in ammunition, which is the largest non-battery end-use, has remained fairly constant in recent years. However, even the use of lead in bullets and shot as well as in fishing sinkers is being reduced because of its harm to the environment.

Lead is a chemical element in the carbon group with symbol Pb and atomic number 82.

SOURCES OF EMISSION & EXPOSURE

Sources of Emission [3]

- Industry sources: Mining and metal manufacturing are the largest sources of lead emissions in Australia. Water supply, sewerage and draining surfaces, oil and gas extraction and electricity supply can also emit lead. Lead is also emitted as a result of coal mining, cement, lime, plaster and concrete product manufacture, ceramic product manufacturing, transport equipment manufacturing, iron and steel manufacturing, petroleum and coal product manufacturing. Other manufacturing industries where lead may be used include: beverages and malt, paper and paper products, glass and glass products, fabricated and structural metal products, motor vehicles and parts, wood products, ceramic products, food and beverage products, textile, yarn and woven fabrics.
- Diffuse sources: Paved roads, windblown dust, burning fuels or wildfires, solid and liquid fuel combustion, lawn mowing and barbeques (from burning fuel) are all capable of causing emissions of lead.
- Natural sources: Lead and compounds occurs naturally in the earth's crust in rocks and soil.
- Transport sources: Lead emissions may be present from the vehicle exhaust of cars, aeroplanes, railway operations and from recreational and commercial shipping or boating.
- Consumer products: Lead and compounds are used in a range of applications. Lead is used in the production of batteries, ammunition, metal products (solder and pipes) and devices to shield X-rays. Lead was present in petroleum, paints and ceramic products, caulking and pipe solder, however due to health concerns, it is now prohibited to include lead in these products.

Sources of Exposure [4]

- Eating food or drinking water that contains lead;
- Water pipes in some older homes may contain lead solder;
- Lead can leach out into the water;
- Spending time in areas where lead-based paints have been used and are deteriorating;
- Deteriorating lead paint can contribute to lead dust;
- Working in a job where lead is used or engaging in certain hobbies in which lead is used, such as making stained glass;
- Using health-care products or folk remedies that contain lead

ROUTES OF EXPOSURE [5]

- Ingestion: Lead exposure in the general population occurs primarily through ingestion.

- Inhalation may be the major contributor for workers in lead-related occupations. Almost all inhaled lead is absorbed into the body, whereas from 20% to 70% of ingested lead is absorbed. Since leaded gasoline additives were phased out beginning in the 1970s, and control measures were implemented in industries, which have reduced air emissions, inhalation is no longer the major exposure pathway for the general population.
- Dermal: Dermal exposure plays a role for exposure to organic lead among workers, but is not considered a significant pathway for the general population. Organic lead may be absorbed directly through the skin. Dermal exposure is most likely among people who work with lead.
- Endogenous Exposure: Endogenous exposure to lead may contribute significantly to an individual's current blood lead level, and of particular risk to the developing foetus. Once absorbed into the body, lead may be stored for long periods in mineralising tissue (i.e., teeth and bones). The stored lead may be released again into the bloodstream, especially in times of calcium stress (e.g., pregnancy, lactation, osteoporosis), or calcium deficiency.

HEALTH EFFECTS [6]

Noncancer Effects

- Studies of humans as well as laboratory animal studies have reported effects on the blood, kidneys, and nervous, immune, and cardiovascular systems.
- Ingestion of large amounts of lead can produce gastrointestinal symptoms, including colic, constipation, abdominal pain, anorexia and vomiting.
- Severe brain and kidney damage can occur in children after exposures resulting in blood lead levels between 70 and 100 µg/dL and in adults at blood lead levels between 100 and 120 µg/dL
- Anaemia has been reported after exposure resulting in blood lead levels of 40 to 70 µg/dL in children and blood lead levels of 50 to 80 µg/dL in adults.
- Other effects from chronic lead exposure in humans include effects on blood pressure and kidney function, immune system effects and interference with vitamin D metabolism.
- Lead also affects the nervous system in occupational-exposed adults. Neurological symptoms have been reported in workers with

CHEMWATCH
Bulletin Board
Hazard Alert
OCT. 28, 2022

blood lead levels of 40 to 60 µg/dL, and slowed nerve conduction in peripheral nerves in adults occurs at blood lead levels of 30 to 40 µg/dL.

- Children are particularly vulnerable to the neurotoxic effects of lead. Exposure to low levels of lead early in life have been linked to effects on IQ, learning, memory, and behaviour.
- Exposure to lead during pregnancy has been associated with toxic effects on the human foetus, including increased risk of preterm delivery, low birthweight, and impaired mental development, including decreased IQ scores. These effects on mental development have been noted at maternal blood lead levels of 10 to 15 µg/dL and somewhat lower.
- Studies on male lead workers have reported severe depression of sperm count and decreased function of the prostate and/or seminal vesicles and suggests an impact on male fertility at blood lead levels of above 40-45 µg/dL.
- Human studies are inconclusive regarding the association between lead exposure and other birth defects, while animal studies have shown a relationship between high lead exposure and birth defects.

Cancer Risk

- Human studies are inconclusive regarding lead exposure and an increased cancer risk. Animal studies have reported kidney tumours in rats and mice exposed to lead via the oral route.
- EPA has considered lead to be a probable human carcinogen, and, under more recent assessment guidelines, it would likely be classified as likely to be carcinogenic to humans.

SAFETY [7]

First Aid Measures

- Eye Contact: Check for and remove any contact lenses. In case of contact, immediately flush eyes with plenty of water for at least 15 minutes. Get medical attention if irritation occurs.
- Skin Contact: Wash with soap and water. Cover the irritated skin with an emollient. Get medical attention if irritation develops.
- Inhalation: If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical attention.
- Ingestion: Do NOT induce vomiting unless directed to do so by medical personnel. Never give anything by mouth to an unconscious person.

If large quantities of this material are swallowed, call a physician immediately. Loosen tight clothing such as a collar, tie, belt or waistband.

Exposure Controls & Personal Protection

Engineering Controls

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

Personal Protective Equipment

The following personal protective equipment is recommended when handling lead:

- Safety glasses;
- Lab coat;
- Dust respirator (be sure to use an approved/certified respirator or equivalent);
- Gloves

Personal Protection in Case of a Large Spill:

- Splash goggles;
- Full suit;
- Dust respirator;
- Boots;
- Gloves;
- A self-contained breathing apparatus should be used to avoid inhalation of the product.
- Suggested protective clothing might not be sufficient; consult a specialist BEFORE handling this product.

REGULATION [3,8]

United States

United States

CHEMWATCH
Bulletin Board
Hazard Alert
OCT. 28, 2022

Exposure Limit	Limit Values	HE Codes	Health Factors and Target Organs
OSHA Permissible Exposure Limit (PEL) – General Industry See 29 CFR 1910.1025 Note: OSHA considers "lead" to mean elemental lead, all inorganic lead compounds, and a class of organic lead compounds called lead soaps. This standard does not apply to other organic lead compounds. Note: Large nonferrous foundries (20+ employees) are required to achieve the PEL of 0.05 mg/m³ by means of engineering and work practice controls. Small nonferrous foundries (<20 employees) are required to achieve an 8-hour TWA of 0.075 mg/m³ by such controls.	0.05 mg/m³ TWA 0.03 mg/m³ Action Level	HE3	Nephrotoxicity
		HE5	Reproductive hazards
		HE7	Cumulative neurologic effects
		HE12	Cumulative blood effects

Exposure Limit	Limit Values	HE Codes	Health Factors and Target Organs
OSHA PEL – Construction Industry See 29 CFR 1926.62	0.05 mg/m³ TWA 0.03 mg/m³ Action Level	HE3	Constipation, nausea, pallor
		HE5	Reproductive risks
		HE7	Nervous irritability, hyperactivity, anxiety, insomnia, headache, weakness, numbness, dizziness
OSHA PEL – Shipyard Employment See29 CFR 1915.1025	0.05 mg/m³ TWA 0.03 mg/m³ Action Level	HE3	Nephropathy, loss of kidney function, increased blood pressure
		HE5	Reduced sperm count and male sterility
		HE7	Subclinical and clinical peripheral neuropathy (muscle weakness, pain, and paralysis of extremities)
		HE12	Disruption of hemesynthesis, anaemia

CHEMWATCH
Bulletin Board
Hazard Alert
OCT. 28, 2022

Exposure Limit	Limit Values	HE Codes	Health Factors and Target Organs
National Institute for Occupational Safety and Health (NIOSH) Recommended Exposure Limit (REL) See Appendix C Note: NIOSH considers "lead" to mean metallic lead, lead oxides, and lead salts (including organic salts such as lead soaps but excluding lead arsenate).	0.05 mg/m³ TWA Air concentrations should be maintained so that worker blood lead remains less than 0.06 mg Pb/100 g of whole blood	HE5	Reproductive toxicity, nephrotoxicity, cardiovascular toxicity, gastrointestinal toxicity
		HE7	Neurotoxicity
		HE12	Hematologic toxicity
American Conference of Governmental Industrial Hygienists (ACGIH) Threshold Limit Value (TLV) (2001)	0.05 mg/m³ TWA A3; BEI	HE3	Cardiovascular toxicity, hypertension, cerebrovascular disease, nephrotoxicity
		HE5	Reproductive toxicity
		HE7	Neurologic and neurobehavioral toxicity
		HE12	Blood dyscrasias

Exposure Limit	Limit Values	HE Codes	Health Factors and Target Organs
CAL/OSHA PELs (See also Section 5198)	0.05 mg/m³ Lead (metallic and inorganic compounds), dust and fume, (as Pb)	HE3	Cardiovascular toxicity, hypertension, cerebrovascular disease, nephrotoxicity
		HE5	Reproductive toxicity
		HE7	Neurologic and neurobehavioral toxicity

Australia

Safe Work Australia: Currently, the eight-hour time weighted average (TWA) exposure limits are 0.15 milligrams tetramethyl lead per cubic metre of air, 0.1 milligram tetraethyl lead per cubic metre of air, 0.15 milligrams lead arsenate per cubic metre of air, 0.15 milligrams of lead (inorganic dusts and fumes) per cubic metre of air and 0.05 milligrams of lead chromate per cubic metre of air. Consult your state or territory occupational health and safety agency for current sources of information.

Australian drinking water guidelines:

In 2004, the National Health and Medical Research Council (NHMRC) and the National Resource Management Ministerial Council (NRMMC) established the following guideline for acceptable water quality: Based on health considerations, the concentration should not exceed 0.01 milligrams of lead per litre of drinking water.

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CHEMWATCH
Bulletin Board

For the first time, researchers find that air pollution is making its way into unborn babies

2022-10-13

The air we breathe is increasingly toxic. The World Health Organization (WHO) estimates that 99 percent of the global population inhales dirty air that exceeds their guideline limits, air that kills about 6.7 million people each year. For perspective, the WHO estimates that there were between 1.8 and 3 million deaths from COVID-19 in the year 2020. Although with the pandemic, official figures are likely an extreme undercount, the fact remains that air pollution is a prevalent, mostly invisible killer.

The problem is only getting worse. In the American Lung Association's 2022 State of the Air report, they found that "nearly 9 million more [American] people were impacted by daily spikes in deadly particle pollution than reported last year." Alarmingly, air pollution's effects are not confined to the breathing, as a growing body of research suggests that air pollution worming its way into the bodies of fetuses and unborn babies vis-a-vis their mothers' lungs.

An alarming study finds that air pollution breathed in by pregnant women is making its way to the fetus

Indeed, even before drawing their first breath, babies are being exposed to air pollution. It was first discovered in 2018 that air pollution particles can make their way into the placenta, an important organ that forms a protective interface in the uterus during pregnancy. But new research in The Lancet's Planetary Health journal shows for the first time that these pollutants can enter the fetus, exposing unborn infants to toxins before they even breathe for the first time.

To determine this, scientists at the University of Aberdeen in the U.K., and Hasselt University in Belgium conducted two studies. In the first, 60 mothers who had just given birth at East-Limburg Hospital in Belgium voluntarily donated their placentas and blood samples, which were analyzed at Hasselt University. Nearly 90 percent of the newborns were white Europeans, so it may not give a picture of what exposure is like in places like, say, New Delhi, India, one of the most polluted regions on Earth.

The researchers analyzed the samples for black carbon, a sooty byproduct of burning fossil fuels and wildfires that long-term exposure has been associated with cardiovascular and respiratory diseases, birth defects and early death. Then, using the volunteers' addresses and public air pollution monitoring data using satellites, they calculated the average level of exposure to toxic air. The level of estimated pollution exposure strongly

correlated with the level of black carbon found in the placenta samples and in cord blood, which accumulates in the umbilical cord.

The second study was conducted in Scotland using liver, lung and brain tissue of fetuses. These samples were blasted with specialized white light lasers for just one quadrillionth of a second, but this was enough to illuminate thousands of tiny black carbon molecules.

Together, these results are pretty damning evidence that air pollutants can spread to a fetus and accumulate in worrying amounts that could lead to severe health problems down the road.

"What we have shown for the first time is that black carbon air pollution nanoparticles not only get into the first and second trimester placenta, but then also find their way into the organs of the developing fetus, including the liver and lungs," Paul Fowler, a professor at the University of Aberdeen and one of the study authors, said in a statement. "What is even more worrying is that these black carbon particles also get into the developing human brain. This means that it is possible for these nanoparticles to directly interact with control systems within human fetal organs and cells."

The researchers are quite sure the fetal samples weren't contaminated by the ambient air in the lab because the black carbon was deeply embedded in the organ tissue. The mothers in both studies were also screened against smoking tobacco, so cigarette use didn't skew the results.

"These findings are especially concerning because this window of exposure is key to organ development," the authors wrote. "It is the life stage during which susceptibility for many diseases later in life is programmed."

However, researchers still need to determine what mechanism of action black carbon and other pollutants actually cause disease. The presence of toxins alone isn't enough evidence, although it is a strong indicator. "Nevertheless," the authors conclude, "the exact impact of direct fetal black carbon exposure requires clarification and must be further elucidated in follow-up studies."

"We know that exposure to air pollution during pregnancy and infancy has been linked with still birth, preterm birth, low weight babies and disturbed brain development, with consequences persisting throughout life," Professor Tim Nawrot, a professor of environmental epidemiology at Hasselt University said in the same release. "We show in this study that the number of black carbon particles that get into the mother are passed

CHEMWATCH
Bulletin Board
Gossip
OCT. 28, 2022

on proportionally to the placenta and into the baby. This means that air quality regulation should recognize this transfer during gestation and act to protect the most susceptible stages of human development."

There are other ways air pollution may damage an infant's health. A study published in August in the journal Gut Microbes examined 103 Latino babies in Southern California and found that air pollution could influence the gut microbiome, the first time this was shown in infants. Some of these changes have "previously been linked with adverse health outcomes such as systemic inflammation, gastroenteritis, multiple sclerosis, and mental health disorders," the authors reported.

"Overall, we saw that ambient air pollution exposure was associated with a more inflammatory gut-microbial profile, which may contribute to a whole host of future adverse health outcomes," senior author Tanya Alderete, assistant professor of Integrative Physiology at University of Colorado, Boulder, said in a statement.

Alderete recommended that mothers avoid walking near high-traffic areas, investing in an air filtration system, opening the windows and breastfeeding as long as possible.

"Breast milk is a fantastic way to develop a healthy microbiome and may help offset some of the adverse effects from environmental exposures," Alderete said.

However, as Salon previously reported, microplastics were recently found in human breast milk for the first time. Breastfeeding is still recommended, of course, but it underscores the ubiquity of pollutants when it comes to reproductive and infant health. It is critical to address this growing issue, as the future health of our children is literally at stake.

Salon, 13 October 2022

https://salon.com

Scientists Reconstruct the Genome of the 180-Million-Year-Old Common Ancestor of All Mammals

2022-10-15

From a platypus to a blue whale, all living mammals today are descended from a common ancestor that existed some 180 million years ago. Although we don't know a lot about this animal, a global team of experts has recently computationally reconstructed the organization of its

University of California, Davis scientists help reveal the genome of the common ancestor of all mammals

genome. The findings were recently published in the journal Proceedings of the National Academy of Sciences.

"Our results have important implications for understanding the evolution of mammals and for conservation efforts," said Harris Lewin, distinguished professor of evolution and ecology at the University of California, Davis, and senior author on the paper.

The researchers used high-quality genome sequences from 32 living species, spanning 23 of the 26 known mammalian orders. Humans and chimpanzees were among these species, as were wombats and rabbits, manatees, domestic cattle, rhinos, bats, and pangolins. The chicken and Chinese alligator genomes were also used as comparison groups in the analysis. Some of these genomes are being produced as part of the Earth BioGenome Project and other large-scale biodiversity genome sequencing initiatives. Lewin is the chair of the Earth BioGenome Project's Working Group.

According to Joana Damas, the first author of the study and a postdoctoral researcher at the UC Davis Genome Center, the mammal ancestor had 19 autosomal chromosomes, which control the inheritance of an organism's characteristics other than those controlled by sex-linked chromosomes (these are paired in most cells, making 38 in total), plus two sex chromosomes. The researchers identified 1,215 blocks of genes that appear on the same chromosome in the same order across all 32 genomes. Damas said that these building blocks of all mammal genomes include genes that are essential for the development of a normal embryo.

Chromosomes stable for over 300 million years

The researchers found nine whole chromosomes or chromosome fragments in the mammal ancestor whose order of genes is the same in modern birds' chromosomes.

"This remarkable finding shows the evolutionary stability of the order and orientation of genes on chromosomes over an extended evolutionary timeframe of more than 320 million years," Lewin said.

In contrast, regions between these conserved blocks contained more repetitive sequences and were more prone to breakages, rearrangements, and sequence duplications, which are major drivers of genome evolution.

"Ancestral genome reconstructions are critical to interpreting where and why selective pressures vary across genomes. This study establishes a clear relationship between chromatin architecture, gene regulation, and linkage

CHEMWATCH
Bulletin Board
Gossip
OCT. 28, 2022

conservation," said Professor William Murphy, Texas A&M University, who was not an author of the paper. "This provides the foundation for assessing the role of natural selection in chromosome evolution across the mammalian tree of life."

The researchers were able to follow the ancestral chromosomes forward in time from the common ancestor. They found that the rate of chromosome rearrangement differed between mammal lineages. For example, in the ruminant lineage (leading to modern cattle, sheep, and deer) there was an acceleration in rearrangement 66 million years ago when an asteroid impact killed off the dinosaurs and led to the rise of mammals.

The results will help to understand the genetics behind adaptations that have allowed mammals to flourish on a changing planet over the last 180 million years, the authors said.

Sci Tech Daily, 15 October 2022
https://scitechdaily.com

Hearing discovery reveals ear architecture that turns vibration into sound

2022-10-13

Scientists have detailed a structure in the inner ear that facilitates hearing, for the first time.

In what's described as a breakthrough decades in the making, scientists at Oregon State Health & Science University (OHSU) have revealed the inner ear architecture that converts vibrations into sound, in near-atomic detail. The discovery for the first time reveals the molecular machinery behind this fundamental sensory function, and opens up exciting new avenues of research into hearing loss.

The ability of the ear to turn vibrations into the sensation of sound is facilitated by an inner structure called the mechanosensory transduction complex. Despite its critical role in human hearing, the composition of this structure and mechanisms that underly its function have remained poorly understood.

"This is the last sensory system in which that fundamental molecular machinery has remained unknown," said senior author of the new study Eric Gouaux. "The molecular machinery that carries out this absolutely amazing process has been unresolved for decades."

The team's work involved the roundworm Caenorhabditis elegans, a popular model for scientists as the creature shares a similar genome and many cellular pathways with humans. The scientists spent five years

studying more than 60 million worms through cryo-electron microscopy, an emerging technique used to create 3D reconstructions of proteins

This enabled the scientists to piece together the protein complex that turns vibrations into the electrical impulses our brain recognizes as sound. The highly detailed portrait of this intricate biological architecture has been a long time coming, according to fellow OHSU hearing scientist Peter Barr-Gillespie, who wasn't directly involved in the research.

"The auditory neuroscience field has been waiting for these results for decades, and now that they are right here – we are ecstatic," he said. "The results from this paper immediately suggest new avenues of research, and so will invigorate the field for years to come."

Because hearing loss can came about through genetic mutations that change the proteins making up the mechanosensory transduction complex, an ability to now visualize the protein complex may present new ways to counter the mutations.

"It immediately suggests mechanisms by which one might be able to compensate for those deficits," said senior author Eric Gouaux. "If a mutation gives rise to a defect in the transduction channel that causes hearing loss, it's possible to design a molecule that fits into that space and rescues the defect. Or it may mean we can strengthen interactions that have been weakened."

The research was published in the journal Nature.

New Atlas, 13 October 2022

https://newatlas.com

"Bioprinting" Plant Cells With 3D Printer To Study Cell Function

2022-10-14

New research reveals a reproducible way of studying cellular communication among varied types of plant cells by "bioprinting" these cells via a 3D printer. Learning more about how plant cells communicate with each other – and with their environment – is key to understanding more about plant cell functions. This could ultimately lead to producing optimal growing environments and better crop varieties.

Published today (October 14) in the journal Science Advances, the study is from North Carolina State University.

The process of 3D bioprinting plant cells is mechanically similar to printing ink or plastics, with a few necessary tweaks.

CHEMWATCH
Bulletin Board
Gossip
OCT. 28, 2022

The scientists bioprinted cells from the model plant Arabidopsis thaliana and from soybeans. They wanted to study whether plant cells would live after being bioprinted – and for how long. Moreover, they also wanted to examine how they acquire and change their identity and function.

"A plant root has a lot of different cell types with specialized functions," said Lisa Van den Broeck, an NC State postdoctoral researcher who is the first author of a paper describing the work. "There are also different sets of genes being expressed; some are cell-specific. We wanted to know what happens after you bioprint live cells and place them into an environment that you design: Are they alive and doing what they should be doing?"

The process of 3D bioprinting plant cells is mechanically similar to printing ink or plastics, with a few necessary tweaks.

"Instead of 3D printing ink or plastic, we use 'bioink,' or living plant cells," Van den Broeck said. "The mechanics are the same in both processes with a few notable differences for plant cells: an ultraviolet filter used to keep the environment sterile and multiple print heads – rather than just one – to print different bioinks simultaneously."

Live plant cells without cell walls, or protoplasts, were bioprinted along with nutrients, growth hormones and a thickening agent called agarose – a seaweed-based compound. Agarose helps provide cells strength and scaffolding, similar to mortar that supports bricks in the wall of a building.

"We found that it is critical to use proper scaffolding," said Ross Sozzani, professor of plant and microbial biology at NC State and a co-corresponding author of the paper. "When you print the bioink, you need it to be liquid, but when it comes out, it needs to be solid. Mimicking the natural environment helps keep cellular signals and cues occurring as they would in soil."

The research showed that more than half of the 3D bioprinted cells were viable and divided over time to form microcalli, or small colonies of cells.

"We expected good viability on the day the cells were bioprinted, but we had never maintained cells past a few hours after bioprinting, so we had no idea what would happen days later," Van den Broeck said. "Similar viability ranges are shown after manually pipetting cells, so the 3D printing process doesn't seem to do anything harmful to cells."

"This is a manually difficult process, and 3D bioprinting controls the pressure of the droplets and the speed at which the droplets are printed," Sozzani said. "Bioprinting provides better opportunity for high throughput

processing and control over the architecture of the cells after bioprinting, such as layers or honeycomb shapes."

The researchers also bioprinted individual cells to test whether they could regenerate, or divide and multiply. The findings showed that Arabidopsis root and shoot cells needed different combinations of nutrients and scaffolding for optimal viability.

Meanwhile, more than 40% of individual soybean embryonic cells remained viable two weeks after bioprinting and also divided over time to form microcalli.

"This shows that 3D bioprinting can be useful to study cellular regeneration in crop plants," Sozzani said.

Finally, the researchers studied the cellular identity of the bioprinted cells. Arabidopsis root cells and embryonic soybean cells are known for high proliferation rates and a lack of fixed identities. In other words, like animal or human stem cells, these cells can become different cell types.

"We found that bioprinted cells can take on the identity of stem cells; they divide and grow and express specific genes," Van den Broeck said. "When you bioprint, you print a whole population of cell types. We were able to examine the genes expressed by individual cells after 3D bioprinting to understand any changes in cell identity."

The researchers plan to continue their work studying cellular communication after 3D bioprinting, including at the single-cell level.

"All told, this study shows the powerful potential of using 3D bioprinting to identify the optimal compounds needed to support plant cell viability and communication in a controlled environment," Sozzani said.

Sci Tech Daily, 14 October 2022

https://scitechdaily.com

Milky Way's Graveyard of Dead Stars Found – First Map of the "Galactic Underworld"

2022-10-16

A graveyard that stretches three times the height of the Milky Way has been revealed in the first map of the 'galactic underworld' – a chart of the corpses of once massive suns that have since collapsed into black holes

A new study creates the first map of our galaxy's ancient dead stars.

CHEMWATCH
Bulletin Board
Gossip
OCT. 28, 2022

and neutron stars. It also shows that almost a third of the objects have been flung out from the galaxy altogether.

"These compact remnants of dead stars show a fundamentally different distribution and structure to the visible galaxy," said David Sweeney, a PhD student at the Sydney Institute for Astronomy at the University of Sydney. He is the lead author of the paper "The Galactic underworld: the spatial distribution of compact remnants" which was published in the latest issue of Monthly Notices of the Royal Astronomical Society.

"The 'height' of the galactic underworld is over three times larger in the Milky Way itself," Sweeney added. "And an amazing 30 percent of objects have been completely ejected from the galaxy."

Black holes and neutron stars are formed when massive stars – more than eight times larger than our Sun – exhaust their fuel and suddenly collapse. This collapse triggers a runaway reaction that blows the outer portions of the star apart in a titanic supernova explosion. At the same time, the core keeps compressing in on itself until – depending on its starting mass – it becomes either a neutron star or a black hole.

In neutron stars, the core is so dense that electrons and protons are forced to combine at the subatomic level into neutrons. This squeezes its total mass into an incredibly dense sphere smaller than a city. If the mass of the original star is greater than 25 times our Sun's, that gravity-driven collapse continues, until the core is so dense that not even light can escape. It has become a black hole. Both types of stellar corpses warp space, time, and matter around them.

Although billions of these exotic carcasses must have been formed since the galaxy was young, they were flung out into the darkness of interstellar space by the supernovas that created them. Therefore, they have slipped beyond the sight and knowledge of astronomers – until now.

By carefully recreating the full lifecycle of the ancient dead stars, the investigators have constructed the first detailed map showing where their corpses lie.

"One of the problems for finding these ancient objects is that, until now, we had no idea where to look," said co-author on the paper Professor Peter Tuthill, of Sydney Institute for Astronomy. "The oldest neutron stars and black holes were created when the galaxy was younger and shaped differently, and then subjected to complex changes spanning billions of years. It has been a major task to model all of this to find them."

Newly-formed neutron stars and black holes conform to today's galaxy, so astronomers know where to look. But the oldest neutron stars and black holes are like ghosts still haunting a house demolished long ago, so they are harder to find.

"It was like trying to find the mythical elephant's graveyard," said Professor Tuthill, referring to a place where, according to legend, old elephants go to die alone, far from their group. "The bones of these rare massive stars had to be out there, but they seemed to shroud themselves in mystery."

Added Sweeney: "The hardest problem I had to solve in hunting down their true distribution was to account for the 'kicks' they receive in the violent moments of their creation. Supernova explosions are asymmetric, and the remnants are ejected at high speed – up to millions of kilometers per hour – and, even worse, this happens in an unknown and random direction for every object."

But nothing in the universe sits still for long, so even knowing the likely magnitudes of the explosive kicks was not enough: the researchers had to delve into the depths of cosmic time and reconstruct how they behaved over billions of years.

"It's a little like in snooker," said Sweeney. "If you know which direction the ball is hit, and how hard, then you can work out where it will end up. But in space, the objects and speeds are just vastly bigger. Plus, the table's not flat, so the stellar remnants go on complex orbits threading through the galaxy.

"Finally, unlike a snooker table, there is no friction – so they never slow down. Almost all the remnants ever formed are still out there, sliding like ghosts through interstellar space."

The intricate models they built – together with University of Sydney Research Fellow Dr. Sanjib Sharma and Dr. Ryosuke Hirai of Monash University – encoded where the stars were born, where they met their fiery end, and their eventual dispersal as the galaxy evolved.

The final outcome is a distribution map of the Milky Way's stellar necropolis.

"It was a bit of a shock," said Dr. Sharma. "I work every day with images of the visible galaxy we know today, and I expected that the galactic underworld would be subtly different, but similar in broad strokes. I was not expecting such a radical change in form."

CHEMWATCH
Bulletin Board
Gossip
OCT. 28, 2022

In the maps generated, the characteristic spiral arms of the Milky Way vanish in the 'galactic underworld' version. These are entirely washed out because of the age of most of the remnants, and the blurring effects of the energetic kicks from the supernovae which created them.

Even more intriguing, the side-on view shows that the galactic underworld is much more 'puffed up' than the Milky Way – a result of kinetic energy injected by supernovae elevating them into a halo around the visible Milky Way.

"Perhaps the most surprising finding from our study is that the kicks are so strong that the Milky Way will lose some of these remnants entirely," said Dr. Hirai. "They are kicked so hard that about 30 percent of the neutron stars are flung out into intergalactic space, never to return."

Added Tuthill: "For me, one of the coolest things we found in this work is that even the local stellar neighborhood around our Sun is likely to have these ghostly visitors passing through. Statistically, our nearest remnant should be only 65 light years away: more or less in our backyard, in galactic terms."

"The most exciting part of this research is still ahead of us," said Sweeney. "Now that we know where to look, we're developing technologies to go hunting for them. I'm betting that the 'galactic underworld' won't stay shrouded in mystery for very much longer."

Sci Tech Daily, 16 October 2022

https://scitechdaily.com

Hair straightening chemicals may increase women's risk of uterine cancer, study finds

2022-10-19

Women who have used hair straightening chemicals, or relaxers, may be at higher risk of developing uterine cancer, according to a new study by researchers at the National Institutes of Health.

The study, released Monday, joins prior research in showing an increased risk of hormone-related cancer in women who have used the chemicals in their hair — a finding that researchers note may be especially concerning for Black women, who are far more likely to report using such products.

"We estimated that 1.64% of women who never used hair straighteners would go on to develop uterine cancer by the age of 70; but for frequent

Women who had ever reported using straightening products in the last year were slightly likelier to develop cancer than those who'd never used them.

users, that risk goes up to 4.05%," said lead author Alexandra White, the head of the NIEHS Environment and Cancer Epidemiology group.

The data comes from the Sister Study, a large research project led by the National Institute of Environmental Health Sciences, which is part of NIH. The project collects medical records and lifestyle surveys from tens of thousands of women ages 35 to 74, all of whom are sisters to women with breast cancer but did not have cancer themselves, in an effort to identify risk factors for breast cancer and other diseases.

Over the course of 11 years, 378 cases of uterine cancer were diagnosed among the study's 33,497 participants. Women who had ever reported using straightening products in the last year were slightly likelier to develop cancer than those who'd never used them. Women who'd used the products more than 4 times in the past year were even more at risk — though researchers caution that uterine cancer is still relatively rare.

The study did not ask participants to report particular brands or chemicals. Other hair products, like hair dyes, highlights and perms, did not have the same link to uterine cancer, researchers said. (Hair dye, along with straighteners, had previously been linked to breast and ovarian cancer by the same research group.)

Thought uterine cancer is rare, Black women develop it at higher rates than women of other races, according to the National Cancer Institute.

And Black women, too, face intense societal pressure about hair. Natural hair, braids and other hairstyles traditionally worn by Black women (and men) have been subject to bans in settings from K-12 schools to the U.S. military. A 2017 study suggested that many people may still have implicit bias against textured hair. In many states, hair discrimination is still legal; earlier this year, the House passed a bill designed to ban it.

"Because Black women use hair straightening or relaxer products more frequently and tend to initiate use at earlier ages than other races and ethnicities, these findings may be even more relevant for them," said Che-Jung Chang, another author on the study.

NPR, 19 October 2022

https://npr.org

CHEMWATCH
Bulletin Board
Gossip
OCT. 28, 2022

Honeybees use a 'mental number line' to keep track of things

2022-10-18

A small team of researchers with members from the University of Toulouse, the University of Lausanne and the University of Padova has found evidence that honeybees have a mental number line in their tiny brains. In their paper published in Proceedings of the National Academy of Sciences, the group describes experiments they conducted with captive honeybees.

Prior research has suggested that in to addition humans, baby chickens possess what scientists call a mental number line. Numbers of things are represented in the brain and are processed in a left-to-right direction. For example, when most people are asked to sort piles of grapes by the number, most do so from left to right, with the smallest pile on the left. In this new effort, the researchers wondered whether honeybees might also use a mental number line to keep track of things. To find out, they conducted a two-stage experiment.

The first stage of the experiment involved teaching a group of honeybees to associate a number (one, three or five) with a sugar water reward using blocks taped to a wall inside of a cardboard box. They ensured that the bees were not associating a reward with shapes by varying size and shape. Once the bees had learned their associations, the researchers conducted the second part of the experiment.

It consisted of setting up two panels inside of the training box with taped blocks. The two panels were set horizontally to allow for reading left to right or vice versa. Next, the bees were introduced into the box while the researchers watched to see which panel they would choose to find their reward.

The researchers found that 72% of the time, the bees trained on the number "one" chose a "three" panel on the right. Seventy-three percent of the time, bees trained on the number "five" chose the "three" panel on the left. They claim this shows that the bees were using a mental number line to keep track of the numbers. They further suggest that the idea of keeping track of numbers using a mental number line is likely prevalent in a wide variety of animals.

Phys Org, 18 October 2022

https://phys.org

Prior research has suggested that in to addition humans, baby chickens possess what scientists call a mental number line.

Are robots made from frogs cells the future of healthcare? This scientist thinks so

2022-10-19

Healthcare has been front of mind for most Australians recently. Yet, according to consultancy firm Deloitte, it could be unrecognisable by 2040, thanks to technology.

This isn't entirely new news.

During the COVID-19 pandemic, telehealth became popular for psychology and other medical consultations, while machines performing surgery or patients seeking prescriptions online have become normal.

But what about tiny robots made from living frog cells?

According to Dr Douglas Blackiston, a senior scientist at Tufts University's Allen Discovery Centre, xenobots could be part of the future of healthcare as they help medical researchers learn more about the human body and disease.

Currently in their third generation, xenobots were created by Dr Blackiston's team. These self-powered robots are half a millimetre in length, made from living frog cells and replicated through artificial intelligence (AI).

"[Xenobot] is a combination of two words," Dr Blackiston says. "Xenopus laevis is the frog species that we work with in the lab that translates roughly to 'strange foot' … and 'bot' from robot,

A xenobot is basically a "micro-biological robot", he tells ABC RN's Future Tense.

"It walks around, it swims, it can sense its environment. All of these are features that we programme and shape through the types of experiments that we do in the lab."

Dr Blackiston says it's difficult to build a tiny self-powered robot of this design from synthetic materials so they created it out of living cells instead.

They're also completely biodegradable. '[Xenobots] live in water, since they're made from frog cells – anywhere that an amphibian lives, you can place these. And also, at the end of their lifespan, there's no garbage left behind."

Described as a 'micro-biological robot', xenobots are part machine and part living organism.

CHEMWATCH
Bulletin Board
Gossip
OCT. 28, 2022

How can xenobots be used?

Xenobots have many medical applications, Dr Blackiston says, but mainly they can help scientists to understand how cells function.

This will help them learn more about various human diseases.

For example, xenobots have helped researchers understand more about defects in human lung cells known as "cilia" – hair-like looking cells that are also present in animal cells, Dr Blackiston explains.

"[We've] learned a lot about how these [cilia cells] organise and how we can get them to move around and polarise. And it's actually given us some insight into a number of airway diseases that humans face currently."

Defects in cilia can result in a range of diseases, including primary ciliary dyskinesia, which affects 1 in every 20,000 people and can lead to infertility, pneumonia and Kartagener syndrome.

Dr Blackiston says applications of xenobot technology are still in their infancy.

"We have a number of [treatments] that we're investigating with [xenobots], from all sorts of things like being able to seek out a damaged spinal cord and release pro-regenerative compounds, to being able to participate in other parts of regeneration in either mammals or in humans in the future," he says.

"That's certainly a ways off …. but that's definitely something that's on our radar and the long term goal of the research programme."

Are xenobots a life form?

Yes and no. Dr Blackiston says that, despite the presence of living cells, xenobots don't meet the "traditional biological characteristics" of a life form, like being able to produce offspring.

Nevertheless, he defines them as "computer-designed life forms".

"These are the first life forms that were not produced by natural selection or evolution. They were evolved by a virtual AI in the simulation, then brought to life in the real world."

But Dr Blackiston says xenobots could potentially evolve in a way that reflects a typical organism, and that there is still a lot to learn about their potential.

"There are a lot of questions about what could [xenobots] be capable of. What type of sensing could they do? What types of behaviours might they have? What sorts of primitive processing might be possible in the system in the future?"

Are there ethical concerns?

Dr Blackiston says there are some potential ethical concerns with xenobots, namely how they increase the presence of AI within health care. He describes this growing interaction as fascinating, frightening and promising.

"We're just now starting to think about how comfortable are we [in] offloading choices that we make as humans to an AI."

"And then from the ethical standpoint, you always get into the questions of safety and ethics of creating something that does not exist in nature.

"We as scientists have a pretty tremendously terrible track record, about releasing things into the environment with unforeseen consequences."

But Dr Blackiston believes xenobot technology is "incredibly benign". He likens it to other self-creating organisms that exist in nature and have been modified by humans, like yeast.

"If you drink alcohol, those yeast [strains] that have been used to produce your alcohol have been selected and bred and are specific strains. If you've eaten bread, and there's been yeast as well in there, there's been certainly vast amounts of selection.

"And every crop that we have, and every domesticated animal has been under the purview of some sort of human alteration for thousands of years."

"Obviously, these can have unforeseen consequences, if the designs are produced in a way that there's genetic manipulation," Dr Blackiston admits.

"[But] I can also say that everything that I built in the lab, the genome is exactly the same as a frog."

ABC News, 19 October 2022

https://abc.net.au

CHEMWATCH
Bulletin Board
Gossip
OCT. 28, 2022

Chinese team syncs clocks over record distance using lasers

2022-10-18

Physicists have devised a way to synchronize the ticking of two clocks through the air with extreme precision, across a record distance of 113 kilometres.

The feat is a step towards redefining the second using optical clocks — timekeepers that are 100 times more precise than the atomic clocks on which coordinated universal time (UTC) is currently based.

Metrologists hope to use optical clocks to redefine the second in 2030. But a hurdle standing in their way is the need to find a reliable way to transmit signals between optical clocks in laboratories on different continents, to compare their outputs. In practice, this will probably mean transmitting the clocks' time through air and space, to satellites. But this is a challenge because the atmosphere interferes with signals.

A team led by Jian-Wei Pan, a physicist at the University of Science and Technology of China in Hefei, succeeded in sending precise pulses of laser light between clocks at stations 113 kilometres apart in China's Xinjiang province1. This is seven times the previous record2 of 16 kilometres.

Scientists hope to use optical clocks to redefine the second.

The result, published in Nature1 on 5 October, is "outstanding", says David Gozzard, an experimental physicist at the University of Western Australia in Perth. Achieving such a high level of synchronization over that distance of air represents "significant progress in being able to do this between a satellite and the ground", he adds.

Synchronizing hyper-precise clocks in hard-to-reach places could also have advantages elsewhere in research, says Tetsuya Ido, director of the Space-Time Standards Laboratory at the Radio Research Institute in Tokyo. For instance, the clocks could be used to test the general theory of relativity, which says that time should pass more slowly in places where gravity is stronger, such as at low altitudes. Comparing the ticking of two optical clocks could even reveal subtle changes in gravitational fields caused by the movement of masses — for example by shifting tectonic plates — he says.

Next-generation clocks

Since 1967, the second has been defined by atomic clocks using caesium-33 atoms: a second is the time it takes to cycle through 9,192,631,770 oscillations of the microwave radiation the atoms absorb

and emit when they switch between certain states. Today, optical clocks use the higher-frequency 'ticking' of elements such as strontium and ytterbium, which allows them to slice time into even finer fractions.

However, official time can't be generated using just one clock. Metrologists must average the output of hundreds of timepieces across the world. For caesium clocks, the time can be transmitted through microwave signals, but microwave radiation is too low-frequency to convey the high-frequency tick of optical clocks.

Sending signals through the air at optical wavelengths is not as easy as sending microwaves, because molecules in the air readily absorb the light, drastically reducing the strength of the signal. Furthermore, turbulence can send a laser beam off target. To compare optical clocks, physicists have so far relied mostly on transmitting signals through fibre-optic cables, or transporting the bulky, complex timepieces themselves, to compare them side by side. But these methods are impractical for creating the kind of global network needed to define the second.

Pan's team succeeded by combining several minor developments, says Gozzard. To create their signal, the researchers used optical frequency combs — devices that produce extremely stable and precise pulses of laser light — and boosted their output using high-powered amplifiers, to minimize the signal lost when the pulses travelled through the air. The team also tuned and optimized receivers so that they could pick up low-powered signals and automatically track the direction of the incoming laser.

The group sent out time intervals using two wavelengths of visible light, and transmitted another through a fibre-optic link. By comparing the tiny differences between signals picked up at the receivers, the researchers showed that, when measured over hours, they could disseminate the ticking with a stability high enough to lose or gain only a second roughly every 80 billion years. The level of accuracy was on a par with that of optical clocks.

Not there yet

Although this transfer method is the most stable humanity has so far, it will need to be improved further to match the stability of the best optical clocks, says Gozzard.

Another limitation is that the experiment was done in a remote region with optimal atmospheric conditions, says Ido. "The humidity is quite low

CHEMWATCH
Bulletin Board
Gossip
OCT. 28, 2022

and air turbulence could be more quiet than in conventional urban areas," he says. Future studies will need to check how well the method works in other locations.

But the experiment seems to be a good proxy for sending such signals into space, says Helen Margolis, a physicist at the National Physical Laboratory in Teddington, UK. The amount of turbulence expected over 113 kilometres on the ground is comparable to that on the way from the ground to a satellite, she says.

Satellite-based transmission will face a further hurdle — the clocks will be orbiting at high speed, which shifts the frequency of their signals, says Gozzard.

Pan says this is one of the challenges his team will take on next. The team previously developed technologies for a quantum-communications satellite, and is now using those to develop ways to transmit between optical clocks in geostationary orbit and on the ground.

Using optical clocks in space, it would also be "possible to provide new probes for fundamental physics, such as hunting for dark matter and detecting gravitational waves", Pan adds.

Nature, 18 October 2022

https://nature.com

Gas stoves can leak chemicals linked to cancer, mounting evidence shows

2022-10-20

Natural gas stoves and ovens can leak harmful chemicals inside homes even when they're not in use.

About 47 million U.S. households use such appliances, according to the federal Energy Information Administration.

A study published Thursday in the journal Environmental Science and Technology found at least 12 hazardous air pollutants emitted from gas stoves in California, including benzene — a chemical known to cause cancer in some people with long-term exposure.

The researchers behind the study — a group from the nonprofit energy research institute PSE Healthy Energy — took gas samples from 159

The results were consistent regardless of a home's gas provider or brand of appliance.

residential stoves in 16 counties throughout California. They found benzene in 99% of the samples.

They also calculated a household's benzene exposure based on the size of the kitchen, the room's ventilation level, how much of the chemical was present and whether the stoves were leaking when they were turned off. The results showed that the leakiest stoves exposed people to indoor concentrations of benzene that were up to seven times the safe exposure level set by the California Environmental Protection Agency.

Over time, such exposure might increase a person's risk of blood disorders or reproductive issues, although scientists are still learning about how benzene affects health.

The chemical has more conclusively been linked to leukemia, multiple myeloma and non-Hodgkin lymphoma. The World Health Organization has said there's no safe level of benzene exposure when it comes to cancer risk.

But benzene isn't the only worrisome chemical that comes from stoves, nor are the emissions limited to California. Decades of research has suggested that gas stoves are a source of indoor air pollution.

"Anywhere natural gas is leaked, hazardous air pollutants are likely being released, as well," a co-author of the new study, Kelsey Bilsback, a senior scientist at PSE Healthy Energy, said on a media call.

Previous research has shown that gas stoves in California homes emit nitrogen oxides, which can irritate the eyes, the nose, the throat or the lungs and can cause some people to feel tired, dizzy or short of breath.

Another co-author of the study, Drew Michanowicz, previously identified 21 hazardous air pollutants from gas stoves and outdoor gas lines at Boston homes. Several of the pollutants were volatile organic compounds: a large group of chemicals, including benzene, that may increase the risk of certain cancers, birth defects or cognitive impairment among people with long-term exposure.

But Michanowicz said some of the lowest concentrations of pollutants in California were still about 10 times higher than the averages from his Boston study. The researchers aren't sure why concentrations vary from one location to the next.

"We think it has something to do with where the gas is being sourced from," said Eric Lebel, another study co-author. "California has two major

CHEMWATCH
Bulletin Board
Gossip
OCT. 28, 2022

pipelines where it imports gas from: one coming from the Rockies and then one coming in from the north from Canada."

Bilsback said benzene can enter a gas supply at different points in the system because of how it is stored or transported. From there, it could be released into the kitchen through a leaky stove.

The presence of benzene in California homes was consistent regardless of their gas providers or brands of appliances, Lebel said. But stoves in the North San Fernando and Santa Clarita valleys had the highest levels, followed by those in greater Los Angeles.

"Benzene emissions from a gas stove, even while it's off, can produce in some cases concentrations of benzene in your house that are equivalent to living with a smoker," Lebel said.

The American Gas Association, however, said in a statement that the new study relied on questionable assumptions about air flow that were inconsistent with typical U.S. homes.

"It is difficult to draw any conclusions from measurements from 159 homes in one state when there are more than 77 million residential, commercial and industrial natural gas customers in all fifty states," the association said.

Andrea De Vizcaya Ruiz, an associate professor of environmental and occupational health at the University of California, Irvine, who wasn't involved in the study, said that people can get exposed to small amounts of benzene when they fill up their cars' gas tanks or sit by a fireplace but that exposure to high amounts over long periods of time is worrisome.

"It's one of the most direct chemicals that induces cancer, because it transforms the cells in the bone marrow," she said.

Pregnant women, infants and young children may be particularly susceptible to adverse health outcomes from long-term benzene exposure, De Vizcaya Ruiz said.

But Lebel said it can be hard to tell whether your home has a leak. Gas companies add compounds to gas that give off a rotten egg smell so major leaks don't go undetected, but the scent usually isn't noticeable unless gas is leaking at high concentrations. In that case, De Vizcaya Ruiz said, people may also start to vomit, feel drowsy or confused or develop headaches.

"If you ever smell gas, you should immediately leave your house, call the gas company," Lebel said.

De Vizcaya Ruiz said opening windows can better ventilate rooms in the short term, which helps mitigate potential exposure, but it won't eliminate the risk or the root cause. People in California may want to consider calling their gas companies as a precaution to make sure there's no leak, she added.

One of the simplest fixes, Lebel said, is to replace a gas stove with an electric one.

"Just having a gas appliance in your house can be a potential health risk," he said. "Eliminating gas altogether is the only sure way to completely eliminate that risk."

NBC News, 20 October 2022

https://nbcnews.com

New research details the microbial origins of Type 1 diabetes

2022-10-13

Almost a decade ago, UO graduate student Jennifer Hampton Hill made a fortuitous find: A protein made by gut bacteria that triggered insulin-producing cells to replicate. The protein was an important clue to the biological basis for Type 1 diabetes, an auto-immune disease in which the pancreas can't make insulin.

Hill has continued researching this protein, called BefA, as a postdoc at the University of Utah. And Karen Guillemin's lab at UO has kept studying BefA, too. Alongside other colleagues, they've now uncovered new insights into what BefA does and why bacteria make it.

Those discoveries have "important, profound implications," said Guillemin. "If we understand how BefA works, it could give us a way to stimulate beta cell production therapeutically." That could someday lead to treatments for Type 1 diabetes, which affects millions of people worldwide.

The researchers reported their findings in a paper published October 13 in Cell Metabolism.

The body needs insulin to regulate blood sugar, but insulin is only made by a select type of cells in the pancreas called beta cells. And there's a narrow window of time during early childhood development when beta cells replicate and expand their population. In people with Type 1 diabetes, the immune system attacks beta cells and depletes their population, limiting insulin production.

Microbiome stimulation of immune development helps properly educate the immune system and prevent autoimmunity. Guillemin's team's work suggests an additional role for the microbiome: It stimulates growth of the beta cell population early in development, buffering against later depletion by autoimmune attack.

Beta cell population growth "is happening at the same time that microbial communities are diversifying in the gut," said Hill. "A hallmark of diabetes is kids who develop it tend to have a less diverse gut microbiome. It's possible they're missing some of the bacteria that make BefA."

In their most recent paper, Hill, Guillemin, and their colleagues take a deeper look at BefA. They captured detailed images of BefA's structure, to identify the parts of it that interact with cell membranes. Then, through a

"A hallmark of diabetes is kids who develop it tend to have a less diverse gut microbiome."

series of experiments in zebrafish, mice and cultured cells, the researchers sketched a picture of BefA's function.

BefA can disrupt the membranes of many kinds of cells, both bacterial and animal, they showed. It makes sense that gut bacteria would attack competing bacteria. But unexpectedly, they also found that BefA's attacks on the membranes of insulin-producing cells triggered those cells to reproduce.

The finding suggests that bacterial warfare in the gut can have collateral beneficial effects on the body, boosting the population of cells that can make insulin throughout the lifespan.

The team also tested a mutated version of BefA that was modified so that it couldn't mess with cell membranes. That version of the protein didn't impact beta cell production, further suggesting that membrane damage is driving BefA's effects.

"There are other examples in developmental biology where poking holes in membranes is critical in stimulating development," Hill said, but the researchers don't yet know exactly how the damage is triggering cell replication here.

And they don't know why BefA, which can actually alter the membranes of many kinds of cells, targets beta cells so specifically.

"We think that there's something special about beta cells that they may be highly sensitized to respond to cues that cause membrane permeabilization," Hill said. "They're the only cell type in the whole body that can secrete insulin—they're highly important."

Hill was awarded the NOSTER & Science Microbiome Prize this year for her work on BefA. The annual award is given to an early career scientist who has contributed new understanding to microbiome research that could influence human health.

"The microbiome plays a role in educating the immune system. If you don't have that education, the immune system can be hyper-reactive," Guillemin said. "We think there's also this other layer here—if you don't develop a pool of beta cells against future disruption, you're more at risk for Type 1 diabetes." And a healthy, diverse microbiome plays a key role in building that cell population.

In the future, Guillemin's team imagines possible therapeutic applications for the finding. For example, proactively fortifying the microbiomes of

CHEMWATCH
Bulletin Board
Curiosities
OCT. 28, 2022

high-risk infants with BefA-producing bacteria could prevent them from later developing Type 1 diabetes.

Medical Xpress, 13 October 2022

https://medicalxpress.com

Even Low Doses of Alcohol Cause Changes in Brain Circuitry

2022-10-15

How many drinks is too much?

According to a recent rodent study, even tiny amounts of alcohol may cause epigenomic and transcriptomic changes in brain circuitry in a region that is essential for the development of addiction.

The pathways that are involved in setting the brain up for addiction, according to researchers at the University of Illinois at Chicago, are also linked to the highs that come with drinking, such as euphoria and anxiolysis, a state of relaxed but awake sedation.

"This suggests that when the brain experiences the anti-anxiety effects of alcohol and the mood lift — the relaxation and the buzz — it is also being primed for alcohol use disorder," said the study's senior author Subhash Pandey, the Joseph A. Flaherty endowed professor of psychiatry and director of the Center for Alcohol Research in Epigenetics in the UIC College of Medicine.

The study found that even low doses of alcohol prepared the brain for addiction.

Pandey states that while the research does not, for instance, imply that one drink results in addiction in individuals, it does provide some insights into why certain people are more susceptible to alcohol use disorder.

"We're seeing that dependent behaviors may not always be from long-term, high-quantity habits but a result of rapid epigenetic changes in the brain, which we show in this study may start happening even at low doses," said Pandey, who is also a senior research career scientist at the Jesse Brown Veterans Affairs Medical Center.

A paper published in the journal Molecular Psychiatry details Pandey's experiments, which studied rats under control and alcohol exposure conditions.

In the experiments, rodents were exposed to low concentrations of alcohol, and researchers watched as they navigated a maze. After that,

the researchers used RNA sequencing to examine brain tissue samples they had obtained after euthanasia and searched for patterns in gene expression.

When the samples were analyzed, the researchers discovered that a gene known as hypoxia inducible factor 3 alpha subunit, or Hif3a for short, was connected to behaviors such as how long rats remained in parts of the maze with enclosed (high anxiety) or open arms (low anxiety).

Alcohol increased Hif3a expression, even after low doses of exposure, and reduced anxiety. And, while many effects of alcohol are different among males and females, there was no difference between the two in this study.

"We saw that low doses, what we consider 'social drinking,' changes the gene expression in the amygdala, a brain region that regulates anxiety. In other words, it creates an epigenetic pathway for addiction," Pandey said.

Pandey and his colleagues also set up additional experiments in which they blocked the gene in the amygdala of rats with or without alcohol exposure to validate its role in mediating anxiety. When Hif3a was blocked, anxiety was increased in control rats, mimicking withdrawal from chronic alcohol exposure. On the other hand, this also prevented the anti-anxiety effects of alcohol.

The researchers showed why, too. Hif3a's chromatin — bundles of DNA and RNA — are loosely bundled, meaning the genes are easily accessible for transcription changes.

One thing the study does not suggest, however, is what level of alcohol exposure was safe for rodents. Instead, Pandey said, it's important to know that low doses created priming for addiction. For people, he thinks the takeaway is simple — don't assume social drinking or even "pandemic drinking" is without risk.

"Alcohol use disorder is complex and challenging to overcome. The information we learned from this study helps us to understand better what is happening in the brain and, one day, may be leveraged to develop better treatments and pharmaceuticals," Pandey said.

Sci Tech Daily, 15 October 2022

https://scitechdaily.com

CHEMWATCH
Bulletin Board
Curiosities
OCT. 28, 2022

Ketamine May Be Safe for Medical Use

2022-10-13

Ketamine is a common anesthetic in medicine which is also increasingly prescribed to treat depressive symptoms. This very fast-acting psychotropic drug is particularly suitable for the treatment of individuals who have become resistant to standard antidepressants.

However, there has been disagreement about its prescription since some people believe there is a significant danger of addiction. A team from the University of Geneva (UNIGE) has investigated this by administering the drug to mice. Like other drugs, it causes an increase in dopamine in their brains, but it also inhibits a specific receptor that precludes the progression to addiction. The findings were recently published in the prestigious journal Nature.

Ketamine, discovered by American scientist Calvin Lee Stevens in 1962, is a synthetic drug produced from phencyclidine with strong anaesthetic effects. It is widely utilized in both human and animal medicine, most notably for pain relief and brief sedation. It is also illegally used for recreational reasons, with the dissociative effect causing a distorted perception of reality.

Ketamine has also been used to treat depressive symptoms in individuals who have failed to respond to conventional treatments for the past ten years or so. Its impact is very rapid: its effect is noticed a few hours after the first dosage, while traditional antidepressants take several weeks to act. Despite the fact that it is increasingly being prescribed for this type of treatment, this drug is still hotly contested within the scientific community.

"Some people believe that ketamine presents a strong addictive risk if taken for a long time, while others do not. The whole point of our research was to try to provide some answers," explains Christian Lüscher, a Full Professor in the Department of Basic Neurosciences at the UNIGE Faculty of Medicine and a specialist in the mechanisms underlying addiction.

Addiction vs. Dependence

Addiction is defined as the compulsive use of a substance despite its negative consequences (behavioral disorder). Dependence, on the other hand, is characterized by the appearance of one or more withdrawal symptoms on abrupt cessation of use (physiological disorder). Dependence – the physical manifestations of which vary greatly

Scientists have demonstrated that ketamine causes just a brief increase in dopamine and has no effect on neuronal communication.

depending on the drug – affects everyone. Addiction, on the other hand, affects only a minority of people and is not caused by all drugs.

In the case of cocaine, for example, only 20% of users become addicted, even after prolonged exposure. For opiates, the rate is 30%. In its recent work, Christian Lüscher's team sought to assess the risk of addiction to ketamine.

Short stimulation of the reward system

The UNIGE researchers used a device that allowed mice to self-administer doses of ketamine. "The drugs intensely stimulate the reward system in the brain, which leads to an increase in dopamine levels. The first step was to observe whether this mechanism was also at work when taking ketamine," explains Yue Li, a Postdoctoral Scholar in the Department of Basic Neuroscience at the UNIGE Faculty of Medicine.

The scientists found that the level of dopamine – also known as the "pleasure molecule" – increased with each dose and induced a positive reinforcement in the mice, which motivated them to repeat the self-administration. "However, unlike cocaine, for example, we found that the dopamine level fell very quickly after taking the drug," says Yue Li.

A drug that does not leave its "mark"

The research team wanted to understand this phenomenon. They discovered that ketamine triggered an increase in dopamine by inhibiting a molecule called the NMDA receptor in the reward center of the rodent brain. Dopamine then binds to another receptor (called the D2 receptor), which acts as a rapid brake on the increase in dopamine. The researchers also confirmed that the action of the NMDA receptor is necessary to modify the communication between the nerve cells that underlie the behavioral change leading to addiction. Ketamine's inhibition of the NMDA receptor makes this modification impossible.

"The consequence of this dual action of ketamine is that it does not induce the synaptic plasticity that addictive drugs do and that persists in the brain after the substance has worn off. It is this memorization of the product in the reward system – absent in the case of ketamine – that drives the repetition of consumption, explains Christian Lüscher. Therefore, the addictive risk of ketamine appears to be zero in rodents. Is this also the case in humans? Could this risk vary according to the individual? Our study

CHEMWATCH
Bulletin Board
Curiosities
OCT. 28, 2022

provides a solid framework for debating access to its therapeutic use," concludes Christian Lüscher.

Sci Tech Daily, 13 October 2022

https://scitechdaily.com

Tiny Sea Creature Reveals Secrets of Immune Evolution

2022-10-14

According to a recent study done by experts at the University of Pittsburgh School of Medicine, the way a tiny marine invertebrate differentiates its own cells from competitors has striking similarities to the human immune system.

The research, which was recently published in the journal Proceedings of the National Academy of Sciences, suggests that the building blocks of our immune system evolved much earlier than previously believed. This new information may help us better understand transplant rejection and, potentially help develop new immunotherapies.

"For decades, researchers have wondered whether self-recognition in a marine creature called Hydractinia symbiolongicarpus was akin to the processes that control whether a piece of skin can be successfully grafted from one person to another," said senior author Matthew Nictora, Ph.D., assistant professor of surgery and immunology at the Thomas E. Starzl Transplantation Institute.

"Our study shows for the first time that a special group of proteins called the immunoglobulin superfamily— which are important for adaptive immunity in mammals and other vertebrates — are found in such a distantly- related animal."

Sea anemones, corals, and jellyfish are all members of the same group as Hydractinia symbiolongicarpus. The animals, which have tube-like bodies and tentacles for catching prey, resemble miniature versions of wacky inflatable tube men dancing outside a car dealership. They grow in colonies and cover hermit crab shells like moss on a rock.

"As colonies grow and compete for space on crab shells, they often bump into each other," explained Nicotra, who is also associate director of the Center for Evolutionary Biology and Medicine in Pitt's School of Medicine. "If two colonies recognize each other as self, they fuse together. But if they identify each other as non-self, the colonies fight by releasing harpoon-like structures from special cells."

This new information may help us better understand transplant rejection and, potentially help develop new immunotherapies.

Nicotra and his colleagues had previously identified two genes, Alr1 and Alr2, that were involved in Hydractinia's fuse-or-fight system, but they hypothesized that there was more to the story.

"If you imagine that the genome of the animal is spread out in front of us, we had a flashlight on these two little points, but we didn't know what else was there," said Nicotra. "Now we've been able to sequence the whole genome and illuminate the whole region around these genes. It turns out that Alr1 and Alr2 are part of a huge family of genes."

In the new study, the researchers identified and sequenced 41 Alr genes, which form a complex that likely controls self- versus non-self-recognition in Hydractinia.

Next, the team wanted to see how the proteins that Alr genes encode compared to those found in vertebrates. Until recently, it was nearly impossible to accurately predict the 3D structure of proteins based on a gene's sequence, but in 2021, the release of a tool called AlphaFold changed that.

Using this tool, the researchers compared the structure of Alr proteins to immunoglobulin superfamily (IgSF) proteins, an important group that includes antibodies and receptors on B and T cells of the immune system. IgSF proteins have three characteristic regions, or domains, including the V-set domain.

"The 'V' stands for variable," said Nicotra. "When a B or T cell becomes specialized to fight a particular pathogen, V-set domains are rearranged to make a variable sequence, which the immune system uses to recognize specific pathogens or cells."

Nicotra was surprised to find that the domains in Alr proteins had 3D structures remarkably similar to V-set domains, even though they lacked telltale features usually found in IgSF proteins.

"Unmistakably, these are V-set domains," he explained. "They're just very, very strange."

Until now, it was thought that V-set domains had arisen in the branch of the animal kingdom known as Bilateria. This group originated about 540 million years ago and includes most familiar animals, including mammals, insects, fish, mollusks and all others with right and left sides.

The finding of V-set domains in Hydractinia — which is part of a group that appeared earlier in the evolution of animals — suggests that V-set

CHEMWATCH
Bulletin Board
Curiosities
OCT. 28, 2022

domains arose further back in the evolutionary tree than previously thought.

Several Alr proteins also had signatures associated with immune signaling in other animals, another clue that this protein complex is involved in self-recognition.

"We know lots about the immune systems of mammals and other vertebrates, but we've only scratched the surface of immunity in invertebrates," said Nicotra. "We think that a better understanding of immune signaling in organisms like Hydractinia could ultimately point to alternative ways to manipulate those signaling pathways in patients with transplanted organs."

Sci Tech Daily, 14 October 2022

https://scitechdaily.com

Harvard Medical Researchers Discover Surprising Protective Properties of Pain

2022-10-16

What if pain is more than just a mere alarm bell?

Pain is one of evolution's most effective mechanisms for detecting injury and letting us know that something is wrong. It acts as a warning system, telling us to stop and pay attention to our body.

But what if pain is more than just a mere alarm signal? What if pain is in itself a form of protection?

A new study led by researchers at Harvard Medical School suggests that may well be the case in mice.

The surprising research reveals that pain neurons in the mouse gut regulate the presence of protective mucus under normal conditions and stimulate intestinal cells to release more mucus during states of inflammation. The study was published on October 14 in the journal Cell.

The work describes the steps of a complex signaling cascade, demonstrating that pain neurons engage in direct crosstalk with mucus-containing gut cells, known as goblet cells.

Goblet cells arise from pluripotent stem cells and get their name from their cup-like appearance that resembles a goblet. Their main function is to secrete mucin and create a protective mucus layer. Goblet cells are also believed to have a role in the regulation of the immune system.

"It turns out that pain may protect us in more direct ways than its classic job to detect potential harm and dispatch signals to the brain. Our work shows how pain-mediating nerves in the gut talk to nearby epithelial cells that line the intestines," said study senior investigator Isaac Chiu. "This means that the nervous system has a major role in the gut beyond just giving us an unpleasant sensation and that it's a key player in gut barrier maintenance and a protective mechanism during inflammation." Chiu is an associate professor of immunobiology in the Blavatnik Institute at HMS.

A direct conversation

Our intestines and airways are studded with goblet cells. Named for their cup-like appearance, goblet cells contain gel-like mucus made of proteins and sugars that acts as protective coating that shields the surface of organs from abrasion and damage. The new research found that intestinal goblet cells release protective mucus when triggered by direct interaction with pain-sensing neurons in the gut.

In a set of experiments, the researchers observed that mice lacking pain neurons produced less protective mucus and experienced changes in their intestinal microbial composition — an imbalance in beneficial and harmful microbes known as dysbiosis.

To clarify just how this protective crosstalk occurs, the scientists analyzed the behavior of goblet cells in the presence and in the absence of pain neurons.

They found that the surfaces of goblet cells contain a type of receptor, called RAMP1, that ensures the cells can respond to adjacent pain neurons, which are activated by dietary and microbial signals, as well as mechanical pressure, chemical irritation or drastic changes in temperature.

The experiments further showed that these receptors connect with a chemical called CGRP, released by nearby pain neurons, when the neurons are stimulated. These RAMP1 receptors, the researchers found, are also present in both human and mouse goblet cells, thus rendering them responsive to pain signals.

Experiments further showed that the presence of certain gut microbes activated the release of CGRP to maintain gut homeostasis.

"This finding tells us that these nerves are triggered not only by acute inflammation, but also at baseline," Chiu said. "Just having regular gut microbes around appears to tickle the nerves and causes the goblet cells to release mucus."

CHEMWATCH
Bulletin Board
Curiosities
OCT. 28, 2022

This feedback loop, Chiu said, ensures that microbes signal to neurons, neurons regulate the mucus, and the mucus keeps gut microbes healthy.

In addition to microbial presence, dietary factors also played a role in activating pain receptors, the study showed. When researchers gave mice capsaicin, the main ingredient in chili peppers known for its ability to trigger intense, acute pain, the mice's pain neurons got swiftly activated, causing goblet cells to release abundant amounts of protective mucus.

By contrast, mice lacking either pain neurons or goblet cell receptors for CGRP were more susceptible to colitis, a form of gut inflammation. The finding could explain why people with gut dysbiosis may be more prone to colitis.

When researchers gave pain-signaling CGRP to animals lacking pain neurons, the mice experienced rapid improvement in mucus production. The treatment protected mice against colitis even in the absence of pain neurons.

The finding demonstrates that CGRP is a key instigator of the signaling cascade that leads to the secretion of protective mucus.

"Pain is a common symptom of chronic inflammatory conditions of the gut, such as colitis, but our study shows that acute pain plays a direct protective role as well," said study first author Daping Yang, a postdoctoral researcher in the Chiu Lab.

A possible downside to suppressing pain

The team's experiments showed that mice lacking pain receptors also had worse damage from colitis when it occurred.

Given that pain medications are often used to treat patients with colitis, it may be important to consider the possible detrimental consequences of blocking pain, the researchers said.

"In people with inflammation of the gut, one of the major symptoms is pain, so you might think that we'd want to treat and block the pain to alleviate suffering," Chiu said. "But some part of this pain signal could be directly protective as a neural reflex, which raises important questions about how to carefully manage pain in a way that does not lead to other harms."

Additionally, a class of common migraine medications that suppress the secretion of CGRP may damage gut barrier tissues by interfering with this protective pain signaling, the researchers said.

"Given that CGRP is a mediator of goblet cell function and mucus production, if we are chronically blocking this protective mechanism in people with migraine and if they are taking these medications long-term, what happens?" Chiu said. "Are the drugs going to interfere with the mucosal lining and people's microbiomes?"

Goblet cells have multiple other functions in the gut. They provide a passage for antigens — proteins found on viruses and bacteria that initiate a protective immune response by the body — and they produce antimicrobial chemicals that protect the gut from pathogens.

"One question that arises from our current work is whether pain fibers also regulate these other functions of goblet cells," Yang said.

Another line of inquiry, Yang added, would be to explore disruptions in the CGRP signaling pathway and determine whether malfunctions are at play in patients with genetic predisposition to inflammatory bowel disease.

Sci Tech Daily, 16 October 2022

https://scitechdaily.com

Sunburn: How exactly does melanin shield you from UV – and what does it have to do with solar panels?

2022-10-20

Melanin pigments in our skin protect us from UV light, and people with higher levels have more protection from the sun's harmful rays.

But how exactly does melanin work?

Scientists have known for a while that melanin absorbs UV light and converts it into heat, but the precise mechanism by which melanin does this has – until now – been unclear.

A team of New Zealand (Aotearoa) researchers have combined a trio of techniques to figure it out.

Publishing their findings in PNAS, they've demonstrated that a type of melanin called 'eumelanin' goes through a two-step reaction to intercept the UV and prevent damage to our skin.

The whole thing happens in less than a trillionth of a second.

Researchers figure out the mechanism that turns dangerous light into harmless heat.

CHEMWATCH
Bulletin Board
Curiosities
OCT. 28, 2022

Senior author Professor Justin Hodgkiss, a researcher at Te Herenga Waka – Victoria University of Wellington, New Zealand, says there are two reasons that the mechanism hasn't already been found.

"One, because that key process happens really fast. And secondly, because the material itself is so heterogeneous and so disordered, and ill-defined, it's really hard to understand exactly what you're looking at."

The researchers countered this by using three different types of ultrafast optical spectroscopy.

Spectroscopy is a way of analysing molecules by how they absorb and emit light. It's a key process for researchers to know how molecules are shaped, and how they react.

Different spectroscopic techniques yield different information about molecules.

These researchers used transient absorption spectroscopy, fluorescence spectroscopy (a technique developed in their lab in the early 2010s), and stimulated Raman spectroscopy, to find out how the eumelanin was behaving.

When levelling these three techniques (all of which can provide resolution at the level of a few femtoseconds, or 0.000000000000001 seconds) at eumelanin from squid ink, alongside eumelanin made in the lab, the researchers were able to show how melanin absorbs UV light.

"Eumelanin's job in nature, at least in our skin, is to convert light energy very rapidly to heat which is the safest way to dissipate it before radicals can be generated," says Hodgkiss.

It turns out that the eumelanin shares the energy from UV light with neighbouring molecules called chromophores, and then undergoes a reaction called a partial proton transfer with water molecules. This stops the UV from prompting free radical molecules to form, which can be carcinogenic.

Having shown it works for melanin, the researchers are trying the technique out on other molecules.

"It's a pretty powerful combination for lots of things," says Hodgkiss.

It's likely to be particularly useful for making better solar panels.

"Most of our work is looking at light-to-current processes in next generation photovoltaic materials," says Hodgkiss.

"There, we're looking at converting light energy to current and mechanism – why it happens efficiently in some materials and not so in others."

Solar panels operate in the same realm as melanin – but, ideally, doing exactly the opposite thing.

The materials in photovoltaics are supposed to use UV to make radicals and charged molecules.

"You're looking for light and converting into charges," says Hodgkiss.

The researchers are also interested in examining another type of melanin called 'pheomelanin,' linked with pinkish colouring and red hair, which doesn't have the same UV protective properties and may even cause more damage in UV light.

"The other thing that this has inspired us to do is to think about whether we can learn from nature to design either components of sunscreens that work with a similar mechanism, or even additives in paints or coatings for things that go outside where they get damaged by UV light," says Hodgkiss.

"When you reduce it down to the mechanisms that we uncovered, can we embody that in some kind of synthetic additive?"

Cosmos, 20 October 2022

https://cosmosmagazine.com

Transparent wood could soon replace plastics

2022-10-18

Transparent wood promises to be an environmentally friendly substitute for glass or plastic used for making car windshields, see-through packaging and biomedical devices, according to a study.

Published in the journal Science of The Total Environment, the study said transparent wood reduced ecological impacts on the environment because of its renewable and biodegradable properties. It is also said to be cost-efficient as it is five times more efficient than glass thus cutting energy cost significantly.

Transparent wood may be a sustainable alternative for glass or plastic used for making windshields, see-through packaging and biomedical devices.

CHEMWATCH
Bulletin Board
Curiosities
OCT. 28, 2022

The world currently produces around 400 million tons of plastic waste each year, with increasing levels of single-use plastic which is used and then discarded, according to the UN Environment Program. Now, transparent wood is emerging as one of the most promising substitute materials of the future.

"Transparent wood as a material can replace the environmentally harmful petroleum-based plastics such as polypropylene, polyvinyl chloride (PVC), acrylic, polyethylene, etc.," said Prodyut Dhar, an author of the study and assistant professor at the Indian Institute of Technology's biochemical engineering school.

Originally fabricated in 1992 by German scientist Siegfried Fink and since improved upon by other researchers, transparent wood is made by removing the lignin content in wood and replacing it with transparent, plastic materials. Lignin is a naturally occurring biopolymer which supports plant tissue; unlike plastics it can biodegrade and is non-toxic.

"Plastics are used as a substitute for glass which is (naturally) fragile. However, transparent wood is an even better alternative from an ecological perspective as observed in our life-cycle analysis," said Dhar.

According to the authors, production of transparent wood using sodium chlorite to remove lignin from wood and infiltrating it with epoxy infiltration had far less environmental impacts than commonly used methods that rely on the use of methacrylate polymer.

The end-of-life analysis suggests that, transparent wood is less environmentally friendly than glass but is still better than producing polyethylene, indicating the need to improve the production technology, the authors said.

Anish M. Chathoth, an assistant professor at Kerala Agricultural University's College of Forestry, in India, and a transparent wood researcher at the Institute of Wood Science and Technology, Bangalore, said the fabrication of transparent wood has generated a lot of recent interest due to its favorable physical, mechanical and optical properties.

"Transparent wood is mostly developed using thin slices of wood, and has good strength as that of regular wood but is lighter in weight. The scope for imparting multiple and advanced properties through the incorporation of specialized materials makes it a unique bio-based substrate for versatile applications," Chathoth told SciDev.Net.

"In recent times transparent wood has been used in construction, energy storage, flexible electronics and packaging applications," said Chathoth, "adding that given the growing concerns about the environmental impact of petroleum-based plastic materials, transparent wood has a role in maintaining environmental sustainability."

Phys Org, 18 October 2022

https://phys.org

A green trifecta: how a concrete alternative can cut emissions, resource use and waste

2022-10-24

Building materials and construction generate about 20% of global greenhouse gas emissions. Much of these emissions are due to the environmentally unfriendly process of producing ordinary Portland cement, which is widely used in construction materials such as concrete and mortar.

Portland cement production generates about 2.6 billion tonnes of carbon dioxide (CO_2) a year – more than 7% of annual global emissions. Cement emissions have doubled in the past 20 years. And over the next 40 years, construction is expected to double the building floor area worldwide.

Every tonne of cement produced also uses about 1.6 tonnes of raw materials, including fuels and other resources. Concrete production also uses large amounts of aggregate such as sand and gravel. This requires energy-intensive quarrying operations that deplete non-renewable natural resources – the world is running out of building sand.

The problems of emissions and resource depletion mean suitable substitutes for Portland cement and natural aggregate are required. Our research shows it is possible to develop more sustainable construction materials, reinforced using natural fibres. Industrial byproducts and waste materials can be used to replace cement binder and aggregate, reducing emissions, resource depletion and waste.

Recycling cuts waste

Recycling waste materials in construction can help reduce the environmental impacts of concrete and mortar production and the disposal of waste materials in landfills.

Portland cement production generates about 2.6 billion tonnes of carbon dioxide (CO_2) a year – more than 7% of annual global emissions.

CHEMWATCH
Bulletin Board
Curiosities
OCT. 28, 2022

These materials include industrial byproducts (fly ash and blast furnace slag), waste glass and lead slag. Fly ash comes from coal-fired power stations. Blast furnace slag is a byproduct of iron and steel production.

A new type of eco-friendly material, geopolymer, has received significant attention as a replacement for conventional concrete. A geopolymer is a hard and durable human-made substance. Geopolymer production produces up to 90% less CO_2 emissions than conventional concrete.

The properties of waste glass and lead slag make them suitable for use in making geopolymer.

Natural fibre reinforcement is sustainable

Steel or other synthetic fibres have been widely used as reinforcement material to improve the mechanical properties of geopolymer. However, steel fibres are expensive and corrode in harsh environments.

The synthetic alternative, mineral fibres, such as polyvinyl alcohol and polypropylene, are produced using antioxidants and amines. This process makes these fibres a non-eco-friendly material.

Natural fibres obtained from plants are a viable alternative to non-renewable, corrosive and expensive synthetic fibres. Natural fibres are renewable, eco-friendly, non-corrosive, cheap and abundant. These properties make natural fibres a sustainable material.

What did the study find?

Any substitutes for the concrete and mortar used today should at least match their engineering properties, such as strength and durability. Our study evaluated the production and performance of geopolymers made with waste glass and lead slag instead of natural sand. We used a combination of fly ash and granulated blast furnace slag as binders instead of Portland cement.

These geopolymers were reinforced with different types of natural fibres such as coir, ramie, sisal, hemp, jute and bamboo fibres.

Our experimental results showed geopolymers containing waste glass sand have higher strength and absorb less water than those containing lead slag and natural sand. Water absorption reduces the durability of concrete.

Geopolymers prepared with lead slag show a lower drying shrinkage than geopolymers made with waste glass sand and lead slag. Drying shrinkage

also reduces durability, as it leads to cracks in the concrete before it bears any kind of load.

We found that geopolymers with 1% ramie, hemp and bamboo fibre have greater compressive and tensile strengths than unreinforced geopolymers. This means the reinforced geopolymer resists breaking when squeezed (under compression loading) and when pulled apart (under tension loading). The higher strength of natural fibre-reinforced mixes is because of the bridging effect of the fibres inside the geopolymer.

Our study also shows that ramie, hemp and bamboo fibre-reinforced geopolymers shrink less than unreinforced geopolymers.

What next?

The next steps in this research would include study of:

- the use of recycled aggregates obtained from construction and demolition waste, which has grown to 27 million tonnes a year in Australia – 44% of all waste
- treating the natural fibres to modify their properties before using in the geopolymer
- the possibility of using the developed geopolymer in 3D printing for automated construction.

Developing sustainable concrete will provide us with a next-generation construction material that greatly improves the sector's resource efficiency while reducing its emissions and other environmental impacts.

The Conversation, 24 October 2022

https:// theconversation.com

What Makes You at Risk for Alzheimer's? Researchers Have New Insight

2022-10-21

Human microglia are immune cells that reside in the brain, and Mount Sinai researchers have attained an unprecedented understanding of their genetic and molecular machinery. This understanding may help shed light on how they contribute to the onset and progression of Alzheimer's disease (AD). The study was recently published in the journal Nature Genetics.

Scientists shed new light on the genetic and molecular machinery that pre-dispose individuals to Alzheimer's disease.

CHEMWATCH
Bulletin Board
Curiosities
OCT. 28, 2022

Researchers found 21 prospective risk genes using fresh human brain tissue collected by biopsy or autopsy from 150 donors, and they highlighted one, SPI1, as a potential key regulator of microglia and AD risk.

"Our study is the largest human fresh-tissue microglia analysis to date of genetic risk factors that might predispose someone to Alzheimer's disease," says senior author Panos Roussos, MD, Ph.D., Professor of Psychiatry, and Genetic and Genomic Sciences, at the Icahn School of Medicine at Mount Sinai and Director of the Center for Disease Neurogenomics. "By better understanding the molecular and genetic mechanisms involved in microglia function, we're in a much better position to unravel the regulatory landscape that controls that function and contributes to AD. That knowledge could, in turn, pave the way for novel therapeutic interventions for a disease that currently has no effective treatments."

In addition to being crucial for the development and maintenance of neurons, microglia play a major role in the immune response in the brain. Although prior research, including some from Mount Sinai, has shown that microglia are important for the genetic risk to and progression of Alzheimer's disease, little is understood about the epigenetic mechanisms behind how this happens.

The majority of earlier research has either employed animal- or cell-line-based models, which do not accurately represent the true complexity of microglia activity in the brain since microglia are difficult to isolate inside the human brain. Because these risk variables are frequently found in the non-coding region of the genome (formerly known as "junk DNA"), which is more challenging to analyze, it has been difficult to link genetic risk variance for AD to specific molecular function.

The Mount Sinai team's solution was to access fresh brain tissue from biopsies or autopsies made possible by a collaboration between four brain bio-depositories, three at Mount Sinai and the other from Rush University Medical Center/Rush Alzheimer's Disease Center. "Using a total of 150 samples from these sources, we were able to isolate high-quality microglia, which provided unprecedented insights into genetic regulation by reflecting the entire set of regulatory components of microglia in both healthy and neurodegenerative patients," explains Dr. Roussos.

That process—comparing epigenetic, gene expression, and genetic information from the samples of both AD and healthy aged patients—allowed researchers to comprehensively describe how microglia functions are genetically regulated in humans. As part of their statistical analysis, they expanded the findings of prior genome-wide association studies to

link identified AD-predisposing genetic variants to specific DNA regulatory sequences and genes whose dysregulation is known to directly contribute to the development of the disease. They further described the cell-wide regulatory mechanisms as a way of identifying genetic regions involved in specific aspects of the microglial activity.

From their investigation emerged new knowledge about the SPI1 gene, already known to scientists, as the main microglial transcription factor regulating a network of other transcription factors and genes that are genetically linked to AD. Data the team is generating could also be important to deciphering the molecular and genetic mysteries behind other neurodegenerative diseases in which microglia play a role, including Parkinson's disease, multiple sclerosis, and amyotrophic lateral sclerosis.

Dr. Roussos concedes that much work remains for his team to fully understand how the identified genes contribute to the development and progression of Alzheimer's disease, and how they could be targeted with new therapeutics. He is greatly encouraged, though, by the results of single-cell analysis by his lab of microglia using highly sophisticated instruments that are uncovering the unique interactions between different types of immune cells in the brain and its periphery that are related to neurodegenerative disease. "We're seeing very exciting results through our single-cell data," Dr. Roussos reports, "and that's bringing us ever closer to understanding the genetically driven variations and cell-specific interactions of inheritable diseases like Alzheimer's."

Sci Tech Daily, 21 October 2022

https://scitechdaily.com

"Marshmallow" World Discovered: Giant Fluffy Planet Orbiting a Cool Red Dwarf Star

2022-10-22

Using the WIYN 3.5-meter Telescope at Kitt Peak National Observatory in Arizona, astronomers have observed an unusual Jupiter-like planet in orbit around a cool red dwarf star. Located in the constellation of Auriga the Charioteer around 580 light-years from Earth, this planet, identified as TOI-3757 b, is the lowest-density planet ever detected around a red dwarf star and is estimated to have an average density akin to that of a marshmallow.

Red dwarf stars are the smallest and dimmest members of so-called main-sequence stars — stars that convert hydrogen into helium in their cores at a steady rate. Although they are "cool" compared to stars like our Sun, red

CHEMWATCH
Bulletin Board
Curiosities
OCT. 28, 2022

Kitt Peak National Observatory telescope helps determines that Jupiter-like Planet is the lowest-density gas giant ever detected around a red dwarf.

dwarf stars can be extremely active and erupt with powerful flares. This can strip orbiting planets of their atmospheres, making this star system a seemingly inhospitable location to form such a gossamer planet.

"Giant planets around red dwarf stars have traditionally been thought to be hard to form," says Shubham Kanodia, a researcher at Carnegie Institution for Science's Earth and Planets Laboratory and first author on a paper published in The Astronomical Journal. "So far this has only been looked at with small samples from Doppler surveys, which typically have found giant planets further away from these red dwarf stars. Until now we have not had a large enough sample of planets to find close-in gas planets in a robust manner."

There are still unexplained mysteries surrounding TOI-3757 b, the big one being how a gas-giant planet can form around a red dwarf star, and especially such a low-density planet. Kanodia's team, however, thinks they might have a solution to that mystery.

They propose that the extra-low density of TOI-3757 b could be the result of two factors. The first relates to the rocky core of the planet; gas giants are thought to begin as massive rocky cores about ten times the mass of Earth, at which point they rapidly pull in large amounts of neighboring gas to form the gas giants we see today. TOI-3757b's star has a lower abundance of heavy elements compared to other M-dwarfs with gas giants, and this may have resulted in the rocky core forming more slowly, delaying the onset of gas accretion and therefore affecting the planet's overall density.

The second factor may be the planet's orbit, which is tentatively thought to be slightly elliptical. There are times it gets closer to its star than at other times, resulting in substantial excess heating that can cause the planet's atmosphere to bloat.

NASA's Transiting Exoplanet Survey Satellite (TESS) initially spotted the planet. Kanodia's team then made follow-up observations using ground-based instruments, including NEID and NESSI (NN-EXPLORE Exoplanet Stellar Speckle Imager), both housed at the WIYN 3.5-meter Telescope; the Habitable-zone Planet Finder (HPF) on the Hobby-Eberly Telescope; and the Red Buttes Observatory (RBO) in Wyoming.

TESS surveyed the crossing of this planet TOI-3757 b in front of its star, which allowed astronomers to calculate the planet's diameter to be about 150,000 kilometers (100,000 miles) or about just slightly larger than that of Jupiter. The planet finishes one complete orbit around its host star in

Curiosities

OCT. 28, 2022

just 3.5 days, 25 times less than the closest planet in our Solar System — Mercury — which takes about 88 days to do so.

The astronomers then used NEID and HPF to measure the star's apparent motion along the line of sight, also known as its radial velocity. These measurements provided the planet's mass, which was calculated to be about one-quarter that of Jupiter, or about 85 times the mass of the Earth. Knowing the size and the mass allowed Kanodia's team to calculate TOI-3757 b's average density as being 0.27 grams per cubic centimeter (about 17 grams per cubic feet), which would make it less than half the density of Saturn (the lowest-density planet in the Solar System), about one quarter the density of water (meaning it would float if placed in a giant bathtub filled with water), or in fact, similar in density to a marshmallow.

"Potential future observations of the atmosphere of this planet using NASA's new James Webb Space Telescope could help shed light on its puffy nature," says Jessica Libby-Roberts, a postdoctoral researcher at Pennsylvania State University and the second author on this paper.

"Finding more such systems with giant planets — which were once theorized to be extremely rare around red dwarfs — is part of our goal to understand how planets form," says Kanodia.

The discovery highlights the importance of NEID in its ability to confirm some of the candidate exoplanets currently being discovered by NASA's TESS mission, providing important targets for the new James Webb Space Telescope (JWST) to follow up on and begin characterizing their atmospheres. This will in turn inform astronomers what the planets are made of and how they formed and, for potentially habitable rocky worlds, whether they might be able to support life.

Sci Tech Daily, 22 October 2022

https://scitechdaily.com

CHEMWATCH
Bulletin Board

Technical Notes

OCT. 28, 2022

(NOTE: OPEN YOUR WEB BROWSER AND CLICK ON HEADING TO LINK TO SECTION)

CHEMICAL EFFECTS

Hematological indices as indicators of inflammation induced by exposure to pesticides

Effects of organic chemicals from diesel exhaust particles on adipocytes differentiated from human mesenchymal stem cells

Fetal exposure to phthalates and bisphenols and DNA methylation at birth: the Generation R Study

ENVIRONMENTAL RESEARCH

Sources of copper into the European aquatic environment

[Role and Mechanism of Low Molecular-Weight-Organic Acids in Enhanced Phytoremediation of Heavy Metal Contaminated Soil]

10-year time course of Hg and organic compounds in Augusta Bay: Bioavailability and biological effects in marine organisms

PHARMACEUTICAL/TOXICOLOGY

Lead Exposure Induced Neural Stem Cells Death via Notch Signaling Pathway and Gut-Brain Axis

Endocrine Disrupting Chemicals' Effects in Children: What We Know and What We Need to Learn?

OCCUPATIONAL

Paternal Occupational Exposure to Heavy Metals and Welding Fumes and Testicular Germ Cell Tumours in Sons in France

Profile of Dermatological Disorders Among Workers Involved in Fruit Growing Industry of Kashmir Valley in North India