CHEMWATCH

Bulletin Board

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OCT. 01, 2021

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ASIA PACIFIC

New 'emerging technologies' webpage

2021-09-20

The APVMA supports innovation and the development of new technologies that support Australian growers and protect the health and safety of people, animals and the environment.

Shortly we will launch a new webpage that will serve as the first point of reference for stakeholders interested in the APVMA's position on emerging technology. The release of this webpage will feature RPAS technology (Remotely Piloted Aerial Spraying).

In June 2019, to aid regulatory understanding of RPAS, the Organisation for Economic Co-operation and Development (OECD) Working Party on Pesticides (WPP) set up a working group to consider the application of plant protection products by RPAS, with its first task to review what regulatory acceptable data currently exists. The outcome of this review will be published on our website shortly under the title *State of the Knowledge Literature Review on Unmanned Aerial Spray Systems in Agriculture*.

The document will also provide detailed background about the quality of the available data and an insight into the type of equipment being used (e.g. single rotor and multi-rotor, boom and nozzle configurations), the way in which it is being used (e.g. common flight heights and speeds), potential levels of drift in comparison to existing application methods, and recommend areas for development for regulatory purposes.

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APVMA, 20 September 2021

https://apvma.gov.au/node/91481

Item 7 applications and pack size changes

2021-09-20

Applications to register a new agricultural product, based on that product being closely similar to a reference product, can have additional pack sizes providing that no data are required to support the pack size.

For example, the reference product has the following approved pack sizes: 10 kg, 20 kg and 110 kg. Your proposed product meets the definition of

The release of this webpage will feature RPAS technology (Remotely Piloted Aerial Spraying).

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'closely similar' but you wish to add a 100 kg and 1,000 kg pack size, which are not approved on the reference product.

As no data are required to support the additional pack sizes, the formulation is closely similar to the reference product and the label instructions are the same as the reference product, this example application would meet the criteria of an Item 7 application.

These applications should not be submitted as an Item 10 with only a preliminary assessment (Module 1) and finalisation (Module 11.2) module with a 2-month timeframe. Applications of this nature will be re-categorised to an Item 7.

More information about the benefits of requesting pack size ranges rather than individual pack sizes is available on our website.

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APVMA, 20 September 2021

https://apvma.gov.au/node/91481

K-BPR: MoE designates lubricants as household chemical products subject to safety confirmation

2021-09-10

On September 6, 2021, the South Korean online chemical management system (CHEMP) published a notice to inform importers and manufacturers of lubricants to start submitting approval application of "household chemical products subject to safety confirmation" under K-BPR.

Read More

Chemlinked, 10 September 2021

https://chemical.chemlinked.com/news/chemical-news/k-bpr-moe-designates-lubricants-as-household-chemical-products-subject-to-safety-confirmation

On September 6, 2021, the South Korean online chemical management system (CHEMP) published a notice to inform importers and manufacturers of lubricants to start submitting approval application of "household chemical products subject to safety confirmation" under K-BPR.

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AMERICA

Easton suing chemical manufacturers over PFAS well contamination

2021-09-08

The town of Easton has filed a lawsuit against chemical companies whose products containing per- and polyfluoroalkyl substances (PFAS) the town alleges caused contamination of drinking water, according to a press release issued by the town.

The companies include the 3M Company, Chemguard, Dupont and Tyco.

The suit, filed for the town by the Napoli Shkolnik law firm, is one of thousands of lawsuits filed nationwide by municipalities, residents and firefighters, including more than 100 cases filed by government entities.

The complaint, filed in the Judicial Panel on Multidistrict Litigation, U.S. District Court, District of South Carolina, alleges that the Easton Fire and Rescue Department used aqueous film-forming foam products containing PFOS and PFOA for firefighting activities, unaware of the serious health effects of the PFOA and PFOS chemicals they contain, the release states.

The town of Easton further alleges that PFOA and PFOS caused groundwater contamination to the town's drinking water supplies.

Read More

Wicked Local, 8 September 2021

https://www.wickedlocal.com/story/journal-news-independent/2021/09/08/easton-joins-lawsuits-against-chemical-manufacturers-over-pfas/5774712001/

The companies include the 3M Company, Chemguard, Dupont and Tyco.

New Pennsylvania PFOS and PFOA cleanup standards reach final major regulatory hurdle

2021-09-08

The process to revise regulations in Pennsylvania is often long and involved, and the Pennsylvania Department of Environmental Protection's (PADEP) revision to its Act 2 Chapter 250 regulations to incorporate cleanup standards for three per- and polyfluoroalkyl substances (PFAS) has proved to be no exception. PADEP first published its regulatory proposal in the Pennsylvania Bulletin on February 15, 2020. Finally, earlier this summer on June 15, 2021, the Pennsylvania Environmental Quality Board (EQB) voted to adopt PADEP's final regulations. Now, on September 23, 2021, the Pennsylvania Independent Regulatory Review Commission (IRRC) will hold a public meeting for its consideration and vote on the PADEP's proposed update to its Act 2 regulations.

Should IRRC vote to approve the update to Act 2 regulations, IRRC will issue an order indicating its approval, and PADEP will then submit the regulatory package to the Pennsylvania Office of Attorney General (OAG) for legal review. If approved by OAG, the final approved regulation will be published in the Pennsylvania Bulletin. The regulation becomes effective, and compliance is required with the new regulation, on the date it is published unless another date is specified by PADEP. PADEP indicated in its Regulatory Analysis Form that these Act 2 regulations will become effective upon publication in the Pennsylvania Bulletin.

This regulatory update includes the following new statewide health standards for soil and groundwater medium-specific concentrations (MSC) for PFOS, PFOA, and PFBS

Read More

JD Supra, 8 September 2021

https://www.jdsupra.com/legalnews/new-pennsylvania-pfos-and-pfoa-cleanup-3985880/

PFAS update: EPA proposes reporting on the last 10 years of manufacture or import of products containing PFAS

2021-09-08

The Environmental Protection Agency ("EPA") is proposing new reporting requirements for Per- and Polyfluoroalkyl Substances ("PFAS") that would require manufacturers, including importers, to report on their manufacture or import of products containing any PFAS compounds in any year looking back to January 1, 2011. The stated intent of this new requirement under the Toxic Substances Control Act ("TSCA") is so that EPA can "better characterize the sources and quantities of manufactured PFAS in the United States." See 86 FR 121 (June 28, 2021).

The stated intent of this new requirement under the Toxic Substances Control Act ("TSCA") is so that EPA can "better characterize the sources and quantities of manufactured PFAS in the United States."

EPA has explained that the Proposed Rule would apply to all chemical substances and mixtures that used a PFAS substance and were manufactured or imported between January 1, 2011 and the effective date of the final rule. See 86 FR 121 (June 28, 2021). A chemical substance is

defined broadly at 40 CFR §720.30(e), but this definition is subject to some exclusions. EPA indicates that at least 1,364 PFAS substances qualify as a chemical substance, and accordingly, are subject to this Proposed Rule. See 86 FR 121 (June 28, 2021).

A public comment period is currently ongoing, and all comments are due by **September 27, 2021**. Potentially affected businesses should consider submitting public comments after reviewing the topics listed below. As drafted, the Proposed Rule has the potential to impose significant reporting obligations on companies that may not understand or appreciate that the products they manufacture or import contain PFAS.

Read More

JD Supra, 8 September 2021

https://www.jdsupra.com/legalnews/pfas-update-epa-proposes-reporting-on-1289950/

Pennsylvania vows to regulate PFAS in drinking water—again. But regulations are at least two years away

2021-09-15

Thousands of Pennsylvanians have been exposed to dangerous chemicals in their drinking water without knowing it, including people in the Pittsburgh region, but state-level regulations on the toxics remain at least two years away, according to state officials.

Pennsylvania first promised to tackle the issue in 2017, and in the meantime around 10 other states have moved forward with regulations to protect residents. While Pennsylvania officials say the process will take at least two more years, PFAS contamination is disrupting residents' lives. Some residents of McKeesport, a town about 11 miles southeast of downtown Pittsburgh, recently went an entire month without drinking water as a result of local contamination.

Pennsylvania residents risk ongoing exposure unless local water authorities start voluntarily filtering PFAS out of drinking water—which is unlikely because they're often underfunded and must prioritize the testing and removal of chemicals that are already regulated.

Some residents of McKeesport, a town about 11 miles south-east of downtown Pittsburgh, recently went an entire month without drinking water as a result of local contamination.

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Public Source, 15 September 2021

https://www.publicsource.org/pennsylvania-pfas-regulations-two-years-away-water-chemical-contamination/

EUROPE

European commission reports on nanomaterials in cosmetic products

2021-09-10

The report to the European Parliament and Council covers the use of nanomaterials in cosmetics in the context of a review of Cosmetics Regulation 1223/2009 as regards nanomaterials. The Cosmetics Regulation establishes that, if the Commission has concerns regarding the safety of a nanomaterial, it shall request its Scientific Committee on Consumer Safety (SCCS) to give an opinion on the safety of its use and on the foreseeable exposure conditions. The report found that **most of** these SCCS **opinions are inconclusive, due to a lack of or insufficient data**. Therefore, there is a need for the responsible **economic operators to provide information** as accurate as possible when making notifications to the Cosmetic Products Notification Portal (CPNP). However, the report addresses **shortcomings of the notification procedure**. For instance, whereas the safety assessment is carried out at ingredient level, notifications are made at product level. In general, the effectiveness of the current notification process via the CPNP merits specific attention, and the scientific safety assessment of nanomaterials could be strengthened, according to the Commission. It sees an urgent need for aligning the horizontal definition of nanomaterial throughout different pieces of EU legislation, as it announced for 2021 in its **CSS** (please also see frESH Law Horizons March 2021).

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The National Law Review, 10 September 2021

https://www.natlawreview.com/article/sustainability-outlook-european-union-august-2021

The report found that most of these SCCS opinions are inconclusive, due to a lack of or insufficient data.

EFSA guidance on nanomaterials and nanomaterial in food products

2021-09-10

The European Food Safety Authority published two guidance documents, one on technical requirements for regulated food and feed product applications to establish the presence of small particles including nanoparticles and another on risk assessment of nanomaterials to be applied in the food and feed chain for human and animal health.

In the first document, EFSA, following a mandate from the Commission, sets out **criteria for assessments, as well as information requirements** for applications in the regulated food and feed product areas (e.g. novel food, food/feed additives, food contact materials (**FCM**) and pesticides. The guidance outlines appraisal criteria that applicants may follow to confirm that a fraction of small particles is either not present or covered by the conventional risk assessment, or to assess whether conventional risk assessment should be complemented with nano-specific considerations. These considerations refer to three aspects: **(1)** solubility and dissolution rate as the main properties to assess whether consumers will be exposed to particles; **(2)** information requirements for assessing whether the conventional material contains a fraction or consists of small particles, and its characterisation; and **(3)** the information to be presented for existing safety studies to demonstrate that the fraction of small particles has been properly evaluated.

The second document updates a previous guidance and, together with the first one, elaborates on physico-chemical characterisation, as well as methods and techniques that can be used for the characterisation of nanomaterials and their determination in complex matrices.

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The National Law Review, 10 September 2021

https://www.natlawreview.com/article/sustainability-outlook-european-union-august-2021

EFSA deems silver nanoparticles used as FCM additive safe

2021-09-10

The EFSA Panel on Food Contact Materials, Enzymes and Processing Aids (**CEP**) issued an assessment on the safety of the silver nanoparticle additives used in plastics. These silver particles are in the size range of 1-100nm, with about 15nm mean diameter and 99% of the particles are smaller than 20nm. These additives are used as a surface biocide in **food contact plastic materials**, such as polyolefins, polyesters and styrenics. The experts panel considered information on theory, specific migration and abrasion tests. The data showed that, under the intended and tested conditions of use, **silver nanoparticles stay embedded in the polymer, do not migrate and resist release by abrasion. Thus,** they d**o not give rise to exposure** via food **and to toxicological concern**. Therefore, they do not raise safety concern for the consumer if used as an additive at up to 0.025% w/w in polymers.

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The National Law Review, 10 September 2021

https://www.natlawreview.com/article/sustainability-outlook-european-union-august-2021

In the first document, EFSA, following a mandate from the Commission, sets out criteria for assessments, as well as information requirements for applications in the regulated food and feed product areas […] pesticides.

Renewal procedure for glyphosate as active substance for pesticides moves forward

2021-09-10

The Assessment Group on Glyphosate (AGG) submitted **updated versions of the Renewal Assessment Report** (RAR) **and the Harmonised Classification and Labelling** (CLH) report to EFSA and ECHA. The updated version of the documents will become available for consultation after the two agencies carry out some administrative formalities. The assessment procedure will continue and will include public consultations (originally expected in September 2021), and subsequent peer-review by experts from the Member States. The parallel consultations that were announced for the first week of September 2021 will be rescheduled.

Glyphosate is currently approved as an active substance for pesticides until December 2022. The Commission appointed four Member States (France, Hungary, the Netherlands and Sweden) acting jointly as "rapporteurs" for the next assessment of glyphosate in 2019, and known as AGG. It concluded in June that glyphosate meets the approval criteria for active substances set in Plant Protection Products Regulation (PPPR) 1107/2009 (please see Sustainability Outlook June 2021).

The updated version of the documents will become available for consultation after the two agencies carry out some administrative formalities.

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The National Law Review, 10 September 2021

https://www.natlawreview.com/article/sustainability-outlook-european-union-august-2021

INTERNATIONAL

New global methane pledge aims to tackle climate change

2021-09-22

A new joint agreement by the European Union and the United States to cut global methane emissions by 30 per cent by 2030 could mark a crucial step in tackling climate change and getting the world closer to the goals of the Paris Agreement to keep global temperature rise to below 2°C.

The announcement on Friday, which ushered in the start of what is hoped to be a 'the Global Methane Pledge,' will see the agreement formally launched at the United Nations Climate Change Conference of the Parties COP26, to be held in Glasgow from 31 October and 12 November.

Methane is a potent greenhouse gas tens of times more powerful than carbon dioxide in warming the atmosphere. It is a short-lived climate pollutant with an atmospheric lifetime of roughly a decade. Intergovernmental Panel on Climate Change (IPCC) research shows that methane is responsible for at least a quarter of today's global warming and reducing human-caused methane, which accounts for more than half of all methane emissions, is one of the most effective ways of combatting climate change.

Methane is a potent greenhouse gas tens of times more powerful than carbon dioxide in warming the atmosphere.

Read More

UNEP, 22 September 2021

https://www.unep.org/news-and-stories/story/new-global-methane-pledge-aims-tackle-climate-change

Animal cosmetics testing is still happening despite bans

2021-09-16

In 1998, the U.K. was the first country to ban animal testing for cosmetics products and their ingredients. In 2007, Israel prohibited animals from testing cosmetics, while India banned cosmetic animal testing in 2014. In 2019, Australia passed a bill that forbids the testing of new chemicals on animals to be used for cosmetics purposes.

Today, there are more than forty countries that have passed laws to limit or ban cosmetics animal testing, including several states in Brazil, Colombia, Guatemala, the U.K., Switzerland, New Zealand, South Korea, Taiwan, Turkey, Iceland, Norway, and every country in the European Union.

However, despite bans that outlawed such testing years ago, a new analysis has revealed that hundreds of cosmetic products sold in the U.K. and Europe still contain ingredients that have been tested on animals. Banned tests were made on ingredients used in products, including lipsticks, sunscreen, moisturizers, and hair conditioner, with over 100 separate experiments executed on rabbits and mice.

Thomas Hartung, an animal testing alternative expert at Johns Hopkins University and one of the analysis authors, points out that "European customers can't assume the products they buy are not tested on animals. Moreover, even products labeled as not tested on animals may contain some ingredients that are tested on animals."

Two sets of competing legislation are at the core of this issue. First, the ban on animal testing of cosmetic ingredients in the E.U. came into force in 2009. Yet, another law regulating chemicals was introduced in 2007, forcing companies to identify and manage the risks associated with chemicals they manufacture and market in the E.U. to guarantee worker safety. According to the European Chemicals Agency (ECHA), this can include chemicals manufactured exclusively for use in cosmetics, obscuring the animal testing ban for cosmetic ingredients.

In 2019, Australia passed a bill that forbids the testing of new chemicals on animals to be used for cosmetics purposes.

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Intelligent Living, 16 September 2021

https://www.intelligentliving.co/animal-cosmetics-testing-still-happening-despite-bans/

REACH Update

OCT. 01, 2021

Registry of restriction intentions until outcome – last updated 22 September 2021

2021-09-22

The registry of restriction intentions until outcome lists the intentions and Annex XV restriction proposals received by ECHA.

A restriction proposal may be prepared by a Member State or by ECHA at the request of the Commission or on its own initiative for substances in the Authorisation List. It is a legal requirement for a Member State to notify ECHA of its intention to prepare a restriction dossier. The advance notice enables interested parties to plan and prepare for commenting later on.

Interested parties can follow the progress of a proposal through the restriction process, from the notification of the intention to the adoption of the final opinions by the Committee for Risk Assessment (RAC) and the Committee for Socio-economic Analysis (SEAC), and the adoption of the restriction by the European Commission.

Stakeholders are encouraged to submit any relevant information to the dossier submitters during the preparation of the restriction proposal and during the consultations. Information to motivate any exemptions to the scope described in the intention is particularly useful to receive in the preparatory phase of the dossier.

Last updated 22 september 2021. Database contains 45 unique substances/entries

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ECHA, 22 September 2021

https://echa.europa.eu/nl/registry-of-restriction-intentions

The advance notice enables interested parties to plan and prepare for com-menting later on.

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Janet's Corner

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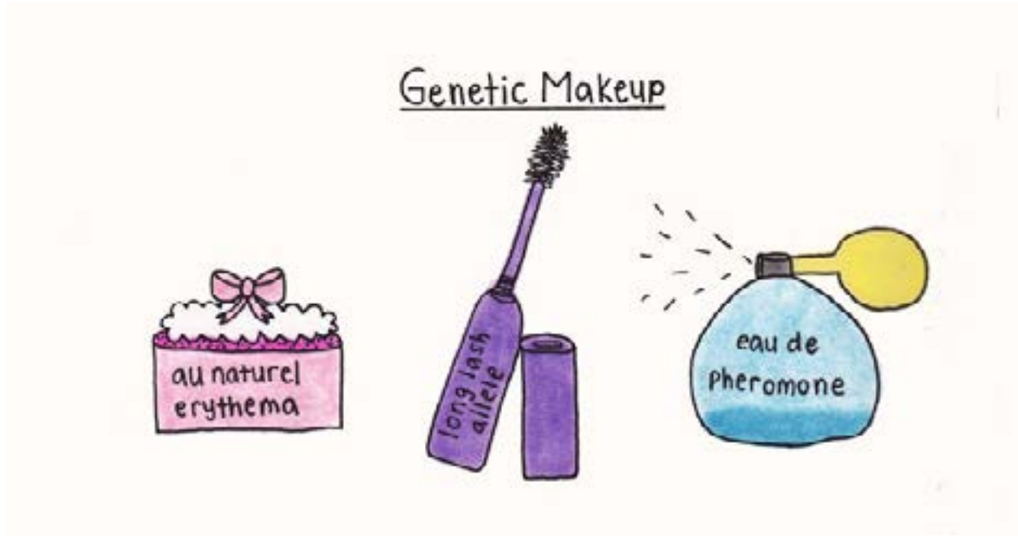
Genetic Makeup

2021-10-01



https://www.calpaclab.com/science-jokes/

Titanium dioxide

2021-10-01

Titanium dioxide (TiO2) (CAS Number 13463-67-7) is a non-combustible, white, crystalline, solid, odourless powder. It is insoluble in water, hydrochloric acid, nitric acid, and alcohol, and it is soluble in hot concentrated sulphuric acid, hydrogen fluoride, or alkali. TiO2 has several naturally occurring mineral forms, or polymorphs, which have the same chemical formula and different crystalline structure. Common TiO2 polymorphs include rutile (CAS Number 1317-80-322 2) and anatase (CAS Number 1317-70-0). While both rutile and anatase belong to the tetragonal crystal system, rutile has a denser arrangement of atoms. Both anatase and rutile are used as white pigment. Rutile TiO2 is the most commonly used white pigment because of its high refractive index and relatively low absorption of light. Anatase is used for specialised applications (e.g., in paper and fibres). TiO2 does not absorb visible light, but it strongly absorbs ultraviolet (UV) radiation. Commercial rutile TiO2 is prepared with an average particle size of 0.22 µm to 0.25 µm. Pigment-grade TiO2 refers to anatase and rutile pigments with a median particle size that usually ranges from 0.2 µm to 0.3 µm. Particle size is an important determinant of the properties of pigments and other final products. [1]

USES [1]

TiO2 is used mainly in paints, varnishes, lacquer, paper, plastic, ceramics, rubber, and printing ink. In addition, it is used in welding rod coatings, floor coverings, catalysts, coated fabrics and textiles, cosmetics, food colorants, glassware, pharmaceuticals, roofing granules, rubber tire manufacturing, and in the production of electronic components and dental impressions. Both the anatase and rutile forms of TiO2 are semiconductors. TiO2 white pigment is widely used due to its high refractive index. Since the 1960s, TiO2 has been coated with other materials (e.g., silica, alumina) for commercial applications.

ROUTES OF EXPOSURE [2]

Exposure to titanium dioxide results from breathing in titanium dioxide dust. Possible exposure to intermediate products in titanium dioxide production may also occur. Exposure may occur at any stage in the mining of ores, in the preparation of titanium dioxide, and in any of the industries in which the powder is stored and used. Whilst the most common route of

Titanium dioxide (TiO2) (CAS Number 13463-67-7) is a non-combustible, white, crystalline, solid, odourless powder.

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exposure is inhalation, ingestion is possible when some dust accumulates on mucosal surfaces of the oropharynx and nasopharynx.

HEALTH EFFECTS

Acute Toxicity [2]

Titanium dioxide is an irritant to the upper airway, as are other nuisance dusts. No evidence indicates that it induces an acute inflammatory reaction at commonly seen exposure concentrations. In workers with pre-existing chronic obstructive airway disease, titanium dioxide may exacerbate symptoms.

Chronic Toxicity [3]

No conclusions can be drawn from the few studies that show respiratory effects in titanium-dioxide exposed workers, because of concurrent exposure to other substances that are well known to cause lung disease. There was no association between titanium dioxide exposure and increased mortality from any cause in a retrospective cohort mortality study of 4241 titanium dioxide workers. A few human population studies or clinical studies involving titanium-dioxide exposed workers have shown effects such as decreased lung function, mild fibrosis, and thickening of the lining of the chest cavity (pleural thickening). However, the workers in these studies were also exposed to other substances including asbestos and/or silica, which are well known to cause lung disease. Therefore, no conclusions can be drawn. In general, long-term exposures to high concentrations of dust may cause increased mucous flow in the nose and respiratory system. This condition usually disappears after exposure stops. Controversy exists as to the role occupational exposure to dust has in the development of chronic bronchitis (inflammation of the air passages into the lungs). Other factors such as smoking and general air pollution are also important, but dust exposure may contribute to this effect. In animal studies, long-term inhalation exposure has caused persistent adverse effects on the lungs (e.g. inflammation, fibrosis, changes to alveolar cells), which are believed to result from dust overloading of the lungs. Effects with ultrafine titanium dioxide occur at much lower exposure concentrations than are required with the larger sized pigment grade particles. The effects are more closely related to lung burden in terms of the surface area rather than the mass of the particles.

Genetic Effects [2]

No data are available regarding human genetic effects, and very limited epidemiologic data about carcinogenicity are available.

Carcinogenic [3]

The International Agency for Research on Cancer (IARC) has determined that titanium dioxide is possibly carcinogenic to humans (Group 2B) based on inadequate evidence in humans and sufficient evidence in experimental animals. This conclusion relates to long-term inhalation exposure to high concentrations of pigmentary (powdered) or ultrafine titanium dioxide. The available human studies do not suggest an association between occupational exposure to titanium dioxide and risk for cancer.

SAFETY [4]

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 Protective Equipment

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

- 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 [5]

United States

OSHA: The Occupational Safety & Health Administration have established the following Permissible Exposure Limit (PEL) for titanium dioxide:

- General Industry: 15 mg/m^3 TWA
- Maritime: 15 mg/m^3 TWA

ACGIH: The American Conference of Governmental Industrial Hygienists has set a Threshold Limit Value (TLV) for titanium dioxide of: 10 mg/m^3 TWA; Appendix A4 - Not Classifiable as a Human Carcinogen

NIOSH: The National Institute for Occupational Safety and Health has set the following Recommended Exposure Limit (REL): Appendix A - NIOSH Potential Occupational Carcinogens

Australia

Safe Work Australia: Safe Work Australia has established a Time Weighted Average (TWA) concentration for titanium dioxide of 10mg/m^3 for an 8 hour workday.

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3. http://www.ccohs.ca/oshanswers/chemicals/chem_profiles/titanium_dioxide/health_td.html
4. http://www.sciencelab.com/msds.php?msdsId=9925268
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6. http://www.safeworkaustralia.gov.au/sites/swa/about/Publications/Documents/772/Workplace-exposure-standards-for-airborne-contaminants.docx

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Baby poop is loaded with microplastics

2021-09-22

WHENEVER A PLASTIC bag or bottle degrades, it breaks into ever smaller pieces that work their way into nooks in the environment. When you wash synthetic fabrics, tiny plastic fibers break loose and flow out to sea. When you drive, plastic bits fly off your tires and brakes. That's why literally everywhere scientists look, they're finding microplastics—specks of synthetic material that measure less than 5 millimeters long. They're on the most remote mountaintops and in the deepest oceans. They're blowing vast distances in the wind to sully once pristine regions like the Arctic. In 11 protected areas in the western US, the equivalent of 120 million ground-up plastic bottles are falling out of the sky each year.

And now, microplastics are coming out of babies. In a pilot study published today, scientists describe sifting through infants' dirty diapers and finding an average of 36,000 nanograms of polyethylene terephthalate (PET) per gram of feces, 10 times the amount they found in adult feces. They even found it in newborns' first feces. PET is an extremely common polymer that's known as polyester when it's used in clothing, and it is also used to make plastic bottles. The finding comes a year after another team of researchers calculated that preparing hot formula in plastic bottles severely erodes the material, which could dose babies with several million microplastic particles a day, and perhaps nearly a billion a year.

Although adults are bigger, scientists think that in some ways infants have more exposure. In addition to drinking from bottles, babies could be ingesting microplastics in a dizzying number of ways. They have a habit of putting everything in their mouths—plastic toys of all kinds, but they'll also chew on fabrics. (Microplastics that shed from synthetic textiles are known more specifically as microfibers, but they're plastic all the same.) Babies' foods are wrapped in single-use plastics. Children drink from plastic sippy cups and eat off plastic plates. The carpets they crawl on are often made of polyester. Even hardwood floors are coated in polymers that shed microplastics. Any of this could generate tiny particles that children breathe or swallow.

Indoor dust is also emerging as a major route of microplastic exposure, especially for infants. (In general, indoor air is absolutely lousy with them; each year you could be inhaling tens of thousands of particles.) Several studies of indoor spaces have shown that each day in a typical household, 10,000 microfibers might land on a single square meter of floor, having

In 11 protected areas in the western US, the equivalent of 120 million ground-up plastic bottles are falling out of the sky each year.

flown off of clothing, couches, and bed sheets. Infants spend a significant amount of their time crawling through the stuff, agitating the settled fibers and kicking them up into the air.

"Unfortunately, with the modern lifestyle, babies are exposed to so many different things for which we don't know what kind of effect they can have later in their life," says Kurunthachalam Kannan, an environmental health scientist at New York University School of Medicine and coauthor of the new paper, which appears in the journal Environmental Science and Technology Letters.

The researchers did their tally by collecting dirty diapers from six 1-year-olds and running the feces through a filter to collect the microplastics. They did the same with three samples of meconium—a newborn's first feces—and stool samples from 10 adults. In addition to analyzing the samples for PET, they also looked for polycarbonate plastic, which is used as a lightweight alternative to glass, for instance in eyeglass lenses. To make sure that they only counted the microplastics that came from the infants' guts, and not from their diapers, they ruled out the plastic that the diapers were made of: polypropylene, a polymer that's distinct from polycarbonate and PET.

All told, PET concentrations were 10 times higher in infants than in adults, while polycarbonate levels were more even between the two groups. The researchers found smaller amounts of both polymers in the meconium, suggesting that babies are born with plastics already in their systems. This echoes previous studies that have found microplastics in human placentas and meconium.

What this all means for human health—and, more urgently, for infant health—scientists are now racing to find out. Different varieties of plastic can contain any of at least 10,000 different chemicals, a quarter of which are of concern for people, according to a recent study from researchers at ETH Zürich in Switzerland. These additives serve all kinds of plastic-making purposes, like providing flexibility, extra strength, or protection from UV bombardment, which degrades the material. Microplastics may contain heavy metals like lead, but they also tend to accumulate heavy metals and other pollutants as they tumble through the environment. They also readily grow a microbial community of viruses, bacteria, and fungi, many of which are human pathogens.

Of particular concern are a class of chemicals called endocrine-disrupting chemicals, or EDCs, which disrupt hormones and have been connected to reproductive, neurological, and metabolic problems, for instance

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increased obesity. The infamous plastic ingredient bisphenol A, or BPA, is one such EDC that has been linked to various cancers.

"We should be concerned because the EDCs in microplastics have been shown to be linked with several adverse outcomes in human and animal studies," says Jodi Flaws, a reproductive toxicologist at the University of Illinois at Urbana-Champaign, who led a 2020 study from the Endocrine Society on plastics. (She wasn't involved in this new research.) "Some of the microplastics contain chemicals that can interfere with the normal function of the endocrine system."

Infants are especially vulnerable to EDCs, since the development of their bodies depends on a healthy endocrine system. "I strongly believe that these chemicals do affect early life stages," says Kannan. "That's a vulnerable period."

This new research adds to a growing body of evidence that babies are highly exposed to microplastic. "This is a very interesting paper with some very worrying numbers," says University of Strathclyde microplastic researcher Deonie Allen, who wasn't involved in the study. "We need to look at everything a child is exposed to, not just their bottles and toys."

Since infants are passing microplastics in their feces, that means the gut could be absorbing some of the particles, like it would absorb nutrients from food. This is known as translocation: Particularly small particles might pass through the gut wall and end up in other organs, including the brain. Researchers have actually demonstrated this in carp by feeding them plastic particles, which translocated through the gut and worked their way to the head, where they caused brain damage that manifested as behavioral problems: Compared to control fish, the individuals with plastic particles in their brains were less active and ate more slowly.

But that was done with very high concentrations of particles, and in an entirely different species. While scientists know that EDCs are bad news, they don't yet know what level of microplastic exposure it would take to cause problems in the human body. "We need many more studies to confirm the doses and types of chemicals in microplastics that lead to adverse outcomes," says Flaws.

In the meantime, microplastics researchers say you can limit children's contact with particles. Do not prepare infant formula with hot water in a plastic bottle—use a glass bottle and transfer it over to the plastic one once the liquid reaches room temperature. Vacuum and sweep to keep floors clear of microfibers. Avoid plastic wrappers and containers when

possible. Microplastics have contaminated every aspect of our lives, so while you'll never get rid of them, you can at least reduce your family's exposure.

wired.com, 22 September 2021

https://www.wired.com

New research cautions about possible risks of acetaminophen use during pregnancy

2021-09-23

Nearly 100 doctors and scientists issued a consensus statement Thursday warning of possible links between the use of acetaminophen during pregnancy and developmental problems in children, including neurological and reproductive issues that start in the womb.

In a paper published by Nature Reviews Endocrinology, the authors reviewed the medical literature going back 25 years to make a set of recommendations. The group is calling on clinicians and regulatory agencies to change their guidelines for the use of acetaminophen during pregnancy while more research is conducted to study the full range of effects the drug could have on fetal development and children.

Acetaminophen, or APAP, is a pain-relieving and fever-reducing ingredient used in hundreds of medications, including prescription drugs as well as over-the-counter formulations like Tylenol, DayQuil, and Benadryl. It is estimated that over half of all pregnant women in the world use APAP.

While the group supports the current global recommendation that already advises taking as little APAP as possible for as short a time as possible during pregnancy, the consensus statement is "asking for more," said Shanna Swan, one of the lead authors and a professor at the Icahn School of Medicine at Mount Sinai. Patients, physicians, and regulators should be fully informed of new data that suggests "pretty significant risk" before casually using APAP, she said.

The group asked, in its list of recommendations, for OB-GYN associations to review the research and update their guidelines. But Christopher Zahn, vice president of practice activities for the American College of Obstetricians and Gynecologists, said in a statement that he did not see a basis for altering what clinicians already do. He said the new paper and past studies "show no clear evidence that proves a direct relationship

It is estimated that over half of all pregnant women in the world use APAP.

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between the prudent use of acetaminophen during any trimester and fetal developmental issues."

Zahn added, "The authors are not recommending anything counter to what is already done by obstetrician-gynecologists when prescribing acetaminophen for a given clinical condition. Physicians should not change clinical practice until definitive prospective research is done and, most importantly, patients should not be frightened away from the many benefits of acetaminophen. However, as always, any medication taken during pregnancy should be used only as needed, in moderation, and after the pregnant patient has consulted with their doctor."

The research was led by Swan and Ann Bauer, a postdoctoral fellow at the University of Massachusetts Lowell, working under the guidance of senior author David M. Kristensen, a professor at the University of Copenhagen. They reviewed experimental and epidemiological papers that were published on the subject from 1995 through October 2020, looking only at studies that analyzed APAP as an independent exposure.

The research the authors reviewed did not include data for pregnant transgender men, nonbinary people, or intersex people.

The authors used findings from rodent models and laboratory and human studies — most of which suggested that, while risk from one-time APAP use during pregnancy "is relatively modest," the risk increases with repeated use and higher dosages, they wrote.

The consensus statement is supported by an international group of 91 scientists, public health experts, and clinicians, including doctors specializing in neurology, obstetrics, gynecology, and pediatrics, and scientists who study toxicology, endocrinology, reproductive medicine, and neurodevelopment.

"Why is this consensus coming out now?" Swan said. "Why is it supported by so many people now and not in the past? And I think it would be because of what we see: As time progresses and studies get better and measurement gets more precise, which is what we're seeing, we see a stronger effect. If it had been in the reverse – if more precise studies made the effects go away – then we wouldn't be here. But the fact that as time progresses, we see stronger and stronger evidence suggests that we've only been underestimating risk."

Researchers identified three key areas of fetal development that the studies suggest might be affected by prenatal exposure to APAP:

neurological, reproductive, and urogenital. APAP is an endocrine disruptor, meaning it can interfere with the distribution of bodily chemicals and hormones that are critical for a fetus's healthy development.

The exact mechanism by which APAP might block these key biological processes is not yet known, the authors say. However, studies suggested that those in utero effects could disrupt the proper formation of reproductive tracts and organs, affecting how well they work later in life. Neurodevelopment problems also showed up in the data. That association, between a commonly used drug and widespread health issues like infertility and ADHD, left Swan and Kristensen "concerned."

Even when studies tried to control for confounding factors, such as genetics and socioeconomic status, which could influence the relationship between APAP use and developmental problems, "the associations remained robust," Bauer said. "So it seems, to me, that it's quite consistent, what they've found."

Those findings led to the main conclusion of the paper: Until the risks are fully known and explored, "we should reduce our use of acetaminophen when possible throughout the entire pregnancy," Bauer said.

It's not yet known how much APAP is too much, and that's because studies on humans often can't pinpoint exactly how much APAP pregnant people use, and how often or when in pregnancy they use it. Studies have shown that pregnant patients often fail to report the drug in their list of medications unless specifically asked by a clinician about name-brand, APAP-containing medicines.

To account for the gap between actual and reported use of APAP during pregnancy, the authors also analyzed studies that tested pregnant patients for biomarkers. With those biological measurements, the links between APAP use and developmental issues became stronger — showing a "twofold increase of risk" for attention deficit hyperactivity disorder (ADHD) and a threefold increased risk of autism, Bauer said in a news conference.

To Kristensen, the inaccuracy of a lot of self-reported use data indicates that some pregnant people "do not consider APAP as a true medication" with side effects. That disconnect could be due to the drug's ubiquity. Unlike in other countries, where acetaminophen products are only available in pharmacies, products containing APAP are available in the United States at gas stations, grocery stores, and even vending machines.

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Medications such as Tylenol have long been considered the safest way to treat fever and pain in infants and children, and are still one of the only types of drugs that haven't been flagged by the Food and Drug Administration as being risky during pregnancy.

In 2020, the agency warned of risks associated with the use of non-steroidal anti-inflammatory medications, such as ibuprofen, in the second half of pregnancy. With those drugs ruled out, "there was nothing left" for patients to take when dealing with fever and pain during the second half of pregnancy, Swan said. The FDA previously reviewed some data on issues related to APAP use during pregnancy, but there have been more than two dozen other studies on the subject since then – convincing ones, according to Bauer.

Among other recommendations, the consensus statement asks the FDA to update its recommendations in a 2015 drug safety communication "based on evaluation of all available scientific evidence, including both epidemiological and experimental evidence."

In a statement, an FDA spokesperson said the 2015 recommendations did review possible risks of acetaminophen use during pregnancy.

"The benefits and risks of acetaminophen use during pregnancy should be carefully considered," the spokesperson said. "Pregnant women should always consult with their health care professional before taking any prescription or nonprescription medicine. The FDA continues to monitor and evaluate the use of acetaminophen during pregnancy and will update the public as new safety information becomes available."

statnews.com, 23 September 2021

https://www.statnews.com

Strange mathematical term changes our entire view of black holes

2021-09-24

Black holes are getting weirder by the day. When scientists first confirmed the behemoths existed back in the 1970s, we thought they were pretty simple, inert corpses. Then, famed physicist Stephen Hawking discovered that black holes aren't exactly black and they actually emit heat. And now, a pair of physicists has realized that the sort-of-dark objects also exert a pressure on their surroundings.

And now, a pair of physicists has realized that the sort-of-dark objects also exert a pressure on their surroundings.

The finding that such simple, non-rotating "black holes have a pressure as well as a temperature is even more exciting given that it was a total surprise," co-author Xavier Calmet, a professor of physics at the University of Sussex in England, said in a statement.

Calmet and his graduate student Folkert Kuipers were examining quantum effects near the event horizons of black holes, something that is fiendishly hard to pin down. To tackle this, the researchers employed a technique to simplify their calculations. As they were working, a strange term appeared in the mathematics of their solution. After months of confusion, they realized what this newly discovered term meant: It was an expression of the pressure produced by a black hole. Nobody had known this was possible before, and it changes the way scientists think about black holes and their relationships with the rest of the universe.

Hawking's engine

In the 1970s, Hawking became one of the first physicists to apply quantum mechanics to try to understand what happens at the event horizon — the area around a black hole beyond which nothing, not even light, can escape. Prior to this work, everyone had just assumed that black holes were simple objects. According to general relativity, the theory of gravity that first suggested black holes could exist, there is nothing at all remarkable about the event horizon. The event horizon is the "boundary" of a black hole, defining the region where exiting the black would require traveling faster than light. But it was just an imaginary line in space — if you happen to cross it, you wouldn't even know you did, until you tried to turn around and leave.

Hawking changed all that. He realized that quantum foam, which refers to a sea of particles constantly popping into and out of existence in the vacuum of space-time, can affect that simplistic view of the event horizon. Sometimes pairs of particles appear spontaneously from the empty vacuum of space-time, then annihilate each other in a flash of energy, returning the vacuum to its original state. But when this happens too close to a black hole, one of the pair can get trapped behind the event horizon and the other escapes. The black hole is left holding the energy bill for the escaped particle, and so it has to lose mass.

This process is now known as Hawking radiation, and it's through these calculations that we discovered that black holes aren't entirely, 100% black. They glow a little. This glow, known as "blackbody radiation," means they also have heat and entropy (also called "disorder") and all the other

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terms we usually apply to much more mundane objects like refrigerators and car engines.

An effective technique

Hawking focused on how quantum mechanics affected the vicinity of a black hole. But that's not the entire story. Quantum mechanics doesn't include the force of gravity, and a complete description of what's going on near event horizons will have to include quantum gravity, or a description of how strong gravity acts at teeny tiny scales.

Since the 1970s, various physicists have tried their luck both at developing a theory of quantum gravity and at applying those theories to the physics of the event horizon. The latest attempt comes from this new study by Calmet and Kuipers, published in September in the journal Physical Review D.

"Although the pressure exerted by the black hole that we were studying is tiny, the fact that it is present opens up multiple new possibilities, spanning the study of astrophysics, particle physics and quantum physics."

Xavier Calmet

"Hawking's landmark intuition that black holes are not black but have a radiation spectrum that is very similar to that of a black body makes black holes an ideal laboratory to investigate the interplay between quantum mechanics, gravity and thermodynamics," Calmet said.

Without a full theory of quantum gravity, the duo used an approximation technique called effective field theory, or EFT. This theory assumes gravity at the quantum level is weak — an assumption that allows you to make some progress in the calculations without everything falling apart, as happens when gravity in the quantum regime is modeled as extremely strong. While these calculations will not reveal the full picture of the event horizon, they may deliver insights around and inside the black hole.

"If you consider black holes within only general relativity, one can show that they have a singularity in their centres where the laws of physics as we know them must break down," explained Calmet. "It is hoped that when quantum field theory is incorporated into general relativity, we might be able to find a new description of black holes."

Here comes the pressure

Calmet and Kuipers were exploring the thermodynamics of black holes using EFT in the vicinity of the event horizon when they noticed a strange

mathematical term pop up in their equations. At first, the term completely stumped them — they didn't know what it meant or how to interpret it. But that changed during a conversation on Christmas day, 2020.

They realized that the term in the equations represented a pressure. An actual, real pressure. The same pressure that the hot air exerts inside of a rising balloon, or pressure on a piston inside the engine of your car.

"The pin-drop moment when we realised that the mystery result in our equations was telling us that the black hole we were studying had a pressure — after months of grappling with it – was exhilarating," recalled Kuipers.

That pressure is almost absurdly tiny, less than 10^54 times smaller than standard air pressure on the Earth. But it's there. They also found that the pressure can be positive or negative, depending on the particular mix of quantum particles near the black hole. A positive pressure is the kind that keeps a balloon inflated, while a negative pressure is the tension you feel in a stretched rubber band.

Their result extends the idea of black holes as thermodynamic entities that have not just temperature and entropy, but also pressure. Because their work only models weak quantum gravity and neglects strong gravity, it can't completely explain the behavior of black holes, but it's an important step.

"Our work is a step in this direction, and although the pressure exerted by the black hole that we were studying is tiny, the fact that it is present opens up multiple new possibilities, spanning the study of astrophysics, particle physics and quantum physics," Calmet concluded.

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Maritime rope could be adding billions of microplastics to the ocean every year

2021-09-22

The hauling of rope on maritime vessels could result in billions of microplastic fragments entering the ocean every year, according to new research.

The results show that new and one-year old ropes can release around 20 micro-plastic fragments into the ocean for every meter hauled.

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The study, by the University of Plymouth's International Marine Litter Research Unit, is the first to explore the potential for rope to become a source of microplastic pollution in the marine environment.

It compared a variety of synthetic ropes commonly used in the maritime industry—but differing in age, wear surface and material—to assess the quantity and characterizes of microplastics produced while they were in use.

This was achieved by simulating, in both laboratory and field experiments, the rope hauling activity which is typically performed on board maritime vessels such as fishing boats.

The results show that new and one-year old ropes can release around 20 microplastic fragments into the ocean for every meter hauled.

However, as the rope gets older it can release significantly more fragments—two-year-old ropes shed on average around 720 fragments per meter, while 10-year-old rope releases more than 760 fragments per meter.

Writing in Science of the Total Environment, researchers say that in fishing activities the rope length deployed during each haul could be up to 220m depending on the type of vessel and the depth of the ocean.

However, based on a modest 50m of rope being hauled from a boat, they estimate that each time new rope is hauled it could release between 700 and 2000 microplastic pieces. Used rope could release anywhere up to 40,000 fragments.

With more than 4,500 active fishing vessels in the UK, their estimates suggest this could result in anything between 326 million to 17 billion microplastic pieces entering the ocean annually from the UK fleet alone.

Research Fellow Dr. Imogen Napper, who led the study, said: "These estimates were calculated after hauling a 2.5kg weight. However, most maritime activities would be hauling much heavier loads, creating more friction and potentially more fragments. It highlights the pressing need for standards on rope maintenance, replacement and recycling in the maritime industry. However, it also shows the importance of continued innovation in synthetic rope design with the specific aim to reduce microplastic emissions."

The University of Plymouth was the first to highlight the global problem of marine microplastics, earning the Queen's Anniversary Prize for Higher and Further Education in 2019.

Previous research, in conjunction with the Fishing for Litter initiative, has shown that commercial fishers are acutely aware of the potential for marine litter to cause lasting damage to their catches and the wider industry.

The University is also part of an ongoing project working to develop biodegradable fishing gear that can be used by both small and large boats across the industry.

Professor Richard Thompson OBE FRS, Head of the International Marine Litter Research Unit, said: "For centuries, most everyday items including rope and netting used in the maritime industry was produced using natural resources. However, the large-scale increase in plastic production since the 1950s has resulted in plastics progressively replacing their natural counterparts. The durability of plastic has however resulted in a major environmental challenge once items reach the end of their lifetime or, as in this study, when they shed microplastics. Greater appreciation of the issues within wider society, are starting to make a difference. However, this study emphasizes a previously unquantified yet substantive source of microplastics and reinforces the level of collaboration required to achieve lasting and positive change."

phys.org, 22 September 2021

https://www.phys.org

World's oldest identical twins are 107 years (and 300 days) old

2021-09-23

Two sisters in Japan have been declared the world's oldest identical twins, at age 107, according to news reports.

The sisters, Umeno Sumiyama and Koume Kodama, were born on Nov. 5, 1913, making them 107 years and 300-plus days old, according to the Associated Press. That breaks the previous record for world's oldest identical twins, held by Kin Narita and Gin Kanie, also from Japan, who were 107 years and 175 days old, the AP reported. (Kin Narita died in 2000 at age 107, according to The Guardian, and Gin Kanie died a year later at 108.)

The sisters, Umeno Sumiyama and Koume Kodama, were born on Nov. 5, 1913, making them 107 years and 300-plus days old, according to the Associated Press.

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Sumiyama and Kodama were certified as the world's oldest twins on Monday (Sept. 20) by Guinness World Records. The sisters are currently living in separate locations and were presented with their certificates by home care staff, the organization said in a statement.

They were born on Shōdoshima Island in Japan into a large family, with 11 total children, according to the AP. After elementary school, Kodama moved to Kyushu in southern Japan to work as a maid, while Sumiyama remained on the island. The pair rarely saw each other for decades until they turned 70, when they reconnected and started making pilgrimages together, the AP reported.

How long a person lives is thought to be influenced by genetics, environment and lifestyle, according to the National Institutes of Health (NIH). Scientists have been studying centenarians (people who live to 100) and "supercentenarians" (people who live to 110 and beyond) to better understand the factors that contribute to long life spans.

Some scientists speculate that lifestyle factors, including diet and exercise, play an important role in the first 80 years of life, after which genetic factors become more and more important in keeping a person healthy as they age, according to the NIH.

Genetic variants that have been linked to longer life spans include variants in the ABO, CDKN2B, APOE and SH2B3 genes, Live Science previously reported. These variants have been found to be more common in centenarians than people with average life spans.

Another recent study found that centenarians may have special gut bacteria that help ward off infections, Live Science previously reported.

The oldest living person today is Kane Tanaka, from Fukuoka, Japan, who is currently 118 years old, according to Guinness World Records.

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https://www.livescience.com

The drought started in early 2020, and conditions have become progressively drier.

Rice feeds half the world. Climate change's droughts and floods put it at risk

2021-09-24

Under a midday summer sun in California's Sacramento Valley, rice farmer Peter Rystrom walks across a dusty, barren plot of land, parched soil crunching beneath each step.

In a typical year, he'd be sloshing through inches of water amid lush, green rice plants. But today the soil lies naked and baking in the 35˚ Celsius (95˚ Fahrenheit) heat during a devastating drought that has hit most of the western United States. The drought started in early 2020, and conditions have become progressively drier.

Low water levels in reservoirs and rivers have forced farmers like Rystrom, whose family has been growing rice on this land for four generations, to slash their water use.

Rystrom stops and looks around. "We've had to cut back between 25 and 50 percent." He's relatively lucky. In some parts of the Sacramento Valley, depending on water rights, he says, farmers received no water this season.

California is the second-largest U.S. producer of rice, after Arkansas, and over 95 percent of California's rice is grown within about 160 kilometers of Sacramento. To the city's east rise the peaks of the Sierra Nevada, which means "snowy mountains" in Spanish. Rice growers in the valley below count on the range to live up to its name each winter. In spring, melting snowpack flows into rivers and reservoirs, and then through an intricate network of canals and drainages to rice fields that farmers irrigate in a shallow inundation from April or May to September or October.

If too little snow falls in those mountains, farmers like Rystrom are forced to leave fields unplanted. On April 1 this year, the date when California's snowpack is usually at its deepest, it held about 40 percent less water than average, according to the California Department of Water Resources. On August 4, Lake Oroville, which supplies Rystrom and other local rice farmers with irrigation water, was at its lowest level on record.

Not too long ago, the opposite — too much rain — stopped Rystrom and others from planting. "In 2017 and 2019, we were leaving ground out because of flood. We couldn't plant," he says. Tractors couldn't move through the muddy, clay-rich soil to prepare the fields for seeding.

Climate change is expected to worsen the state's extreme swings in precipitation, researchers reported in 2018 in Nature Climate Change.

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This "climate whiplash" looms over Rystrom and the other 2,500 or so rice producers in the Golden State. "They're talking about less and less snowpack, and more concentrated bursts of rain," Rystrom says. "It's really concerning."

Farmers in China, India, Bangladesh, Indonesia, Vietnam — the biggest rice-growing countries — as well as in Nigeria, Africa's largest rice producer — also worry about the damage climate change will do to rice production. More than 3.5 billion people get 20 percent or more of their calories from the fluffy grains. And demand is increasing in Asia, Latin America and especially in Africa.

To save and even boost production, rice growers, engineers and researchers have turned to water-saving irrigation routines and rice gene banks that store hundreds of thousands of varieties ready to be distributed or bred into new, climate-resilient forms. With climate change accelerating, and researchers raising the alarm about related threats, such as arsenic contamination and bacterial diseases, the demand for innovation grows.

"If we lose our rice crop, we're not going to be eating," says plant geneticist Pamela Ronald of the University of California, Davis. Climate change is already threatening rice-growing regions around the world, says Ronald, who identifies genes in rice that help the plant withstand disease and floods. "This is not a future problem. This is happening now."

The top rice producers are in Asia

The world's top rice producer is China, at 214 million metric tons. India, Bangladesh, Indonesia and Vietnam are next. In Africa, Nigeria (6.8 million) is the largest producer. Brazil (11.8 million) and the United States (10.2 million) are also top producers, according to 2018 data from the U.N. Food and Agriculture Organization.

Saltwater woes

Most rice plants are grown in fields, or paddies, that are typically filled with around 10 centimeters of water. This constant, shallow inundation helps stave off weeds and pests. But if water levels suddenly get too high, such as during a flash flood, the rice plants can die.

Striking the right balance between too much and too little water can be a struggle for many rice farmers, especially in Asia, where over 90 percent of the world's rice is produced. Large river deltas in South and Southeast Asia, such as the Mekong River Delta in Vietnam, offer flat, fertile land that is ideal for farming rice. But these low-lying areas are sensitive to swings

in the water cycle. And because deltas sit on the coast, drought brings another threat: salt.

Salt's impact is glaringly apparent in the Mekong River Delta. When the river runs low, saltwater from the South China Sea encroaches upstream into the delta, where it can creep into the soils and irrigation canals of the delta's rice fields.

"If you irrigate rice with water that's too salty, especially at certain [growing] stages, you are at risk of losing 100 percent of the crop," says Bjoern Sander, a climate change specialist at the International Rice Research Institute, or IRRI, who is based in Vietnam.

In a 2015 and 2016 drought, saltwater reached up to 90 kilometers inland, destroying 405,000 hectares of rice paddies. In 2019 and 2020, drought and saltwater intrusion returned, damaging 58,000 hectares of rice. With regional temperatures on the rise, these conditions in Southeast Asia are expected to intensify and become more widespread, according to a 2020 report by the Economic and Social Commission for Asia and the Pacific.

Then comes the whiplash: Each year from around April to October, the summer monsoon turns on the faucet over swaths of South and Southeast Asia. About 80 percent of South Asia's rainfall is dumped during this season and can cause destructive flash floods.

Bangladesh is one of the most flood-prone rice producers in the region, as it sits at the mouths of the Ganges, Brahmaputra and Meghna rivers. In June 2020, monsoon rains flooded about 37 percent of the country, damaging about 83,000 hectares of rice fields, according to Bangladesh's Ministry of Agriculture. And the future holds little relief; South Asia's monsoon rainfall is expected to intensify with climate change, researchers reported June 4 in Science Advances.

A hot mess

Water highs and lows aren't the entire story. Rice generally grows best in places with hot days and cooler nights. But in many rice-growing regions, temperatures are getting too hot. Rice plants become most vulnerable to heat stress during the middle phase of their growth, before they begin building up the meat in their grains. Extreme heat, above 35˚ C, can diminish grain counts in just weeks, or even days. In April in Bangladesh, two consecutive days of 36˚ C destroyed thousands of hectares of rice.

In South and Southeast Asia, such extreme heat events are expected to become common with climate change, researchers reported in July in

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Earth's Future. And there are other, less obvious, consequences for rice in a warming world.

One of the greatest threats is bacterial blight, a fatal plant disease caused by the bacterium Xanthomonas oryzae pv. oryzae. The disease, most prevalent in Southeast Asia and rising in Africa, has been reported to have cut rice yields by up to 70 percent in a single season.

"We know that with higher temperature, the disease becomes worse," says Jan Leach, a plant pathologist at Colorado State University in Fort Collins. Most of the genes that help rice combat bacterial blight seem to become less effective when temperatures rise, she explains.

And as the world warms, new frontiers may open for rice pathogens. An August study in Nature Climate Change suggests that as global temperatures rise, rice plants (and many other crops) at northern latitudes, such as those in China and the United States, will be at higher risk of pathogen infection.

Meanwhile, rising temperatures may bring a double-edged arsenic problem. In a 2019 study in Nature Communications, E. Marie Muehe, a biogeochemist at the Helmholtz Centre for Environmental Research in Leipzig, Germany, who was then at Stanford University, showed that under future climate conditions, more arsenic will infiltrate rice plants. High arsenic levels boost the health risk of eating the rice and impair plant growth.

Leaching in

When grown in a greenhouse at 5 degrees Celsius above preindustrial temperatures with elevated carbon dioxide levels (representing a future climate), California rice varieties absorbed more of a type of highly toxic arsenic from the soil, raising the rice's arsenic levels above European Union safety thresholds.

Arsenic naturally occurs in soils, though in most regions the toxic element is present at very low levels. Rice, however, is particularly susceptible to arsenic contamination, because it is grown in flooded conditions. Paddy soils lack oxygen, and the microbes that thrive in this anoxic environment liberate arsenic from the soil. Once the arsenic is in the water, rice plants can draw it in through their roots. From there, the element is distributed throughout the plants' tissues and grains.

Muehe and her team grew a Californian variety of rice in a local low-arsenic soil inside climate-controlled greenhouses. Increasing the temperature

and carbon dioxide levels to match future climate scenarios enhanced the activity of the microbes living in the rice paddy soils and increased the amount of arsenic in the grains, Muehe says. And importantly, rice yields diminished. In the low-arsenic Californian soil under future climate conditions, rice yield dropped 16 percent.

According to the researchers, models that forecast the future production of rice don't account for the impact of arsenic on harvest yields. What that means, Muehe says, is that current projections are overestimating how much rice will be produced in the future.

Managing rice's thirst

From atop an embankment that edges one of his fields, Rystrom watches water gush from a pipe, flooding a paddy packed with rice plants. "On a year like this, we decided to pump," he says.

Able to tap into groundwater, Rystrom left only about 10 percent of his fields unplanted this growing season. "If everybody was pumping from the ground to farm rice every year," he admits, it would be unsustainable.

One widely studied, drought-friendly method is "alternate wetting and drying," or intermittent flooding, which involves flooding and draining rice paddies on one- to 10-day cycles, as opposed to maintaining a constant inundation. This practice can cut water use by up to 38 percent without sacrificing yields. It also stabilizes the soil for harvesting and lowers arsenic levels in rice by bringing more oxygen into the soils, disrupting the arsenic-releasing microbes. If tuned just right, it may even slightly improve crop yields.

But the water-saving benefits of this method are greatest when it is used on highly permeable soils, such as those in Arkansas and other parts of the U.S. South, which normally require lots of water to keep flooded, says Bruce Linquist, a rice specialist at the University of California Cooperative Extension. The Sacramento Valley's clay-rich soils don't drain well, so the water savings where Rystrom farms are minimal; he doesn't use the method.

Building embankments, canal systems and reservoirs can also help farmers dampen the volatility of the water cycle. But for some, the solution to rice's climate-related problems lies in enhancing the plant itself.

Better breeds

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The world's largest collection of rice is stored near the southern rim of Laguna de Bay in the Philippines, in the city of Los Baños. There, the International Rice Genebank, managed by IRRI, holds over 132,000 varieties of rice seeds from farms around the globe.

Upon arrival in Los Baños, those seeds are dried and processed, placed in paper bags and moved into two storage facilities — one cooled to 2˚ to 4˚ C from which seeds can be readily withdrawn, and another chilled to –20˚ C for long-term storage. To be extra safe, backup seeds are kept at the National Center for Genetic Resources Preservation in Fort Collins, Colo., and the Svalbard Global Seed Vault tucked inside a mountain in Norway.

All this is done to protect the biodiversity of rice and amass a trove of genetic material that can be used to breed future generations of rice. Farmers no longer use many of the stored varieties, instead opting for new higher-yield or sturdier breeds. Nevertheless, solutions to climate-related problems may be hidden in the DNA of those older strains. "Scientists are always looking through that collection to see if genes can be discovered that aren't being used right now," says Ronald, of UC Davis. "That's how Sub1 was discovered."

The Sub1 gene enables rice plants to endure prolonged periods completely submerged underwater. It was discovered in 1996 in a traditional variety of rice grown in the Indian state of Orissa, and through breeding has been incorporated into varieties cultivated in flood-prone regions of South and Southeast Asia. Sub1-wielding varieties, called "scuba rice," can survive for over two weeks entirely submerged, a boon for farmers whose fields are vulnerable to flash floods.

Some researchers are looking beyond the genetic variability preserved in rice gene banks, searching instead for useful genes from other species, including plants and bacteria. But inserting genes from one species into another, or genetic modification, remains controversial. The most famous example of genetically modified rice is Golden Rice, which was intended as a partial solution to childhood malnutrition. Golden Rice grains are enriched in beta-carotene, a precursor to vitamin A. To create the rice, researchers spliced a gene from a daffodil and another from a bacterium into an Asian variety of rice.

Three decades have passed since its initial development, and only a handful of countries have deemed Golden Rice safe for consumption. On July 23, the Philippines became the first country to approve the commercial production of Golden Rice. Abdelbagi Ismail, principal scientist at IRRI, blames the slow acceptance on public perception and

commercial interests opposed to genetically modified organisms, or GMOs (SN: 2/6/16, p. 22).

Looking ahead, it will be crucial for countries to embrace GM rice, Ismail says. Developing nations, particularly those in Africa that are becoming more dependent on the crop, would benefit greatly from the technology, which could produce new varieties faster than breeding and may allow researchers to incorporate traits into rice plants that conventional breeding cannot. If Golden Rice were to gain worldwide acceptance, it could open the door for new genetically modified climate- and disease-resilient varieties, Ismail says. "It will take time," he says. "But it will happen."

Climate change is a many-headed beast, and each rice-growing region will face its own particular set of problems. Solving those problems will require collaboration between local farmers, government officials and the international community of researchers.

"I want my kids to be able to have a shot at this," Rystrom says. "You have to do a lot more than just farm rice. You have to think generations ahead."

sciencenews.org, 24 September 2021

https://www.sciencenews.org

The unusual headaches that upended this man's life began with a new car

2021-09-25

As Tom Wells and his wife, Susan, settled into their seats in a recently renovated Maryland movie theater in October 2015, she asked him if they should leave.

Wells had spent more than a decade battling headaches triggered by exposure to the smell of new cars or fresh paint. Susan Wells noticed the faint but unmistakable chemical smell of new carpet and paint and asked her husband what he wanted to do.

Wells, who had also detected the odor, replied that he would probably be fine — it was a big theater, he rationalized — so the couple stayed to watch the Cold War drama "Bridge of Spies."

What Wells did not anticipate was that the three hours he spent in that theater would be the worst decision he ever made. "I don't know what the hell I was thinking," he said recently.

Wells had spent more than a decade battling headaches triggered by exposure to the smell of new cars or fresh paint.

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Six years later, the headache he developed hours after seeing the movie has not completely dissipated.

"The poor guy has really made the rounds," observed his longtime neurologist, Nirjal K. Nikhar, referring to the panoply of experts — pain specialists, neurosurgeons, headache experts and neurologists — the 57-year-old retired Freddie Mac senior director consulted. For the past 18 months, a new treatment regimen appears to be working.

"The two big questions in his case are, 'Why did this happen?' and 'What do you do about it?'" observed Nikhar, adding that aspects of Wells's unusual malady continue to puzzle him.

New-car smell

Wells's problem started in 2002 when he bought a new car. A few hours after driving it off the lot near his suburban Maryland home he developed an unusual headache — a burning sensation in the center of his head as though "someone was sandpapering my brain."

Wells, who was in good health and had no history of headaches, noticed that when he drove his wife's older car he had no problem. Fearing the new car had an exhaust leak, he returned it. But when he bought a used vehicle, the same thing happened.

He consulted an allergist, who referred him to a physician at Johns Hopkins Hospital in Baltimore who specializes in environmental health.

The Hopkins specialist told Wells that he appeared to be highly sensitive to volatile organic compounds (VOCs), gasses that are emitted into the air and are found in a wide variety of products or processes. Among them are those used in the building of vehicles, resulting in what's known as the new-car smell.

These ubiquitous compounds, some of which are not detectable by smell, may increase the risk of health problems in people with respiratory difficulties or those who are unusually sensitive to them. The effects of VOC exposure are related to the particular chemical, the length of exposure and the amount circulating in the air.

Chronic exposure to high levels of some VOCs such as benzene has been linked to neurological damage and cancer. Cigarette smoke and gasoline are sources of benzene exposure.

Wells said the doctor told him that he should try to avoid fresh paint, new carpeting and new cars, all of which are significant sources of VOCs.

If he didn't, he remembers the doctor telling him, his headaches would probably become more severe and prolonged.

For the next several years Wells took pains to follow that advice and remained headache-free.

"I called ahead to a hotel and talked to the manager to ask for rooms that hadn't been recently renovated," he recalled. When his family went to Florida on vacation, they stayed in the same condo, which had tile floors. Wells did not buy a new car. And when he rented cars, he asked for the oldest one on the lot and requested that it not be cleaned before he picked it up.

In 2008, the couple bought new living room furniture. Soon after it arrived, so did a severe headache. Wells subsequently learned that the furniture was made of pressed or composite wood. Composite wood often contains formaldehyde, a VOC. The furniture was returned, replaced by items made of solid wood, which contains lower levels of VOCs. This time his headache lingered for several weeks.

Worried that his headaches were lasting longer, Wells consulted a second Hopkins specialist. She told him she couldn't determine the cause of his headaches and suggested he might benefit from biofeedback, a mindfulness therapy that uses sensors to measure body functions with the goal of reducing pain and stress. Wells tried it briefly but could not find a specialist who used the therapy for headaches.

He then saw Nikhar, who ordered an MRI brain scan, which was normal.

In an effort to treat the headaches, which the neurologist suspected had an "inflammatory component," Nikhar prescribed increasingly large doses of prednisone, a potent corticosteroid that reduces inflammation but can cause serious side effects if taken long term and at high doses.

Wells said it was hard to tell if the drug worked. On one occasion he parked in the garage at work, then realized the floor had been newly painted; Wells said he developed a headache within 30 minutes. Despite high doses of prednisone and weeks avoiding the garage, his headache lasted two months.

Ill-fated movie night

Wells can't explain his decision to stay and watch the movie, except to say that he let his guard down. The burning headache began the following

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day. At first the pain was so severe he had trouble focusing and one night wound up in a local emergency room.

"I remember thinking what have I done?" he said. "It scared the hell out of me."

In early 2016, Nikhar ordered a second brain MRI. This scan, unlike the first, was not normal. It showed multiple deep white matter lesions of unknown significance. Migraines, multiple sclerosis, and other ailments can cause such lesions.

"No one can say what they mean," said Nikhar, adding that they are an unexpected finding in a man in his 50s. Wells has since undergone several MRIs that show no change.

For the next three years Wells consulted multiple specialists in an effort to treat his relentless headache: neurologists, pain management experts, neurosurgeons, and a rheumatologist. He tried a cornucopia of medications: drugs to treat migraines, depression and nerve pain, along with muscle relaxants, an antihistamine, pain relievers and sedatives; none seemed to make a difference. Neither did a dozen injections in his forehead that were supposed to relieve pain or several months of acupuncture.

"Nobody said, 'Hey, it's all in your head,' " Wells recalled. But doctors were baffled that his headaches would last months and uncertain about their origin. Sometimes chronic headaches are the result of a rebound reaction caused by frequent or excessive use of pain medication.

Wells said he was vigilant about avoiding the VOCs he knew might be problematic and his employer was accommodating. When his office was scheduled to undergo renovation, he was moved to an old workspace.

By 2019, his pain had diminished. Wells had started taking a benzodiazepine, a sedative used to treat anxiety, insomnia and panic disorder that Nikhar prescribed.

"How it helps his headaches is not clear," Nikhar said. "Maybe calming him down relaxes his muscles." But the neurologist said he does not believe Wells's headaches are the result of anxiety. "I think the anxiety is there as a result of the symptoms," Nikhar said. "I don't think the anxiety is a driver of his headaches."

Using a benzodiazepine, a class of drugs known to be addictive can be risky, the neurologist said. "You're conflicted between two factors. You want to help patients but not create a dependency."

By the end of 2019, Wells's headache was significantly worse.

"My anxiety really ratcheted up," he recalled. "I wondered, 'Is this going to be my life?'"

Some relief

In early 2020 Wells, with Nikhar's encouragement, made an appointment with a Cleveland Clinic neurologist who specializes in treating headaches.

The appointment was set for the end of March, two weeks after the pandemic shut down travel and the ability to seek in-person, non-emergency care.

During a 30-minute phone conversation, the Cleveland doctor suggested that Wells might be experiencing a phenomenon called central sensitization, in which the central nervous system amplifies pain signals sent to the brain.

The cause of central sensitization is unclear; genetic factors such as a heightened response to pain may play a role. Sometimes there is a precipitating event such as trauma or surgery.

Wells said the neurologist told him that he had seen a few similar cases and that a key objective was to interrupt the cycle.

Shortly before their call, Wells had begun taking a second medication, an antidepressant approved to treat nerve pain that Nikhar prescribed. The Cleveland specialist advised Wells to continue taking the drug, which is used in the treatment of migraines, at higher doses if necessary, to gauge its effectiveness.

Four months later Wells's headaches were greatly diminished. He continues to take the antidepressant, along with the benzodiazepine, which he uses when the pain flares. So far he said, his headaches have remained "very manageable. I'm trying to take as little medication as I can," he said, adding that he hopes to stop taking both drugs entirely.

Nikhar has no idea why the drug combination works, calling the treatment "somewhat out of the box." Central sensitization, he noted, is "well-recognized in headaches."

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Wells's sole symptom, he added, has been "very specific and consistent over the years" which is somewhat unusual.

Nikhar said he doesn't know what to make of Wells's abnormal MRI or whether the lesions are related to his headache or something else.

"In neurology," he observed, "there's no end of unanswered questions."

washingtonpost.com, 25 September 2021

https://www.washingtonpost.com

'Grandma' killer whale missing from pod, feared dead

2021-09-25

An aging killer whale "grandmother" in a large, extended orca family in the northeastern Pacific Ocean hasn't been seen in months and is thought to have died.

The orca (Orcinus orca), known as L47, was one of the most prolific females in the Southern Resident clan; she gave birth to seven calves that lived long enough to receive their own alphanumeric "names," more than any other Southern Resident female has produced, representatives of the Center for Whale Research (CWR) said in a statement.

The Southern Resident group is made up of three pods — J, K and L — of closely related whales that swim in waters near British Columbia, Washington and Oregon. Each pod centers around an older female, and at 47 years old, L47 was a long-standing matriarch in the L pod, according to the statement.AY SOUND

On Sept. 20, CWR representatives reported that L47 was missing from their 2021 census for Southern Resident killer whales. She was last spotted Feb. 27 in Swanson Channel near British Columbia, and while she did not appear malnourished or in distress, she was not seen again in surveys conducted during the early summer in the Strait of Juan de Fuca, a body of water connecting the Salish Sea to the Pacific Ocean.

Nor was she observed in September, when CWR researchers repeatedly encountered and photographed L47's L pod kids and grandkids. "Her repeated absence meets our criteria for declaring a whale missing and likely deceased," CWR representatives wrote in the statement.

Two of L47's adult daughters are still alive, and the daughters have sons of their own. (Female orcas reproduce until they are about 40 years old,

Each pod centers around an older female, and at 47 years old, L47 was a long-standing matriarch in the L pod, according to the statement.AY SOUND

according to the National Oceanic and Atmospheric Administration (NOAA)). L47 also leaves behind a roughly 10-year-old son, named L115.

Killer whale pods depend on their matriarchs for leadership, especially when salmon is hard to find, and L47's death could spell trouble for the pod's youngest and most vulnerable members, who rely on older females to make sure that the youngsters get enough to eat, according to the statement.

"Her son, L115, is at an approximately three times greater risk of death in the next two years than a male of the same age would be with a surviving mother," CWR representatives said.

L47's presumed death brings the number of Southern Resident killer whales to 74 individuals, but that number represents just a small fraction of killer whales worldwide. While some orca populations, including the Southern Resident clan, have declined in recent decades, there are an estimated 50,000 orcas globally, and about 2,500 of them live in northeastern Pacific waters, NOAA says.

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https://www.livescience.com

Half of young, American kids have lead in their blood, study finds

2021-09-28

More than half of young American children who underwent lead testing had detectable levels of the poisonous metal in their blood, according to a massive study of more than a million kids living in the world's richest country.

There's no safe amount of lead that a kid can have in their blood, and the negative effects of lead poisoning—like learning disabilities, anemia, hearing problems, and more—can happen even with low exposure levels, according to the U.S. Environmental Protection Agency (EPA). Monday's study, published in the peer-reviewed journal JAMA Pediatrics, found that more than 50% of the 1.1 million kids younger than 6 years old that were tested between October 2018 and February 2020 had some level of lead in their blood.

The CDC has considered lowering its blood lead threshold for young kids to 3.5 micrograms per deciliter.

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A "detectable" level—or what was found in half the children—was described as 1 microgram per deciliter or more, while an "elevated" level was defined as 5 micrograms per deciliter or more.

Nearly 2% of all the kids in the study clocked an elevated level 5 micrograms per deciliter of lead in their blood or more—meeting the CDC's threshold for a public health intervention, and the level that's most often researched.

The CDC has considered lowering its blood lead threshold for young kids to 3.5 micrograms per deciliter.

Although blood lead levels have dropped significantly in the past few decades thanks to better regulations and public health efforts, disparities in who's harmed by the toxin—sometimes found in paint chips or water pipes—persist. Young kids who were poor, on public insurance, living in majority-Black or Hispanic neighborhoods, or living in pre-1950s housing were more likely to have detectable lead in their blood, according to the study, which examined clinical lab data from Quest Diagnostics.

"The fact we're still talking about lead in 2021 indicates that we need to invest in public health infrastructure and make sure families, pregnant women, infants, and children are as safe as possible," Marissa Hauptman, the assistant director at the Pediatric Environmental Health Center at Boston Children's Hospital and a lead author of the study, said in an article for her hospital's website. "We need to invest more in our housing stock and not rely on residents and landlords to mitigate lead hazards. In Massachusetts, only 10 to 15 percent of homes have ever been inspected for lead."

Even so, researchers did not find "associations between lead exposure and elevated [blood lead levels] in children residing in zip codes with predominantly Black or Hispanic and Latinx populations," but non-white kids disproportionately rely on programs like Medicaid and are more likely to be impoverished. The most prominent example of mass lead contamination also occurred in a majority-Black community: Flint, Michigan.

On top of harming children, doing nothing will cost America. Just helping kids born in 2018 reach a blood lead level of zero would save the country

The ancient raptor has no direct descendants living today, they determined.

some $84 billion over their lifetimes, researchers wrote—largely because children would be able to reach their full productivity potential.

vice.com, 28 September 2021

https://www.vice.com

Koala-hunting eagle terrorized Australia 25 million years ago

2021-09-28

Twenty-five million years ago, an eagle with half-foot long talons snatched ancient koalas out of trees in Australia, a new study suggests.

Paleontologists discovered 63 fossilized bones from the ancient koala-hunter in 2016, while on an expedition to Lake Pinpa, a salt lake east of the Flinders Ranges in South Australia. After thoroughly examining the bones, the team recently named the newfound eagle species Archaehierax sylvestris. The ancient raptor has no direct descendants living today, they determined.

Since the bones date to the Oligocene epoch, which lasted from 33.9 million to 23 million years ago, the A. sylvestris specimen represents the oldest eagle fossil ever found in Australia, as well as one of the best preserved, the scientists reported Sept. 27 in the journal Historical Biology.

PLAY SOUND

"As apex predators, eagles and hawks are less abundant than the species they prey on," first author Ellen Mather, a doctoral student at Flinders University in Adelaide, Australia, told Live Science in an email. "This tends to carry over into the fossil record, as there are fewer chances an individual from these species will be fossilized."

And when they are found, eagle fossils often include very few bones — or sometimes only one — making the newfound fossil, with its 63 bones, an exceptionally rare find, the authors noted in their report.

Nowadays, Lake Pinpa, where the fossil was found, rarely holds any water and sits within a landscape of sand dunes sparsely adorned with grass and trees. But back when A. sylvestris soared through the skies, the lake looked strikingly different, senior author Trevor Worthy, a vertebrate paleontologist and associate professor at Flinders University, told Live Science in an email.

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At that time, the Lake Pinpa excavation site sat on the shore of a larger lake, or lake system, which extended for about 62 miles (100 kilometers) through a temperate rainforest. Fossil records indicate that fish, crocodiles and freshwater dolphins populated the lakes, and an array of shorebirds, possums and ancestral koalas hung out on the shore.

"Lake Pinpa, as a whole, is the most rich fossil site for this time period in South Australia," Worthy said. The earliest known ancestors of modern marsupials, such as bandicoots, possums, kangaroos and wombats, have all been found at the site, along with many avian herbivores, such as ducks and cormorants. But even in this treasure trove of ancient Australian fossils, hawk and eagle specimens have been few and far between, he said.

When Worthy's team first discovered the A. sylvestris fossil in 2016, "we knew instantly we had a large bird, but it was highly fragmented and so not spectacular," he said. Among the first bone fragments they excavated, the team found claws and a lower leg bone called a tarsometatarsus; these bones revealed that the specimen was an eagle, but at that time, they didn't know which species. So they carefully scooped up the bones in a big lump of sediment, encased the whole lot in plaster and shipped the specimen back to their lab.

Worthy and the team then carefully freed the bone bits from their surrounding sediment, one piece at a time, and jig-sawed all the bits back together into complete bones. Some bones contained as many as 20 tiny fragments, Worthy said. Mather then compared the assembled bones with those of various falcons, ospreys, eagles and hawks. Based on this analysis, she determined that the fossil belonged to a family of raptors called Accipitridae, which includes hawks, eagles, kites and Old World vultures.

That said, specific features of the newfound fossil, such as the spacing of its toes and insertion points for its leg muscles, set the bird apart from other members of the Accipitridae family, Mather said. Based on these features, as well as the age of the Lake Pinpa site, the team concluded that the bird belonged to a previously unknown subfamily and species of eagle.

"We can be confident that the fossil represents a new species as the only other eagle species of a similar age, Pengana robertbolesi from Riversleigh, Queensland, has a very different morphology from Archaehierax," Mather said.

The unique features of the A. sylvestris bones also hinted at the ancient bird's hunting style. The eagle had a 5.9-inch-long (15 centimeters) foot-span and long legs compared with its overall size, meaning the predator

was equipped with the perfect tools to reach out and snatch large prey from the treetops. And the eagle's relatively short wings hint that, while not a particularly fast flier, A. sylvestris likely excelled at dive-bombing unsuspecting koalas from above.

Although eagle fossils are generally hard to come by, at certain excavation sites, they're relatively common, Mather noted. For example, at the La Brea Tar Pits in Los Angeles, eagles and other predators would become trapped in tar while attempting to eat other animals in the pits; that means today, a fair number of predator fossils can be found at the site.

"However, this is not the case at Lake Pinpa," where no specific feature of the environment favors the preservation of predators, Mather said. "The fossilization of our eagle was a matter of luck."

livescience.com, 28 September 2021

https://www.livescience.com

Our brains have more in common with testicles than you ever wanted to know

2021-06-02

That delightful saying about men thinking with their nether regions has gained a new meaning. A new study has found an unnerving lot of similarities between men's brains and the innards of their scrotums.

"Brain and testis have the highest number of common proteins, compared with other human body tissues," a team led by biomedical scientist Bárbara Matos from the University of Aveiro in Portugal writes in their new paper.

While the brain has a highly complex role - controlling our bodies, receiving and interpreting signals from sensory organs, not to mention doing all our thinking and feeling, human testes have just two main functions - the production of sperm and hormones. (Although, many of us should be forgiven for attributing these gonads with their own thoughts and feelings too.)

Previous studies have suggested there are links between sexual dysfunction and brain disorders, and even between intelligence and semen quality. Of course, such links do not mean much by themselves, but now the team of researchers from Portugal and the UK has found an explanation for why they might exist.

They compared proteins across 33 tissue types, including the heart, intestine, cervix, ovaries and placenta, and found that testes and brains share 13,442 proteins in common. This is corroborated by gene expression studies showing these two distantly positioned organs share the highest number of genes among all the organs in the body.

Taking a closer look at the shared proteins most highly expressed in these tissues, Matos and colleagues found they're mostly involved in tissue development and cell communication. These shared proteins make sense when you consider how unexpectedly similar the two tissues are in many ways, the team explains.

The brain and testes are both greedy for energy to fuel highly demanding processes like thinking and the production of several million little sperms per day. So both organs have specialized cells to support the hard-working neurons in the brain and germ cells in the testes - to keep them well fed and physically comfortable.

Also, despite being very differently purposed cells, neurons function similarly to sperm in several ways. Both cells have important tasks

A new study has found an unnerving lot of similarities between men's brains and the innards of their scrotums.

involving moving stuff from within themselves to their outside environment - a process called exocytosis.

This is how brain cells pass neurotransmitters between each other. In sperm, the same process is used to release important fertilization factors.

In neurons, exocytosis is also involved in the growth of their reaching little branching arms collectively called neurites (dendrites and axons), while in sperm this process allows its innards to fuse with an egg.

"This is an underexplored topic, and the connection between these tissues needs to be clarified, which could help to understand the dysfunctions affecting brain and testis," the team wrote.

These findings raise a lot of questions, the obvious being how did two such disparate organs end up sharing so much in common? The researchers suspect it's because they're both strongly influenced by the speciation process.

Just like animals separated by millions of years of evolution and evolved half a world away from each other can develop the same traits, so too can different tissue groups within the human body.

For example, unlike most other animals, koalas have fingerprints confusingly similar to ours - thanks to the obvious selection pressure exerted by our (well, our primate ancestors') need to grip trees - despite 70 million years of evolution between us. This process is called convergent evolution.

In this case, the researchers propose the same selection pressures involved in keeping species distinct from each other may be imposed on both organs, causing them to evolve convergently. They point to 60 protein-coding genes, unique to humans, many of which are found within the brain and testis.

"The highest expression levels in cerebral cortex and testis suggested that these genes may contribute to phenotypic features that are exclusive of humans, such as the improved cognitive ability," the team wrote.

While owners of testes may not be so thrilled by these biological revelations, the rest of us might be inclined to think it makes an awful lot of sense. But before we get too ahead of ourselves, this finding means female brains share these similarities with balls, too.

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Their research was published in Royal Society Open Biology.

sciencealert.com, 2 June 2021

https://www.sciencealert.com

DNA offers a new look at how Polynesia was settled

2021-09-22

Polynesian voyagers settled islands across a vast expanse of the Pacific Ocean within about 500 years, leaving a genetic trail of the routes that the travelers took, scientists say.

Comparisons of present-day Polynesians' DNA indicate that sea journeys launched from Samoa in western Polynesia headed south and then east, reaching Rarotonga in the Cook Islands by around the year 830. From the mid-1100s to the mid-1300s, people who had traveled farther east to a string of small islands called the Tuamotus fanned out to settle Rapa Nui, also known as Easter Island, and several other islands separated by thousands of kilometers on Polynesia's eastern edge. On each of those islands, the Tuamotu travelers built massive stone statues like the ones Easter Island is famed for.

On each of those islands, the Tuamotu travelers built massive stone statues like the ones Easter Island is famed for.

That's the scenario sketched out in a new study in the Sept. 23 Nature by Stanford University computational biologist Alexander Ioannidis, population geneticist Andrés Moreno-Estrada of the National Laboratory of Genomics for Biodiversity in Irapuato, Mexico, and their colleagues.

The new analysis generally aligns with archaeological estimates of human migrations across eastern Polynesia from roughly 900 to 1250. And the study offers an unprecedented look at settlement pathways that zigged and zagged over a distance of more than 5,000 kilometers, the researchers say.

"The colonization of eastern Polynesia was a remarkable event in which a vast area, some one-third of the planet, became inhabited by humans in … a relatively short period of time," says archaeologist Carl Lipo of Binghamton University in New York, who wasn't involved in the new research.

Improved radiocarbon dating techniques applied to remains of short-lived plant species unearthed at archaeological sites are also producing a chronology of Polynesian colonization close to that proposed in the genetic study, Lipo says.

In the new investigation, researchers identified DNA segments of exclusively Polynesian origin in 430 present-day individuals from 21 Pacific island populations. Island-specific genetic fingerprints enabled the scientists to reconstruct settlement paths, based on increases in rare gene variants that must have resulted from a small group moving from one island to another and giving rise to a new, larger population with novel DNA twists. Comparisons of shared Polynesian ancestry between pairs of individuals on different islands were used to estimate when settlements occurred.

In an intriguing twist, the DNA evidence "is consistent with the [statue] carving tradition arising once in a single point of common origin, likely the Tuamotu islands," Moreno-Estrada says. Polynesian ancestry on all the islands with massive statues traces back to the one island in the Tuamotus where the researchers were able to obtain Indigenous peoples' DNA.

The Tuamotus include nearly 80 islands situated between Tahiti to the west and other islands to the north and east where settlers carved statues. The latter outposts consist of the Marquesas Islands, Mangareva and Rapa Nui. Another late-settled island where inhabitants carved statues, Raivavae, lies southwest of the Tuamotus.

Settlers reached the island of Mataiva in the northern Tuamotus by about 1110, the researchers suggest. Statue makers navigated northward and eastward from Mataiva or perhaps other Tuamotu islands to as far east as Rapa Nui — eventually curving back west before arriving at Raivavae — around the same time as an earlier DNA study suggests eastern Polynesians mated with South Americans (SN: 7/8/20). (It's not clear whether South Americans crossed the ocean to Polynesia or Polynesians traveled to South America and then returned.)

Pacific trek

Caption: An analysis of 430 present-day individuals is shedding new light on the timings and routes of early Polynesians' migrations. Modern DNA indicates that voyagers left Samoa and went south and then east, reaching Rarotonga in the Cook Islands by around the year 830. From the mid-1100s to the mid-1300s, people who had traveled to the Tuamotu Islands, located just east of Tahiti, spread out to settle Rapa Nui, also known as Easter Island, and several other islands separated by thousands of kilometers.

Ioannidis and colleagues' conclusions generally support prior scenarios of Polynesia's settlement, but some disparities exist between their

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genetic evidence and earlier archaeological and linguistic findings, writes archaeologist Patrick Kirch of the University of Hawaii at Manoa in a commentary published with the new study.

For instance, the new DNA analysis overlooks extensive contacts that occurred across eastern Polynesian in its early settlement stages, Kirch says. Analyses of closely related eastern Polynesian language dialects and discoveries of stone tools that were transported from one island to another point to substantial travels and trading throughout the region during that time.

Kirch, who has previously suggested that these long-distance contacts in eastern Polynesian influenced stone carving traditions, calls the new proposal that people with a shared ancestry brought stone carving to Rapa Nui and other islands "a provocative hypothesis."

And there's still no answer to one major question regarding the settlement of the islands, says molecular anthropologist Lisa Matisoo-Smith of the University of Otago in Dunedin, New Zealand, who didn't participate in the new research. No current line of evidence can resolve the mystery of why, after spending nearly 2,000 years on Samoa, Tonga and Fiji, Polynesians began voyaging thousands of kilometers eastward in search of new lands.

sciencenews.org, 22 September 2021

https://www.sciencenews.org

How green is your food? Eco-labels can change the way we eat, study shows

2021-09-22

It's lunchtime at a workplace cafeteria in Birmingham, and employees returning to work after months away during the coronavirus pandemic are noticing something has changed. Next to the sandwiches and hot and cold dishes is a small globe symbol, coloured green, orange or red with a letter in the centre from A to E. "Meet our new eco-labels", a sign reads.

Researchers at Oxford University have analysed the ingredients in every food item on the menu and given the dishes an environmental impact score, vegetable soup (an A) to the lemon, spring onion, cheese and tuna bagel (an E).

"It probably does help you to start making some choices," said Natasha King, while eating a plant-based hot meal. She is an employee in the Birmingham headquarters of the UK division of the food services business

How much information do you include in a label?

Compass Group. The company has teamed up with the university for a trial at more than a dozen of its cafeterias across the UK to see if a label can change the way people eat.

Getting people to switch to environmentally sustainable food options through labels is not new: hundreds of food labels exist, from ones that certify organic, to those that promise sustainable fishing. But a new type is gaining steam, one that summarises multiple environmental indicators from greenhouse gas emissions to water use into a single letter indicating the product's impact.

Some businesses in France began using one this year and the NGO Foundation Earth announced its own trial to begin in UK and EU supermarkets this autumn.

The first challenge for the scientists designing the trial is the image the diners see on the signs. How much information do you include in a label? How do you strike a balance between effective and practical?

During the pandemic, researchers ran studies on an online supermarket where people were given fake money to complete their fake shopping list. The trial gave a sense of what labels were more likely to sway people to buy eco-friendly. They found the most effective way to get people to not buy an item was to use a dark red globe symbol with the word "worse" printed on it. But while effective, it had real world limitations.

"You're not going to be able to get anyone to use that unless you threaten them with legislation, because they don't want to say 'don't buy this'," said Brian Cook, the senior researcher at Oxford's Leap programme leading the project.

And what works for this cafeteria setting, with lots of room for information on walls and beside the food, may not work on food packaging in a supermarket that's already full of information, much of it government mandated. "The real estate there is highly competitive," Cook said.

The next challenge in supermarkets is the scale. The sandwiches, soups, and hot dishes laid out in this cafeteria only scratch the surface of the Compass food options. It was the Oxford researcher Michael Clark's job to go through the hundreds of meals made up of roughly 10 ingredients each, determining the environmental impact. Doing the same for the tens of thousands of products and myriad ingredients in a supermarket would be a Herculean task.

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Then the scientists had to create a formula to determine environmental impact – a process full of tough decisions using imperfect data. "There's neverending ways you can do it and how you weight the different indicators … how you want to nudge people," Cook said.

This research team decided on four indicators for this trial's formula: greenhouse gas emissions, biodiversity loss, water pollution, and water use (calculated differently based on water scarcity in each region). They weighted each indicator equally in their equation for overall impact.

Other research has looked at land use instead of biodiversity, or using a total of 16 indicators. Whatever the choice, it can change the eco-score that comes out.

"Almonds, you know: great for your health and low in a lot of environment indicators, but then you get to the water, and they are off the charts," Cook said.

But in most cases, the researchers say the biggest environmental impact will be to get people off meat. "Given that the premise is to get people to shift behaviour, that most correct and scientifically robust approach may actually not be the best approach," Clark said.

He has considered that a national rollout of labels might need to be based on indicators already prioritised by businesses or mandated by governments, to make the integration as easy as possible for businesses.

In a corner table at the Compass cafeteria, five employees eat together, four of them have chosen a vegetarian meal. They say many of them would usually have opted for meat.

At another table sits Jenny Haines, eating a vegetable stew (rated a C). She does not often think about the environmental impact of the food she eats, but she says it looked appetising, healthy, and was placed right at the front of the hot meals counter.

This was part of an intentional strategy by Compass to find ways to get customers to buy food with a better environmental impact score. Plant-based dishes are placed at the top of menus and at the front of cafe counters, with meat dishes at the back. They do not use the words "vegan" or "plant-based" so people do not feel dictated to, and they gave their dishes a rebrand. "Vegan sweet potato mac n cheese" became "Ultimate New York 'cheezy' sweet potato mac", for example.

At the centre of everything is taste. "Ticking the box isn't good enough," said Ryan Holmes, a culinary director at Compass. "We need to put plant-based dishes that can stand next to the meat dishes."

Some politicians are also interested in this issue. MPs in the UK and Canada have introduced private member's bills this year aiming to mandate environmental impact labels on food.

Cook gives presentations to business groups and some policymakers in the UK, and says people have a lot of interest in labels. He thinks we will see these labels in some form on products sooner or later.

"It's definitely part of the toolkit of what you need," he said. "And in terms of the things that are risky to all stakeholders, this is relatively low risk."

theguardian.com, 22 September 2021

https://www.theguardian.com

A little radiation is not good for you

2021-09-24

In a rare pushback against the radioactive pollution industry, the Nuclear Regulatory Commission — well known as a rubber stamp for the nuclear lobby — has flatly rejected an attempt to further weaken the agency's radiation exposure regulations.

After six years of deliberation, the NRC's three commissioners, two Democrats and one Republican, voted unanimously to reject formal petitions submitted in February 2015 urging the agency to adopt a cost-cutting scheme known as "hormesis" which claims that "a little radiation is good for you." The September 16 decision by the NRC says this "threshold theory posits that "there is some threshold dose below which there is either no radiation-related health detriment or a radiation-related health benefit that outweighs any detriment." The order then rebukes this concept, finding the petitioners "fail to present an adequate basis supporting the request," and "Convincing evidence has not yet demonstrated the existence of a threshold below which there would be no … effects from exposure to low radiation doses."

The basis for hormesis had been explicitly rejected ten years earlier, the NRC pointed out, by the National Academy of Sciences in its 2005 report "Biologic Effects of Ionizing Radiation, 7th Ed" or BEIR-VII. The National Research Council summed up its book-length BEIR-7 report saying, "the smallest dose has the potential to cause a small increase in risk to humans."

The National Research Council summed up its book-length BEIR-7 report saying, "the smallest dose has the potential to cause a small increase in risk to humans."

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Industrial producers of radioactive pollution have for years pushed for weaker radiation exposure limits and for deregulation of radioactive emissions from nuclear reactors, uranium processing plants, fuel fabrication operations, medical isotope manufacturing systems, and weapons production sites. In 2002, Roger Clarke, then president of the International Commission on Radiological Protection (ICRP), warned in the Bulletin of the Atomic Scientists, "Some people think that too much money is being spent to achieve low[er] levels of residual contamination."

Clarke's "some people" are nuclear industrialists who build and operate nuclear weapons and reactors, produce uranium fuel rods and medicinal isotopes, create radioactive waste, and waste storage systems, and who are permitted by the NRC to disperse radioactively contaminated water and gases. The industry and the 2015 petitioners want, in Roger Clarke's words, "a threshold in the dose-response relationship in order to reduce the expenditure." And as the journal Science reported, "Billions of dollars are at stake. Stricter standards could increase the amount that agencies and industries must spend to clean up radioactive waste and protect workers."

The same year that the petitioners appealed to the NRC, a landmark international study reported in British journal Lancet Haematology concluded "In summary, this study provides strong evidence of an association between protracted low dose radiation exposure and leukemia mortality." As reported in the journal Nature, "The finding scuppers the popular idea that there might be a threshold dose below which radiation is harmless [i.e. hormesis] — and provides scientists with some hard numbers to quantify the risks of everyday exposures."

In addition, between 1977 and 1990, scientists tripled their estimate of the damage inflicted by a given dose of radiation. A 1992 study published in the American Journal of Industrial Medicine found that nuclear weapons production workers exposed to small doses were four to eight times more likely to contract cancer than previously estimated. And in 2012, a wide-ranging analysis of 46 peer-reviewed studies published in Biological Reviews found that even the very lowest background levels of radiation exposure are harmful to health and have statistically significant negative effects on DNA.

In public comments made to the NRC about the original petitions, Nukewatch suggested that, "Contrary to the petitioners' recommendation, the NRC should adopt the 1990 recommendations of the International Commission on Radiological Protection and drastically reduce the

maximum allowable radiation dose for nuclear industry workers, medical personnel, and others exposed to radiation on the job. The ICRP's 1990 recommendations were to cut annual exposure limits by over half, from 50 to 20 milliSieverts per-year for nuclear workers, and from five milliSievert-per-year to one for the general public. These 1990 recommendations have never been adopted by the United States, although most other countries have done so."

At long last, at least in this case, the NRC has decided not to make radiation matters worse.

counterpunch.org, 24 September 2021

https://www.counterpunch.org

Researchers call for expanded regulations on chemicals that fuel obesity

2021-09-26

Chemical exposure is fueling obesity problems around the world, and now researchers are calling for governments to expand regulations that target these substances. Called obesogens, the chemicals have hormone-disrupting effects that may play a big role in the development of obesity, as well as making it harder for people to keep the weight off when they lose it.

The researchers presented evidence that obesogen chemicals are a "significant risk to public health" at the 59th Annual European Society of Paediatric Endocrinology Meeting. The researchers describe certain chemicals as disruptors that can "scramble our normal metabolism," making individuals exposed to them more likely to gain weight.

The researchers describe certain chemicals as disruptors that can "scramble our normal metabolism," making individuals exposed to them more likely to gain weight.

These substances include phthalates, bisphenols, and PFOS; the latter chemical, for example, is found on non-stick cookware and has been found to program the body to store fat even if the conditions are such that you'd normally burn calories, such as when out in cold weather. Bisphenols, meanwhile, can increase the size of fat cells and make the body more likely to store fat.

Then there are phthalates, which are used in things like food packaging and personal care products. Studies have linked this substance to altering protein metabolism, triggering the storage of fat despite one's diet and exercise. These are three common chemicals that people are likely to be exposed to during normal everyday life.

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Dr. Leonardo Trasande, one of the researchers behind multiple studies on the topic, explained:

The old 'calories in, calories out' mantra for obesity prevention neglects the crucial role of chemical exposures as a third leg of the stool. In contrast to diet and physical activity interventions, which can hard to be implement, let alone, sustain, levels of obesogens in food packaging and other materials can be modified through regulation.

slashgear.com, 26 September 2021

https://www.slashgear.com

These colorful butterflies were created using transparent inks

2021-09-28

You've heard of disappearing ink. Now get ready for suddenly appearing ink. Using a clear liquid, researchers can print a full rainbow of colors on transparent surfaces. The trick is printing the liquid in precise, microscale patterns that create structural color.

The trick is printing the liquid in precise, microscale patterns that create structural color.

Structural colors arise from the way different wavelengths of light bounce off microscopic imperfections on surfaces (SN: 8/17/21; SN: 6/1/16). "In nature, there are many beautiful structure colors, such as the wings of butterflies, the feathers of peacocks, the skin of chameleons and so on," says Yanlin Song, a materials chemist at the Chinese Academy of Sciences in Beijing.

Song and colleagues printed structural colors on transparent silicone sheets using an ordinary ink-jet printer and clear polymer ink. The printer studded the silicone sheets with millions of microscopic ink domes, each of which served as a single pixel in the resulting image. Adjusting the size of a microdome changed the wavelengths of light that the dome reflected and therefore its color (SN: 3/8/19). Increasing the width of a single dome from 6.6 to 11 micrometers shifted its hue along the spectrum from blue to red and back again, the researchers report online September 22 in Science Advances.

The denser the domes were packed, the brighter the image. And printing a medley of differently colored ink pixels across a single area created blended shades, such as brown and gray. Using the technique, Song's team printed multicolor, photorealistic portraits of Isaac Newton, Marilyn Monroe and other famous figures.

"I was excited to see that somebody had used [structural color] for this purpose," says Lauren Zarzar, a materials chemist at Penn State who has studied similar structural colors cast by water and oil droplets. "They had some nice examples that I think illustrated the versatility of this mechanism."

Zarzar imagines using structural colors to create complex optical signatures for anti-counterfeiting features on ID cards or currency. Such shimmery, colorfast hues could also make useful materials for cosmetics, clothing or architecture, she says.

sciencenews.org, 28 September 2021

https://www.sciencenews.org

How radioactive is the human body?

2021-09-27

A lifetime of reading comic books and watching Hollywood blockbusters may make some of us believe that radiation is a rare and dangerous thing that turns people either into superheroes or deformed monsters. In reality, though, radiation is all around us, all the time, even within our own bodies.

But what, exactly, is radiation, and how much of it is in our bodies?

Radiation encompasses many processes — all of which look different to us. Fundamentally, it's when an object, like the sun, emits energy through particles or waves. But when many of us refer to "radiation," we're referring to particularly high-energy waves, such as gamma-rays, and high-energy particles emitted by radioactive atoms like uranium atoms. High-energy waves and particles are dangerous to living organisms and can damage cells exposed to them.

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Moreover, all elements on the periodic table have isotopes, or forms of the same element that contain different numbers of neutrons in their nuclei. Some isotopes are stable, but others are unstable, meaning they're radioactive and release high-energy waves or particles, according to the U.S. Department of Energy. What's more, some elements, such as uranium, exist only in an unstable form.

Many isotopes and radioactive elements occur naturally in the environment, where they get into plants and water. So, every time a person eats food or drinks water, they may be imbibing tiny amounts

But what, exactly, is radiation, and how much of it is in our bodies?

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of radioactive isotopes. The biggest sources of radiation in our bodies are trace amounts of carbon 14 and potassium 40, said Mike Short, an associate professor of nuclear science and engineering at MIT. Though these isotopes make up most of our body's radiation, we take in only about 0.39 milligrams of potassium 40 and 1.8 nanograms of carbon 14 a day. The amount of radioactivity caused by isotopes inside the human body is comparable to 1% of the radiation dose people would get on a flight from Boston to Tokyo, Short said.

"Most of these radioisotopes make their way into our bodies through the food we eat, the water we drink and the air we breathe," Short told Live Science. Some foods have higher concentrations of radioactive isotopes — like bananas, which contain a small amount of potassium 40, and Brazil nuts, which contain radium. Of course, the amounts of these foods an average person consumes does not significantly increase radiation-related health risks, according to the U.S. Environmental Protection Agency.

Other environmental factors can lead the human body to become far more radioactive. "For example, people who live in unventilated basements with large amounts of granite, bearing lots of radium, absorb much more radon and associated daughter isotopes," or the products created when a radioactive atom decays, Short said. (Radon is a radioactive, odorless gas that occurs naturally in the environment.)

In 1984, Stanley Watras, a radiation worker in Pennsylvania, unexpectedly set off an alarm that detected people's exposure to radiation. Safety personnel were puzzled to find that Watras was not physically carrying any sources of radiation, but it was later discovered that his body had absorbed huge amounts of radon gas from his basement — which he was told significantly increased his risk of lung cancer.

Short said that the radioactive isotopes humans take in are created through different processes. Potassium 40, for instance, is a "primordial nuclide," meaning it has existed in its current form since before Earth's genesis. Primordial nuclides take so long to break down, or decay, that they are essentially the same today as they were at their creation in stars or in the Big Bang.

"All potassium contains 0.011% potassium 40 naturally, so it's all around us and unavoidable," Short said. "We evolved in a radioactive environment, including ubiquitous potassium 40 from the creation of the solar system."

Radioactive isotopes, like carbon 14 and a hydrogen isotope known as tritium, are the "daughter" products of heavier elements decaying. When

heavier nuclei, like those of uranium atoms, break apart because they are unstable, the constituent parts they break into are often other isotopes.

Of note, stable isotopes are held together by the strong force, a fundamental force that binds protons and neutrons together. But as a nucleus gets bigger, the strong force may be overcome by forces that drive protons and neutrons apart — like the electrostatic repulsion between protons. When nuclei decay into smaller nuclei, they emit high-energy particles or high-energy energy waves, which is where radiation originates.

Some isotopes that people absorb may be in the environment because of human activities. "Atmospheric testing of nuclear weapons in the 50s and 60s produced small amounts of strontium 90, and Fukushima and Chernobyl released some cesium 137 and cesium 134," Short said, "though most of the latter has already decayed away."

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https://www.livescience.com

'Russian doll' set of stomach-bursting parasites released inside butterfly on remote Finnish island

2021-09-27

An ecologist's blunder led to the release of a "Russian doll" set of stomach-bursting parasites onto a remote Finnish island, a new study has revealed.

Thirty years ago, when ecologist Ilkka Hanski introduced Glanville fritillary butterflies (Melitaea cinxia) onto the island of Sottunga in the Åland archipelago, he planned to watch how a population of one species that had been placed inside a harsh habitat could survive.

But he had no idea that a trio of nested parasites would come along for the ride — with two parasites living inside another parasite, which was itself nested inside some of the butterflies.

The latter parasites, the larvae of the parasitic wasps Hyposoter horticola, eat the Glanville caterpillars they are injected into from the inside out — erupting from their host's abdomen to spin a cocoon around the caterpillar's corpse, for pupation.

Two more species of parasites nest inside H. horticola. The second is a "hyperparasitoid": parasitic wasps called Mesochorus cf. stigmaticus. The

Two more species of parasites nest inside H. horticola.

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third species is a bacterium, Wolbachia pipientis, which makes H. horticola more susceptible to M. stigmaticus. If all three stowaways are aboard a caterpillar host, H. horticola kills the caterpillar before being killed by M. stigmaticus. The hyperparasite burrows out 10 days later — consuming its way through the bacteria-ridden flesh of the first wasp parasite and then the carcass of the caterpillar.

Yet somehow, 30 years after their introduction and in spite of multiple, significant population crashes among their butterfly hosts, all four species remain alive on the tiny, 10.4-square-mile (27 square kilometer) island. In a new study, published July 7 in the journal Molecular Biology, researchers analyzed the genetics of the H. horticola population and its bacterium to figure out how these parasites achieved this incredible feat.

Anne Duplouy, the lead author of the study, said that the butterflies' fragile foothold on the island, and the numerous instances of their near-elimination from the habitat, is "a classic loss of biodiversity story."

Glanville butterflies feed exclusively on two meadow plants as caterpillars, leaving the species vulnerable to sudden changes in its environment, said Duplouy, an evolutionary biologist at Lund University in Sweden. If these meadows are allowed to become overgrown, for instance, "bushes and trees take over and the host plants go extinct under tree covers," she said. Glanville caterpillars are also strongly impacted by climatic events, such as drought, which can wake them too early from their diapause — the state of suspended animation some animal embryos enter to survive harsh conditions.

"If the drought occurs in the [fall], when the caterpillars wake up from their diapause, they will starve to death," Duplouy told Live Science. "Because under a strong drought event, their host plant cannot grow and thus they have no food to feed on to reach the adult stage, the population will crash."

Despite numerous near-extinction events, however, the butterflies have survived, and with remarkably high genetic diversity — owing to the high genetic diversity of the individuals that were first introduced to the island.

The parasites are surviving just as well as their butterfly hosts. Duplouy gives two reasons for their survival. Firstly, Sottunga's butterfly population may be isolated from populations of its species elsewhere on the archipelago, but its wasp parasites are not. Both H. horticola and M. stigmaticus are superior flyers to the butterflies, with H. horticola in particular having an ability to surf on strong winds. Some gusts have

even transported individual H. horticola wasps to previously uninhabited islands north of Sottunga, the researchers discovered in their surveys.

Secondly, the wasps — in particular H. horticola — have an incredibly efficient reproductive strategy.

"The butterfly lays its eggs in clutches of 50 to 200 eggs. And research suggests that the wasp can find every single one of these butterfly egg clutches in the field," Duplouy said. "One parasitoid female will tour around the field and, daily, check the development of the butterfly eggs. When those are ready to hatch as larvae, the parasitoid lays its eggs inside the yet-intact butterfly eggshell. So as long as the butterfly is present, it is likely that the wasp will persist too."

Hyperparasitoid M. stigmaticus wasps, which aren't as good flyers as their H. horticola wasp hosts, are less well dispersed across the islands surrounding Sottunga and have resorted to inbreeding to survive, according to the researchers.

The accidental introduction of the parasites makes for a fascinating case study, but the researchers believe it also provides a clear warning about the need to understand both endangered species and the species associated with them before any attempt is made to restore any of them to a new environment. The parasitoid wasps, for example, are commonly deployed as pest control in agriculture, so they are relatively well understood by humans, but a more elusive species could have wreaked havoc upon the new environment.

Despite the amazing survival of the butterflies and their parasitoids so far, Duplouy said that population crashes — caused by sudden drought — are likely to become worse as the effects of climate change become more intense.

"We are worried for the Sottunga populations, for the butterfly and its parasitoids. The last few years, drought events have been more regular, and the population crashes across Åland are stronger," she said. "The population in the south of Sottunga, in Föglö, has gone extinct a couple of years ago, and Sottunga has been a very, very small population for many years now, we fear we might see the end of it very soon. It would be a shame to lose it after 30 years of persistence."

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Hunger is getting worse, not better, around the globe. The pandemic didn't help.

2021-09-23

Is "zero hunger" in the world attainable? This week's U.N. Food Systems Summit hopes to make progress on the U.N.'s Sustainable Development Goal No. 2: "End hunger, achieve food security and improved nutrition and promote sustainable agriculture." The virtual summit, held on the sidelines of the annual U.N. General Assembly in New York, will address urgent and perennial food security issues with participants from public, multilateral, private and nonprofit groups working on these challenges.

The last time the international community gathered for a summit of this magnitude was the 1996 World Food Summit in Rome, which pledged to "reduce by half the number of chronically undernourished people on Earth by the year 2015."

Our research for the Institute for the Study of Diplomacy's new report, "Peace Through Food: Ending the Hunger-Instability Nexus," identified four urgent reasons to redouble efforts to address the rise in global hunger, both through meetings like this and targeted efforts at the local level. Here are some of the report's key findings:

All countries have people at risk of hunger

Perhaps a billion people or more worldwide are malnourished or suffer the pains of hunger — while the world wastes a third of the food produced. Analysts have long attributed the lack of access to food and food insecurity as drivers of political instability and conflict. Political and economic disruptions during the covid-19 pandemic — including fractured governments and the collapse of supply chains, have added nearly 120 million people to the ranks of the world's food insecure and malnourished.

The World Food Program won the Nobel Peace Prize. Does food aid boost peace?

Scholars and practitioners who participated in the institute's working groups on this report note that global food production and distribution

The last time the international community gathered for a summit of this magnitude was the 1996 World Food Summit in Rome, which pledged to "reduce by half the number of chronically undernourished people on Earth by the year 2015."

systems have not kept pace with significant threats presented by disease outbreaks, conflict and climate change. In May 2021, global food prices rose at their fastest monthly level in more than a decade, and the food price index hit its highest levels since September 2011. Higher prices leave an increasing number of poor farmers, women and people in marginalized groups, in particular, with limited access to nutrition.

The ongoing humanitarian crisis in Afghanistan demonstrates how the coronavirus, conflict and climate change exacerbate a hunger crisis. The World Food Program's executive director, David Beasley, likened the situation in Afghanistan to a "perfect storm" brewing. After "several years of drought, conflict, economic deterioration, compounded by covid," 1 in 3 Afghans are going hungry, and 2 million malnourished children may need urgent treatment.

Climate change has deepened food insecurity

The 2021 Intergovernmental Panel on Climate Change report links the rise in global temperatures over the past century, the increase in the number and severity of storms, and worsening droughts and floods to decreased food security. The effects of ongoing climate change are likely to lead to decreased production of rice, corn, wheat and soy — the four essential crops upon which the world depends.

Despite farmers' efforts to adapt to changing conditions, for instance, wheat yields in India fell 5.2 percent between 1981 and 2009 — while the population grew by 66 percent.

Unusually heavy rains in recent years produced recent swarms of locusts across East Africa and Southwest Asia, destroying crops and disrupting food supplies. At the same time, food production is responsible for almost one-quarter of all greenhouse gas emissions due to deforestation, transport and storage and livestock emissions, among other factors.

The pandemic has worsened existing food system challenges

Supply chain breakdowns and covid restrictions caused consumer prices to increase and producer prices to fall at the same time, worsening food security for the urban and rural poor. Pandemic curfews in many African countries inadvertently led to food losses, as drivers who normally transported fresh produce during the cooler nighttime hours were no longer able to do so.

But the pandemic also revealed that high-income countries are similarly vulnerable to price increases and shortages. Early on in the pandemic,

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Americans faced grocery store shortages, including empty meat aisles in late spring 2020. According to the latest U.S. government reports, prices of meat, poultry, fish and eggs rose 5.9 percent over last year, and were up 15.7 percent from August 2019 levels. Many Americans felt these price increases acutely, and 60 million Americans relied on federal and private food assistance.

A lack of access to food can spur conflict

The role of food as a driver of conflict probably will increase in coming decades. Research shows that as competition over scarce resources grows, conflict is more likely to occur along ethnic and religious lines. Whether out of desperation or as a way for unemployed people to gain sustenance, hungry individuals are more likely to participate in armed conflict.

The situation in Ethiopia highlights the cyclical and interconnected nature of the hunger-instability nexus: Food insecurity can be both a driver of conflict as well as a consequence. The ongoing conflict in Ethiopia's Tigray region has left at least 400,000 people in acute food insecurity, while in the broader context, over 5 million Ethiopians are in need of humanitarian assistance. The food crisis probably will continue, as the fighting has reduced harvests by at least half of average levels — and the country's crops, pastures and rangelands are struggling to recover from the desert locust infestation.

With the effects of climate change expected to worsen in coming decades and the pandemic continuing to create restrictions in countries around the world for the foreseeable future, the growing food crisis is likely to continue. This awareness adds a new urgency to the need for greater global and local coordination — at all levels — on efforts to tackle the food crisis — efforts that include international summits like the U.N. Food Systems Summit.

washingtonpost.com, 23 September 2021

https://www.washingtonpost.com

Secret cave chamber may be one of the last Neanderthal hideouts

2021-09-29

A cave chamber sealed off by sand for some 40,000 years has been discovered in Vanguard Cave in Gibraltar — a finding that could reveal more about the Neanderthals who lived in the area around that time.

After climbing through it, they found it is 43 feet (13 meters) in length, with stalactites hanging like eerie icicles from the chamber ceiling.

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"Given that the sand sealing the chamber was [40,000] years old, and that the chamber was therefore older, it must have been Neanderthals," who lived in Eurasia from about 200,000 to 40,000 years ago and were likely using the cave, Clive Finlayson, director of the Gibraltar National Museum, told Live Science in an email.

While Finlayson's team was studying the cave last month, they discovered the hollow area. After climbing through it, they found it is 43 feet (13 meters) in length, with stalactites hanging like eerie icicles from the chamber ceiling. Along the surface of the cave chamber, the researchers found the remains of lynx, hyenas and griffon vultures, as well as a large whelk, a type of sea snail that was likely carried into the chamber by a Neanderthal, the archaeologists said in a statement.

The researchers are eager to see what they will find once they start excavating. One possibility is that the team will discover Neanderthal burials, Finlayson said. "We found the milk tooth of a 4-year-old Neanderthal close to the chamber four years ago," he said. The tooth "was associated with hyenas, and we suspect the hyenas brought the child [who was likely dead] into the cave."

Researchers have discovered plenty of evidence of Neanderthals' presence in the cave system, called the Gorham's Cave Complex, including a carving that may have been early Neanderthal artwork. In addition, findings have suggested that, at this cave system, our closest extinct relatives butchered seals, plucked feathers off birds of prey to wear as ornaments and used tools, Live Science previously reported. Scientists have speculated that this cave system may have been one of the last places Neanderthals lived before they went extinct around 40,000 years ago.

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Technical Notes

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CHEMICAL EFFECTS

Emerging investigator series: the role of chemical properties in human exposure to environmental chemicals

Filling the knowledge gap: A suspect screening study for 1310 potentially persistent and mobile chemicals with SFC- and HILIC-HRMS in two German river systems

Organic carbon and acidic ions in PM 2.5 contributed to particle bioreactivity in Chinese megacities during haze episodes

ENVIRONMENTAL RESEARCH

An integrated approach for chemical water quality assessment of an urban river stretch through Effect-Based Methods and emerging pollutants analysis with a focus on genotoxicity

Organic Markers of Tire and Road Wear Particles in Sediments and Soils: Transformation Products of Major Antiozonants as Promising Candidates

Social status modulates the behavioral and physiological consequences of a chemical pollutant in animal groups

[Environmental endocrine disruptors and fertility]

OCCUPATIONAL

Under-reporting of non-fatal occupational injuries among precarious and non-precarious workers in Sweden

Examining the cost-effectiveness of personal protective equipment for formal healthcare workers in Kenya during the COVID-19 pandemic

PHARAMACEUTICAL/TOXICOLOGY

The Protective Effect of Natural Compounds on Doxorubicin-Induced Cardiotoxicity via Nicotinamide Adenine Dinucleotide Phosphate Oxidase Inhibition